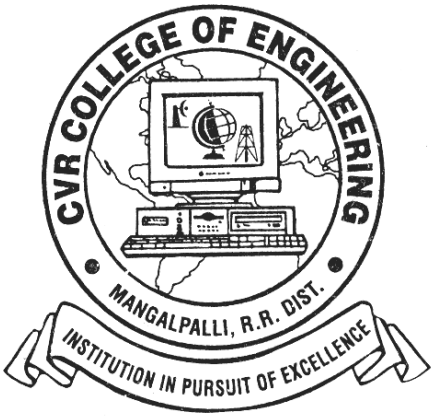
CVR JOURNAL OF SCIENCE & TECHNOLOGY



CVR COLLEGE OF ENGINEERING

(An Autonomous College affiliated to JNTU Hyderabad)
Mangalpalli (V), Ibrahimpatan (M),
RR District, A.P. - 501510
http://cvr.ac.in

Message from President and Chairman

I am really excited about the college taking an encouraging step to launch a Journal entitled "CVR JOURNAL OF SCIENCE AND TECHNOLOGY". I am sure that the Journal would provide a platform for the teaching and research community to project their research contributions and exchange the expertise in the various branches of Science and Engineering.

I am sure it is an excellent beginning. I hope the Journal will grow from strength to strength in the years to come.

RAGHAVA V CHERABUDDI, Ph.D.

Message from Director

It is a happy event to see the first issue of "CVR JOURNAL OF SCIENCE AND TECHNOLOGY" coming out with contributions by the staff of the various departments of the college. The first issue of the journal contains a good mix of papers from different specializations and I am confident that the journal will continue to give a good opportunity for the staff members to present the work in their respective areas of research. I hope the journal will help in strengthening the research and establishing a strong academic base in the college.

I convey my best wishes for the continued growth of the journal in content and quality.

K. RAMA SASTRI

Message from Principal

It is gratifying to know that the college is bringing out the technical journal "CVR JOURNAL OF SCIENCE AND TECHNOLOGY" with contributions from staff members. The journal provides an excellent opportunity for staff members to present their research work, and it will give a boost to the research culture of the college. Research is an important activity which needs to be pursued by everyone in the teaching profession to develop insight into various concepts and applications. Peer review is done to ensure acceptable standards of papers published.

Considering the excellent in-house talent in the college and the interest being shown by the staff in contributing to the journal, I have every confidence that the journal will continue to maintain high quality in its future issues too.

I wish all the best in this effort.

A. D. RAJKUMAR

EDITORIAL

The twin guiding principles for Engineering and Technical Education are relevance and excellence. The role of teachers in this context cannot be exaggerated, as the quality of education is directly determined by the competence of the teachers. Apart from teaching the subjects included in the curriculum, teachers need to constantly update themselves on the current trends in the area of their respective specializations, for which there is a need for them to be engaged in active research. Research culture should form an integral part of an Engineering College and a technical journal with papers and articles exclusively contributed by the faculty members of the college will go a long way in inculcating the appropriate research culture in the college.

CVR Journal of Science and Engineering, the first issue of which is being launched, is an attempt in this direction. The current volume contains research papers as well as perceptive articles by the staff of the college. The papers span a wide range including basic sciences and management science, apart from the engineering disciplines.

The Editor thanks all the members of the Editorial committee for readily accepting his request. A special word of appreciation is due to the authors for their interest in contributing to the Journal. It is our earnest hope that the enthusiasm will continue for the future issues of the journal.

Knowledge grows by sharing and the print medium is the best, with its lasting value, and it is hoped that our venture will prove beneficial to the scientific and technical community at large.

K. V. CHALAPATI RAO

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Computational Image Quality Metrics for Watermarking Applications

N.V.Rao[1] and Prof. S.N.N.Pandit[2]
[1]CVR College of Engineering, Department of CSE, Ibrahimpatan, R.R.District, A.P., India
Email: nvrao@ieee.org
[2]Honorary Director, Center for Quantitative Methods, Osmania University, Hyderabad A.P., India

Abstract—**Measurement of image Quality has been a challenging problem in many image-processing fields. Many procedures have been proposed to define metrics for image quality comparison in the context of image compression and watermarking. Subjective and Objective measures are considered to be the prime groups in the classification of quality measures as reported in the literature. Subjective evaluation is not an easy task as it involves environmental conditions. Mean square error (MSE), peak signal to noise ratio (PSNR), correlation coefficients, structural similarity index (SSIM), universal quality index (UQI) are some of the objective measures proposed for evaluation of Image quality. In this paper some widely used measures have been reviewed in general and considered especially through case studies in image compression and digital watermarking.**

Index Terms—**Image quality assessment, MSE, PSNR, SSIM, UQI, Objective evaluation and Digital watermarking.**

I. INTRODUCTION

In general, with human visual system (HVS), the quality of similar images can be assessed based on how they look, and a comparison can also be made. Many procedures have been proposed to define metrics for image quality comparison. Wilsow et al. [6] proposed that image quality metrics can be categorized into three types through

1. Human perception
2. Objective measures based on theoretical models
3. Subjective measures based on mathematically defined models of the HVS.

The first category of metrics employs a selected group of human viewers to judge the quality of selected images. The second category employs matrix representation of images, and mathematically based proven models that use transforms. The third type is based on human visual system models.

1.1 A brief survey of Image quality measures

Image and video data is to be compressed by many times in order to accomplish the transmission at a suitable rate. In fact data compression becomes an enabling technology to bridge the gap between the required high volume of video data and the limited hardware capability. Similarly Watermarking introduces distortion in the digital data. But it is very difficult to accurately measure the amount and visibility distortions caused by watermarks in image or video contents. Eskicioglu et al. in their survey papers presented many approaches to measure image quality in compressed images [7] and watermarked images [8]. They suggested two types, subjective and objective measures. The subjective evaluation is based on human observations or perception. It can not be taken as standard because human observation is based on some critical factors such as environment, motivation and mood. In spite of their complicated algorithms, the human visual system (HVS) based objective measures do not appear to be superior to the simple pixel based measures like the mean square error (MSE), peak signal to noise ratio (PSNR) or root mean square error (RMSE). The objective category includes bivariate measures such as MSE, L_2-norm and other measures similar to HVS. An ideal image quality measure should be able to describe the amount of distortion, the type of distortion and the distribution of the error [8].

Wang et al. [10] presents a new numerical measure for gray scale images, namely, Universal Image Quality Index (UQI) whose range is [-1 1]. The best value results when both images are the same. The index is computed using a sliding window of size 8x8, leading to a quality map of the image. The overall quality index is the average of all UQI values in the quality map. To make it stable [11], the measure has been generalized to the Structural Similarity Index (SSIM). The overall image quality, Mean of Structural Similarity Index of image (MSSIM) is obtained by computing the average of SSIM values over the windows.

In this work, widely used objective measures are considered for measurement of similarity of the original

and watermarked images and original and extracted watermarks. Similarly image compression with 20%, 30%, 50% are also considered for quality measurement. The present section describes these measures and their formulations. Values of PSNR, MSE are computed and the SSIM index between two images has been computed using MATLAB code given by Wang et al. [11].

In the context of watermarking, the quality of the watermarked image must be very high. The embedded watermark in the host should be perceptually invisible. In general, a PSNR (peak signal-to-noise ratio) larger than or equal to 30 dB in a reconstructed image is considered acceptable [12].However acceptable value depends on application requirement.

The ultimate receivers of the data are users and hence visual quality should be judged by human view. In general, image quality is evaluated subjectively by rating the image quality, and also by measuring the image impairment. A fine scale rating system of the degree of impairment: Noticeable/just noticeable/definitely noticeable but not objectionable/ objectionable/ extremely objectionable is now being used in industries as ITU-recommendations [13]. However, subjective quality assessments are costly and time consuming because human eyes are easily fatigued. Evaluation depends on user and hence may not be standardized.

II. OBJECTIVE QUALITY MEASURES

Signal to noise (SNR) measures are estimates of the quality of a reconstructed or modified image compared with the original. They are easier to compute and reasonable estimates as a single number that reflect the quality of the reconstructed image.

2.1 Mean Square Error (MSE)

$$MSE = \frac{1}{MN}\sum_{x=1}^{M}\sum_{y=1}^{N}\left(f(x,y) - f^{1}(x,y)\right)^2$$

where f and f^1 are the host and stego (watermarked) images. MxN, the size of the images. Small values of MSE indicates acceptable degradation.

RMSE is the root mean squared error

$$RMSE = \sqrt{MSE}$$

2.2 Signal to noise Ratio (SNR)

$$SNR = 10\log_{10}\left(\frac{MSE2}{MSE1}\right)dB$$

Where MSE1 is the mean square error of original image and MSE2 is the mean square error of processed image.

2.3 Peak Signal to Noise Ratio (PSNR)

Peak signal to reconstructed image measure is computed by

$$PSNR = 10\log_{10}\left(\frac{255^2}{MSE}\right)dB$$

PSNR penalizes the visibility of noise in an image. In multimedia applications, any image with more than 30 dB is accepted in general.

2.4 SVD based Gray-scale Image Quality Measure

In [4,9], a graphical measure (which is a bivariate measure) that computes the distance between the singular values of the original image and the singular values of the distorted image block, has been defined as

$$D_i = \sqrt{\sum_{i=1}^{n}\left(S_i - S_i^1\right)^2}$$

Where S_i *and* S_i^1 are the singular values of the original and distorted block respectively. This numerical measure is a Minkowski metric $\left(\sum\left|S_k - \overline{S_k}\right|^{\beta}\right)^{1/\beta}$ with $\beta = 2$.

If the image is of size K x K, we have K/n x K/n blocks.

The set of distortions when displayed in a graph represents a distortion map. A numerical measure is derived from the graphical measure. It computes the global error expressed as a single numerical value depending on distortion type

$$\text{M-SVD} = \frac{\sum_{i=1}^{(K/n)x(K/n)}\left|D_i - D_{mid}\right|}{(K/n)(K/n)}$$

Where D_{mid} represents the mid point of the sorted D_i*'s,* K x K is the image size, and n is the block size.

2.5 Difference Image Visibility

An important technique for displaying errors is to construct an error image which shows the pixel-by pixel errors. The simplest computation of this image is to create an image by taking the difference between the reconstructed and original pixels. In order to create an image, the difference is multiplied by a constant and the entire image is converted to gray level by adding a constant for visibility as shown below. (to make it non-negative)

$$E(x,y) = 2\,[f(x,y) - f^1(x,y)] + 128$$

More details are given in [1,2]

2.6 Frobenius norm

One of the good ways of measuring error in images is that the error measure agrees with human perception. Frobenius norm, which is related to L2 - norm for

functions and also to the concept of energy, is used in image processing.

Consider a digital image represented as the MxN matrix I and its elements denoted as I_{ij}, i = 1,2,3….. M, j= 1,2,3 …..N. Frobenius norm of the matrix I is defined as

$$\|\boldsymbol{I}\|_{Fro} = \sqrt{\sum_{i=1}^{M}\sum_{j=1}^{N}\left|\boldsymbol{I}_{ij}\right|^2}$$

The relative error (Frobenius Error) is given by

$$\boldsymbol{E}_{rel} = \frac{\|\boldsymbol{I}-\boldsymbol{I}_c\|_{Fro}}{\|\boldsymbol{I}\|_{Fro}}$$

Where I_c represents a modified image. Frobenius norm and singular values of an image are related through

$$\sqrt{\sum_{i=1}^{M}\sum_{j=1}^{N}\left|I_{ij}\right|^2} = \sqrt{\sum_{i=1}^{N}\sigma_i^2}$$

σ_i, i = 1, 2 …..N denotes the singular values of I.

One way of measuring error in images is to compute a measure that *agrees with our eyes* or in other words, in a manner *what you see is what you get*. It is related to L2 – norm for functions, which in turn, is related to the concept of energy. For this reason, Frobenius norm is used in image processing.

2.7 Structural Similarity Index (SSIM)

Wang and Bovik [10] proposed universal Image Quality index (UQI) and improved in [11] as Structural SIMilarity (SSIM) index. In UQI, the dynamic range of quality is [-1 1] and the best value is achieved when $y_i = x_i$, i = 1,2,….n. This index models any distortion as a combination of three different factors i) loss of correlation, ii) mean distortion and iii) variance distortion. A sliding window of 8x8 size is used for computing the index that results in quality map of the image. The overall index is the average of all UQI values in the quality map. To avoid some mathematical instability, SSIM is proposed in [11] as a refinement. MSSIM is obtained by computing the average SSIM values over all windows.

The universal image quality index is defined as

$$Q = \frac{4\sigma_{xy}\overline{x}\,\overline{y}}{(\sigma_x^2+\sigma_y^2)[\overline{x}^2+\overline{y}^2]}$$

Where $\overline{x} = \frac{1}{n}\sum_{i=1}^{n}x_i$, $\overline{y} = \frac{1}{n}\sum_{i=1}^{n}y_i$,

$$\sigma_x^2 = \frac{1}{n-1}\sum_{i=1}^{n}\left(x_i-\overline{x}\right)^2 \text{ , } \sigma_y^2 = \frac{1}{n-1}\sum_{i=1}^{n}\left(y_i-\overline{y}\right)^2$$

$$\boldsymbol{\sigma}_{xy} = \frac{1}{\boldsymbol{n-1}}\sum_{i=1}^{n}\left(\boldsymbol{x}_i-\overline{\boldsymbol{x}}\right)\left(\boldsymbol{y}_i-\overline{\boldsymbol{y}}\right)$$

Where x_i, y_i, i = 1,2,3…… n represents the original and distorted signals respectively.

2.8 SSIM index

SSIM index between X, Y is defined as

$$\text{SSIM(X, Y)} = \frac{\left(2\overline{x}\,\overline{y}+C_1\right)\left(2\sigma_{xy}+C_2\right)}{\left(\overline{x}^2+\overline{y}^2+C_1\right)\left(\sigma_x^2+\sigma_y^2+C_2\right)}$$

where C_1,C_2 are small constants given by $C_1 = (K_1R)^2$ and $C_2 = (K_2R)^2$ respectively, R is the dynamic range of pixel values i.e R = 255.

K_1 and K_2 <<1 are two scalar constants. (K_1 = 0.01, K_2 = 0.03 for the experiments presented in [11])

2.9 Normalised Correlation Coefficient (NCC)

The presence of watermark is evaluated quantitatively by measuring the similarity between the original and extracted watermarks. [3]. A commonly used similarity measure is given by the Normalized Correlation Coefficient, which is represented with ρ.

$$\rho(W,W^1) = \frac{\sum_{x=1}^{m}\sum_{y=1}^{n}W(x,y)W^1(x,y)}{\sqrt{\sum_{x=1}^{m}\sum_{y=1}^{n}\left|W(x,y)\right|^2}\sqrt{\sum_{x=1}^{m}\sum_{y=1}^{n}\left|W^1(x,y)\right|^2}}$$

Where W and W^1 represents the original and extracted watermark sequence of *mxn* size respectively. Watermark is detected if $\rho(W,W^1) > T$, where T is a specified threshold, chosen to minimize false alarm (detection indicates positively even if no watermark is embedded). But it is clear that the extracted watermark is also a visually recognizable pattern, which can be used to subjectively evaluate the performance of the watermarking scheme. In addition to visual similarity, a high correlation between W and W^1 indicates that they are the same or statistically similar.

2.10 Pearson's Correlation Coefficient (PCC)

In objective evaluation, statistical measures like Pearson's correlation coefficient can be used [5]. Pearson product moment correlation coefficient is a dimensionless index that ranges from –1.0 to 1.0 and reflects the extent of a linear relationship between two data sets to make it clear further the square of the correlation coefficient gives the percentage of the variation explained in one of the variable when the variation in the other is taken into account to predict its value. In the case of SVD based watermarking methods, these moment correlation coefficients are computed between the original vector of singular values and

extracted vector of singular values. This is done for every quadrant in case of DCT or DWT based (multi-band) embedding.

2.11 Pearson's Correlation Coefficient: A general form

The correlation coefficient *r* as given [13] (also called Pearson's product moment correlation after Karl Pearson) is calculated by

$$r = \frac{\sum_{i=1}^{n}(x_i - \bar{x})(y_i - \bar{y})}{\sqrt{\sum_{i=1}^{n}(x_i - \bar{x})^2 \sum_{i=1}^{n}(y_i - \bar{y})^2}}$$

Where x_i, y_i, i = 1, 2, ...n, represent original and distorted signals

The correlation coefficient may take any value between -1.0 and +1.0. A linear relationship between x and y is assumed.

The above formula can be replaced by the following equivalent, which avoids to use the means and is therefore much faster to compute.

$$r = \frac{\sum_{i=1}^{n} x_i y_i - \frac{1}{n}\sum_{i=1}^{n} x_i \sum_{i=1}^{n} y_i}{\sqrt{\sum_{i=1}^{n} x_i^2 - \frac{1}{n}(\sum_{i=1}^{n} x_i)^2}\sqrt{\sum_{i=1}^{n} y_i^2 - \frac{1}{n}(\sum_{i=1}^{n} y_i)^2}}$$

The correlation coefficient stands in close relationship to linear regression [13]. The square of r is called the *goodness of fit* and denotes the portion of total variance in a regression model.

III. Experiments and Results

In this section, we consider two applications and evaluate the objective quality measures and also display the images for subjectivity. The first application is digital watermarking, in which quality assessment is required to assess the quality of the watermarking images. The second application is image compression. In this application, quality metrics are needed to evaluate the quality of reconstructed images and also to determine the appropriate compression factor.

3.1 Digital watermarking

Digital image watermarking is the process of embedding a logo or data called watermark into a host image. One of the main characteristics of a digital image watermarking is the imperceptibility. The quality of the image should not be compromised for the sake of authenticity. The primary quality observation is through human visibility or how the image appears to the human eye. In addition, some objective measures based on statistics can provide the distortion quantitatively, enabling the limit of acceptability. A case study of digital watermarking employing Satish Chandra's SVD algorithm [3] has been considered. The host,watermark and stego images considered are shown in figure 1.

The algorithm proposed by Chandra [3] treats host and watermark images globally for computation of SVD and for embedding watermark. A brief account of algorithm is given below for completeness.

Watermark Embedding Technique:

Let *X* represents the cover image of size *MxN*, let *W*, the watermark be an array of size *PxQ*. Singular value decomposition (SVD) of *X* and *W* are computed as

$$X = U\Sigma_x V^T$$

$$W = U_w \Sigma_w V_w^T$$

The diagonal elements of Σ_x and Σ_w represents the singular values of *X* and *W* respectively and are represented by

$$[\sigma_x = \sigma_{x_1} \quad \sigma_{x_2} \quad \sigma_{x_3} \ldots\ldots\ldots\ldots \quad \sigma_{x_N}]$$

$$[\sigma_w = \sigma_{w_1} \quad \sigma_{w_2} \quad \sigma_{w_3} \ldots\ldots\ldots\ldots \quad \sigma_{w_Q}]$$

1 The watermark is embedded into singular values of *X* according to relationship

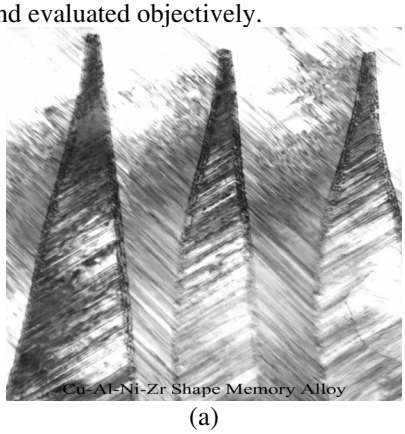
$$\sigma_{y_i} = \sigma_{x_i} + \alpha\sigma_{w_i}$$

Where α is the scaling parameter which determines the embedding strength and is chosen to maintain perceptual fidelity of the watermarked image Y.

Let $\Sigma_y = [\sigma_{y_i}]$, i.e Σ_y represents the diagonal matrix whose elements corresponds to σ_{y_i}. The watermarked image *Y* is computed as

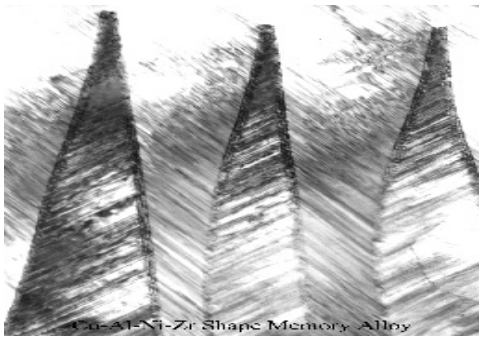
$$Y = U\Sigma_y V^T$$

'Alpha' (α), the strength of watermark, is varied so as to decide the acceptable level of the watermark. The original and watermarked images are compared for visibility and evaluated objectively.



(a)

(b)



(c)

Figure 1. Host, Watemark and Stego Images: (a) Host (Original) (b) Watermark (c) Stego Images

Table 1:

Table showing the error metrics between original and watermarked images with respect to the controllable parameter alpha.

ALPHA	MSE	SNR	PSNR	R_Error	Q_Fact
0.0010	0.0464	58.6578	61.4650	0.001	1.000
0.0060	1.6706	43.1433	45.9020	0.007	1.000
0.0110	5.6152	37.9268	40.6371	0.013	1.000
0.0160	11.8801	34.7203	37.3826	0.019	0.999
0.0210	20.4654	32.4062	35.0206	0.025	0.998
0.0260	31.3710	30.5987	33.1655	0.030	0.998
0.0310	44.5970	29.1182	31.6378	0.036	0.997
0.0360	60.1433	27.8665	30.3389	0.042	0.995

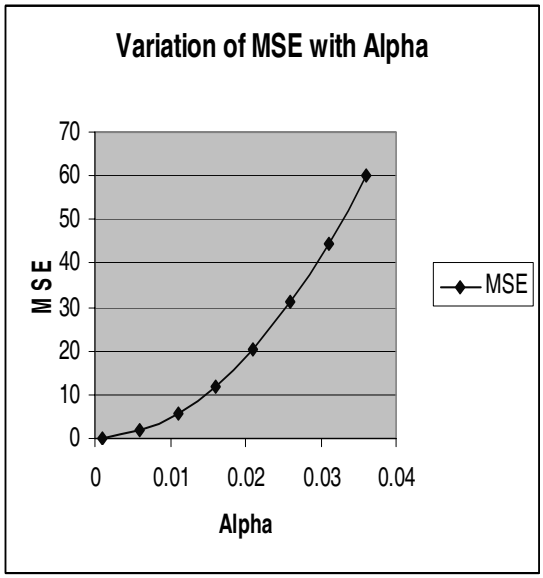


Figure 2.

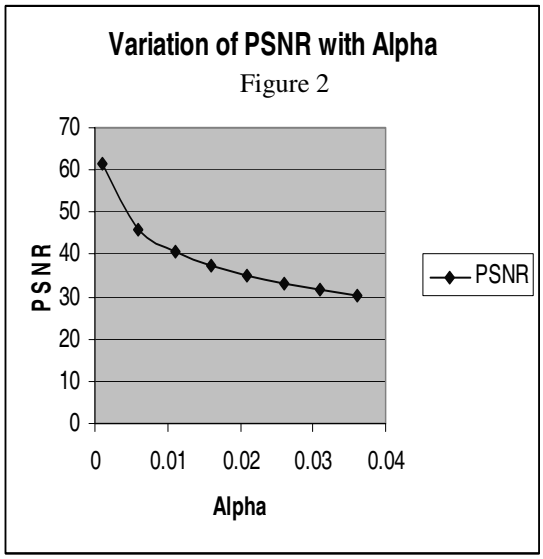


Figure 2

Figure 3

MSE, SNR, PSNR, R-error (Frobenius), Q-fact (SSIM index) are tabulated for different values of alpha in table 1. These five measures are considered in this paper for illustration. PSNR and SSIM index are widely accepted for image quality assessment. Variation of MSE and PSNR with alpha are shown graphically in figures 2-3. In general a PSNR>40 dB is acceptable for watermarking applications in quality critical applications like Medical Image watermarking.

3.2 Image compression

Quality in image compression depends on closeness of the reconstructed image with the original. On the other hand the data is to be reduced especially the redundant data in coding is to be eliminated, resulting in optimum data with storage reduction. The reconstructed image from compressed image data is expected to be very close to the original without any noticeable difference. In this present paper, compression is achieved by JPEG compression technique.

An example of Lena image is considered, compressing it with 20%, 30%, and 50% Factors. The original and resulting compressed figures are shown as figures 4(a)-(d). The compressed image and the original are compared for quality measures. It can be noticed that a PSNR>40 is acceptable from the quality point of view.

(a)

(b)

(c)

(d)

Figure 4:

(a) Original Image

(b) 20% Compressed image

(c) 30% Compressed image

(d) 50% Compressed image

SUMMARY AND CONCLUSIONS

Both subjective and objective assessments are necessary for image processing applications. Objective measures numerically give an indication of the quality and subjective test is for user's view. In this paper good number of objective measures have been reviewed and demonstrated through two applications. These objective measures definitely help in selecting critical parameters in the applications such as strength of watermark in watermark embedding and compression factor in image and video compression.

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An Overview of Object-Oriented Frameworks with Application in Spatiotemporal Data Mining

K.Venkateswara Rao[1], A.Govardhan[2] and K.V.Chalapati Rao[3]
[1] CVR College of Engineering, Department of CSE, Ibrahimpatan, R.R.District, A.P., India
Email: kvenkat.cse@gmail.com
[2]JNTUH College of Engineering, Department of CSE, Jagityala, Karimnagar Dist, A.P., India
Email: govardhan_cse@yahoo.co.in
[3] CVR College of Engineering, Department of CS*E,* Ibrahimpatan, R.R.District, A.P., India
Email: chalapatiraokv@gmail.com

***Abstract*—An object-oriented framework is a reusable software system providing large scale reuse, including reuse of analysis and design. Frameworks offer reuse of its elements through mechanisms like inheritance and composition and avoid development of applications from scratch. Spatiotemporal data mining has wide variety of applications in transportation systems, surveillance applications, geographical systems and environmental systems. So there is a need to develop a framework that takes care of common requirements at analysis and design level so that spatiotemporal data mining applications can be built through software reuse. The main focus of this paper is to provide an overview of object oriented frameworks, capturing requirements, analysis and design of object-oriented framework for spatiotemporal data mining. The process of reusing the framework for application development is also described and results of such application are provided.**

***Index Terms*—Object-Oriented Frameworks, Data mining, Spatiotemporal data mining**

I. INTRODUCTION

An object-oriented framework is a set of collaborating classes, both abstract and concrete, that embodies a reusable design to provide solutions to a family of related problems. It supports reuse at functionality and architecture level [1]. A framework, then, is an incomplete software system in the sense it provides a partial design and implementation for an application in a given domain. Thus a framework is much more than a class library as shown in Fig 1. A class library is a set of classes designed to provide reusable, general purpose functionality. On the other hand, the goal of a framework is to capture a set of concepts related to a domain and the way they interact. In addition a framework calls specific application code by dynamic method binding [2].

A framework provides a basic system model for a particular application domain within which specialized applications can be developed. It consists of already coded, reusable functions called frozen spots which represent the static parts of the framework. The framework also consists of functions that need to be customized to change the behavior of the framework. These flexible elements are called hot spots and they allow the user to adjust the framework to the needs of the concrete application.

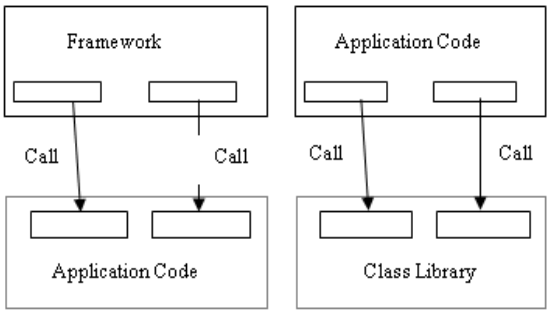

Fig 1: The difference in control between frameworks and class libraries [3].

Spatiotemporal data mining refers to the extraction of knowledge, spatiotemporal relationships, or other interesting patterns like spatiotemporal associations, clusters and evolution rules which are not explicitly stored in spatiotemporal databases. It is an emerging area dedicated to the development and application of novel computational techniques for the analysis of very large spatiotemporal databases. It presents a number of challenges due to complexity of geographic domains and mapping of all data values into spatial and temporal frameworks [4].

The research community in spatiotemporal data mining in different domains is investigating techniques for addressing the issues and requirements of those mining tasks [4]. The research community in spatiotemporal databases could develop conceptual models for spatiotemporal databases, and techniques to implement these models in object-relational and relational database systems [4]. This development enables further investigations in spatiotemporal data mining to discover requirements of various data mining techniques that are developed in various domains and come out an object-oriented framework. The framework help generate various spatiotemporal data mining applications by reusing the architecture and extending functionalities in the framework. The spatiotemporal data mining involves selection, pre-processing and transformation of data, application of the data mining techniques and evaluation and visualization of resulting patterns and trends.

Keeping the above requirements in view, our work presents an overview of object-oriented frameworks and their application in discovering knowledge from spatiotemporal databases. Section 2 presents

categorization of frameworks based on their scope and context of usage. Different Phases in framework-centered application development are described in section 3. Various activities in the framework development and execution of those activities for spatiotemporal data mining are discussed in section 4. Finally conclusions are given in section 5.

II. FRAMEWORKS CLASSIFICATION

Frameworks are composed of numerous reusable assets which include knowledge, design, captured requirements and software components. As a coherent collection of reusable assets, a framework can be an important investment for an organization. Based on the context of its usage, the frameworks are classified into the following categories.

- White Box Frameworks
- Black Box Frameworks
- Grey Box Frameworks

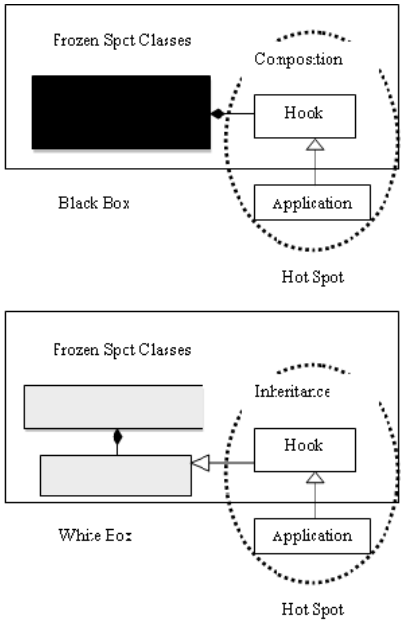

Fig 2: Hot spots in object oriented frameworks: the black box approach and the white box approach [5]

Figure 2. Hot spots in object frameworks: the black box approach and the white box approach [5].

In a white box framework, as shown in fig 2, the architecture of the framework is known and application developers build their applications upon it. The complete design has to be documented because this knowledge is necessary to adapt the framework to a concrete application. The mechanism used to provide flexibility is usually limited to inheritance. The user, therefore, must have knowledge of the framework architecture in order to customize the framework so as to address the needs of the particular application.

Black box framework, as shown in Fig 2, hides its internal structure. The user just knows the hot spots of the framework and a general description of the framework's usage rather than having a comprehensive knowledge of its architecture. Very often the mechanism used to provide flexibility in black box framework is composition. The capabilities of a black box framework are limited to what has been implemented in the set of components provided in it.

Grey Box Framework offers both inheritance and composition mechanisms. It will have a white box layer consisting of interfaces and abstract classes providing the architecture that can be used for white box reuse. It has a black box layer too consisting of concrete classes and components that inherit from the white box layer and can be plugged into the architecture. By using the concrete classes, the developer has easy access to the framework's features. If more is needed than the default implementation, the developer will have to make a custom class either by inheriting from one of the abstract base classes or by inheriting from one of the concrete classes.

Based on the scope of the framework which describes how broad an area of the framework is, they are classified as

- Application frameworks
- Domain frameworks
- Support frameworks

Application Framework is a horizontal framework which covers functionality that can be applied to different domains. Examples of application frameworks are frameworks for graphical user interfaces.

Domain Framework is a vertical framework which captures knowledge and expertise in a particular problem domain. Frameworks for spatiotemporal data mining and manufacturing control are examples of domain frameworks.

Support Framework offers low-level system services such as memory management, device drivers and file access. Other frameworks or applications would be built on this framework.

III. PHASES IN FRAMEWORK DEVELOPMENT

The presence of reusable frameworks influences the development process for the application. There are three phases in framework-centered software development [6].

- framework development phase
- framework usage phase
- framework evolution & maintenance phase

The framework development is the most effort consuming phase and is aimed at producing a reusable design in a domain. Major results of this phase are the domain analysis model and a core framework design. This phase is depicted in Fig 3.

The framework usage phase is also referred as the framework instantiation phase or application development phase. The main result of this phase is an application developed reusing one or more frameworks. Here, the framework user has to include the core framework design or part of it depending on the application requirements. After the application design is finished, the software engineer has to decide which internal increments to include. For those parts of the

application design not covered by reusable classes, new classes need to be developed to fulfill the actual applications requirements. These new classes are referred as the application-specific increment.

Frameworks are typically developed and evolved in an iterative way [7]. Once the framework is released, it is used to create applications. After some time it may be necessary to change the framework to meet new requirements. This process is called framework evolution. Framework evolution has consequences for applications that have been created with the framework. If APIs in the framework change, the applications that use it have to evolve to remain compatible with the evolving framework.

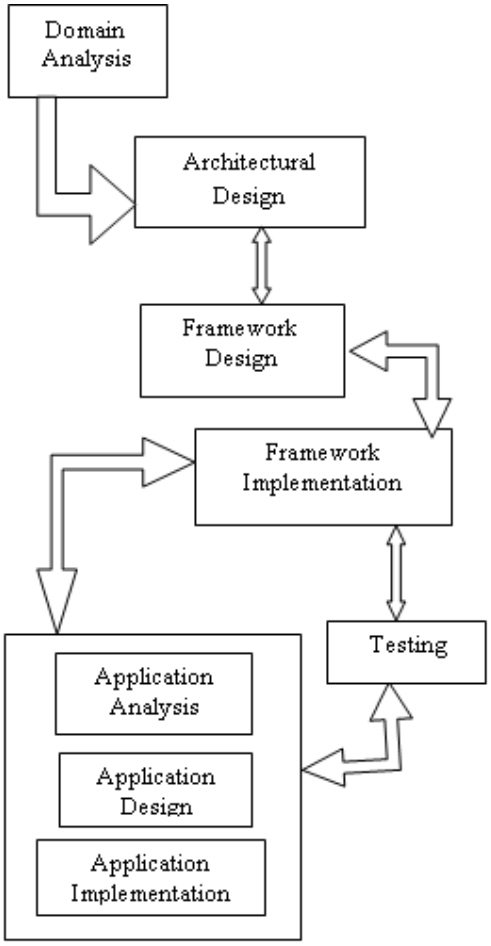

Fig 3: Framework development phase

IV. Spatiotemporal Data Mining Framework Development

The development of a framework is somewhat different from the development of a standard application. The important distinction is that the framework has to cover all relevant concepts in a domain, whereas an application is concerned only with the concepts mentioned in the application requirements. The activities of a simple framework development for spatiotemporal data mining are described in following sections.

A. Domain Analysis

Domain analysis aims at describing the domain that is to be covered by the framework. It captures the requirements and identification of concepts by referring to previously developed applications in the domain, domain experts and existing standards for the domain. The result of the activity is a domain analysis model, containing the requirements of the domain, the domain concepts and the relations between those concepts.

The Literature on spatiotemporal data mining is analyzed and spatiotemporal applications requirements at the modeling level are extended to cover knowledge discovery process [8] as follows.

- Need for representation of objects with position in space and existence in time: An example is "waterpipes" occupying certain parts of space at certain time point in utility management information system.
- The need to capture the change of position in space over time: If the change of object's position is continuous, then it results into motion. An example is the continuous change of the position of a vehicle in a navigational system. If the change is discrete, then it results into snapshots, versions of the object. An example is a "land parcel" having a position in space at some point in time. When it changes shape (e.g., a new part of land is attached to it) its position changes.
- Need for the definition of spatial attributes in time and organizing them into temporal layers or fields, i.e., snapshots of thematic maps. For example, "soil erosion" is a property of space organized in a layer, representing sets of regions (with different values). Spatial attributes can be visualized as continuous (e.g., "temperature") or as discrete ("soil type").
- Need to capture the change of spatial attributes over time: The changes can be discrete (e.g., changes on a map of "land parcels" or "vegetation") or continuous (change of "temperature").
- Need to connect spatial attributes to objects: An example, a land-parcel that has "soil type" as an attribute. The "soil type" is an attribute of space and land-parcels inherit part of it.
- Need for the representation of different spatiotemporal topological relationships among spatial objects in time for analysis.
- Need for the representation of relationships among spatial attributes in time: For example, the "soil type" is a result of the combination of the "acidity" and the "corrosively" of soil.
- Need to specify spatiotemporal integrity constraints: The constraints are imposed either by the user or by the designer for the integrity of the database.
- Need to represent the orientation and direction features of spatio-temporal objects during their change.

- Need to represent events and list of changes associated with each event: An event may represent abrupt change or it may have duration.
- Need for the representation of multiple granularities for spatiotemporal objects: As an example, when tracing modifications to spatial areas, the history of the areas under observation has to be maintained and retrieved at multiple temporal granularities (e.g., years, months, decades).
- Need for representation of spatiotemporal data in multi-dimensional model for analytical processing.
- Need for the representation of concept hierarchies for the dimensions.

A. Architectural Design

In this stage, a suitable architectural style underlying the framework is to be decided upon domain analysis. The architectural design for spatiotemporal data mining framework can be specified using layered pattern and model-view-controller pattern. The four layer architecture specified for information systems in [9] can be used as an underlying architecture for spatiotemporal data mining framework. The layers are described in the following Fig 4.

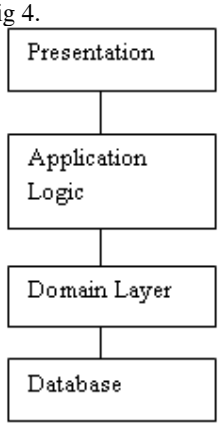

Fig 4: Layered architectural pattern for spatiotemporal data mining

The database layer holds domain specific spatiotemporal data. The domain layer models the conceptual structure of the problem domain in terms of classes and class diagrams. Application logic contains the data mining algorithms and data pre-processing and analysis techniques. Presentation layer is used to show the data mining results to the user and accepting input in interactive data mining.

A model-view-controller pattern [9, 10] can also be used to describe the architecture of spatiotemporal data mining framework. The model holds data in the form of multi-dimensional data cube and contains algorithms to perform appropriate analysis and mining on the data in the multi-dimensional model. The user input comes to the controller. The controller translates the user events into service requests for the model or the view. The view part of the pattern obtains results from the model and displays them to the user. So this pattern spans the presentation, application logic and domain layers of the layered pattern. The MVC is shown in Fig 5.

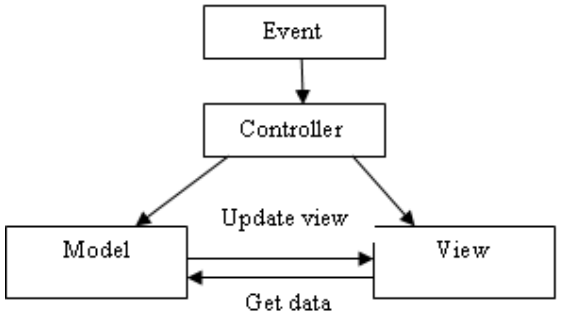

Fig 5: MVC architectural pattern for spatiotemporal data mining

B. Framework Design

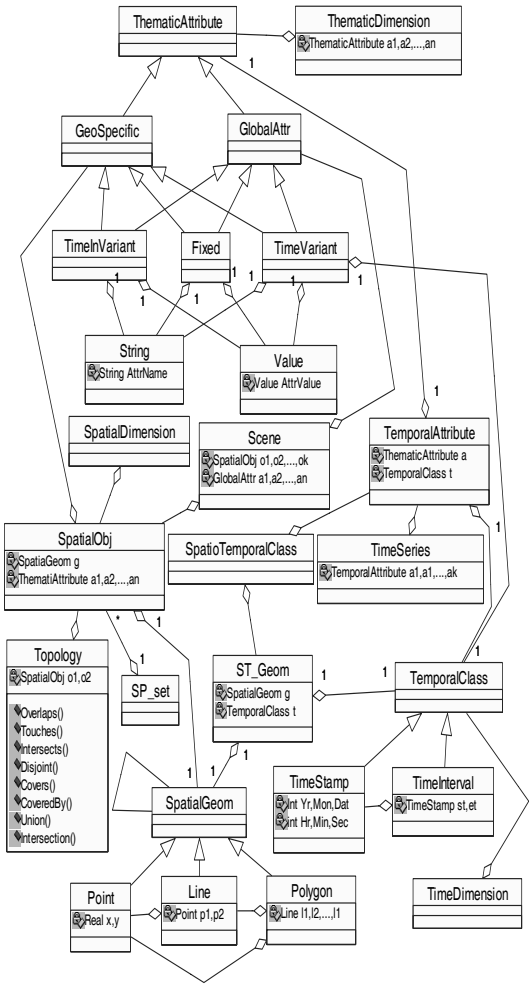

Fig 6a: Class diagrams of the system

The classes in the architectural design of the framework are refined and additional classes are designed during this phase. Results from this activity are the functionality scope given by the framework design, the framework's reuse interface, design rules based on architectural decisions that must be obeyed and a design history document.

The requirements of spatiotemporal applications are analyzed to identify different classes, attributes and methods of each class and relationships among the classes. The results are represented in a class diagram [8] as shown in Fig 6a and Fig 6b. The classes can be extended using inheritance mechanism, while building the applications to meet their requirements.

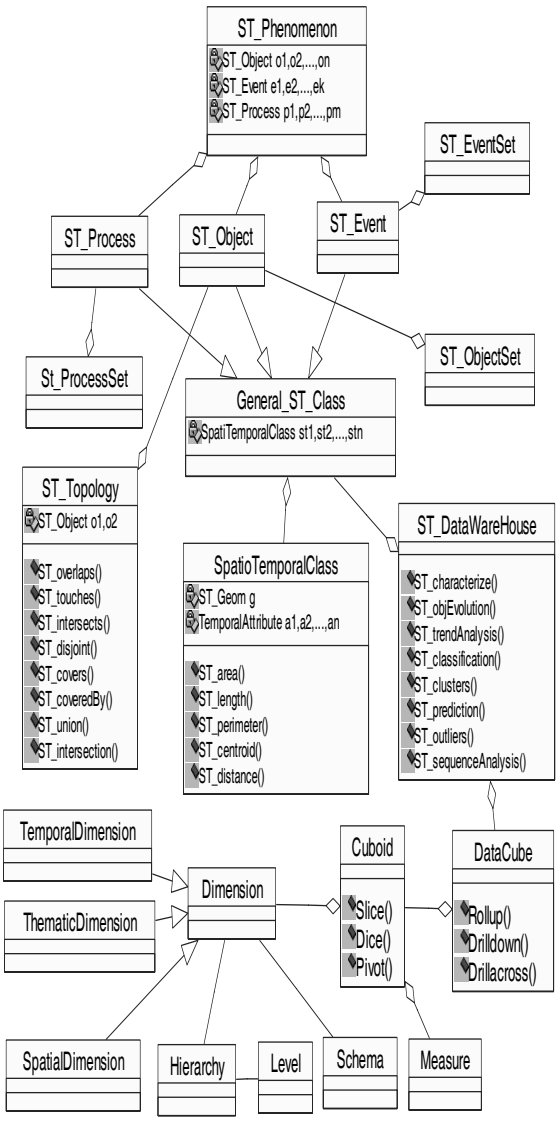

Fig 6b: Class diagrams of the system

An object relational spatiotemporal database which consists of a set of tables and relationships among them is designed to facilitate the spatiotemporal data analysis and mining [11]. Different sorts of spatiotemporal data to be handled are states, events and episodes. A state represents a version of an entity in a given moment. States can consist of different versions of an individual entity. An event is the moment in time when an occurrence takes place. Event causes one state to change to another. An episode is the length of time during which change occurs, a state exists or an event lasts. Two main strategies to represent multiple versions of an object are tracking the versions either at the level of objects or attributes. First one involves a different identifier (oid) to each new version and chaining the older versions to new oid. Second one involves a single object identity (oid) with versions actually associated with attributes. The attributes of spatiotemporal objects can be categorized as version significant, non-version significant and invariant. The version significant attribute values are to be updated in non-destructive manner, the non-version significant attribute values are to be updated in a destructive manner and invariant attributes values are not allowed to be changed. Following entities are designed to address these requirements.

1. Temporal_tab: This table stores timestamps which correspond to the time at which change to any spatial object has taken place.
2. Spatial_obj_tab: This table contains spatiotemporal objects with unique identifier, geometry and existence time which has from time (st) and to time(et) as attributes. It also has other attributes to indicate category and type of spatial object and type of change. The events and episodes or processes are also considered as spatiotemporal objects and stored in this table.
3. split_tab: This composite entity is used to record splitting of any spatial object into multiple objects. It has object identifier that got split and new object identifiers for objects derived due to split and timestamp attribute that records time of split.
4. Merge_tab: This composite entity keeps the data related to merging of two or more objects into a single object. It maintains object identifiers which are merged, new object identifier for object derived due to merging and timestamp attribute which records the time of merge. The new objects created due to split or merge are stored in spatial_obj_tab with their new object identifiers.
5. Geom_version : This table records geometry changes by creating new object identifier for each change to the geometry of the object. It has oid of the object changed, new object identifier and timestamp attribute that records time of the change.The new object is stored in spatial_obj_tab table.
6. VsAttr_tab: This table manages version significant attributes of all objects in spatial_obj_tab. It has oid, attribute name, timestamp and attribute value as its fields.
7. VinAttr_tab: This table manages version insignificant and invariant attributes of all objects in spatial_obj_tab. It has oid, attribute name and attribute value as its fields.
8. Result_tab : This entity is used by analysis algorithms to store results back into database. This table can be accessed using OpenJump (An Open source GIS software) to visualize the results.

C. Framework Implementation

Framework implementation is concerned with the coding of its abstract and concrete classes. The database

designed for spatiotemporal data mining [11] is created and implemented using postGIS, postgresql. The Topology class specified in the class diagram in fig 6 is implemented as GeometryRelation using Postgis application programming interface.

```
Public class GeometryRelation
{
        PGgeometry obj1, obj2;
        Methods:
        PGgeometry Union();
        PGgeometry Intersection();
        Float Distance();
        Boolean isintersects()
        Boolean istouches()
        Boolean isequals()
        Boolean isdisjoint()
        Boolean iscrosses()
        Boolean isoverlaps()
        Boolean iscovers()
        Boolean iscoveredby()
}
```

The ST_Toplogy class is also implemented by using GeometryRelation object in algorithm1 and algorith2 [11] given below.

Algorithm 1: Tracking Spatial object or History Topology
Input: Spatiotemporal dataset (D),Spatial Object Identifier (oid), from time(f_t) and to time(t_t)
Output: The Object (oid) details changing with time.
Method: Process(oid)

```
Begin
  Obj = getobjdetails(oid) /* connect to dataset D get spatial object details and load them into variable  obj */
   Display(Obj)
   If ( Obj.et  <  t_t) Track(Obj)
End

Display(Obj)
Begin
 If ( Obj.st > f_t and Obj.et < t_t )
   Print or save id, geom, st, et, area, centroid and perimeter of Obj. The attribute ChangeType of Obj indicates type of change the Obj has undergone at time et.
 Elseif ( Obj.st > f_t and Obj.et >= t_t )
   Print or save id, geom, st, t_t, area, centroid and perimeter of Obj.
 Elseif ( Obj.st <= f_t and Obj.et >= t_t )
   Print or save id, geom, f_t, t_t, area, centroid and perimeter of Obj.
 Elseif ( Obj.st <= f_t and Obj.et < t_t )
   Print or save id, geom, f_t, et, area, centroid and perimeter of Obj. The attribute ChangeType of Obj indicates type of change the Obj has undergone at time et.
 Else Print " Obj is not valid between f_t and t_t"
End

Track(Obj)
Begin
Next = Obj.changeType
Switch(Next)
Begin
Case C:
        Look into Geom_version table and find new object identifier (n_oid).
        Process(n_oid)
        Break;
Case S:
        Look into split_tab and find list L of identifiers of objects which are result of split of the Obj.
        For each object identifier e_oid in L, Process(e_oid)
        Break
Case M:
        Look into Merge_tab and find the new object identifier (n_oid) which is the result of merge of Obj with some other spatial object.
        Process(n_obj)
        Break
Case default: break
End
End
```

Algorithm 2: Finding change in spatiotemporal topological relationships, intersection, Union, distance between two objects.
Input: : Spatiotemporal dataset (D), Object Identifier (oid1, oid2), from time(f_t) and to time(t_t)
Output: Topological relationships, Intersection, Union, distance changes between the oid1 and oid2 from f_t to t_t
Method :

```
Begin
```

1. Using Algorithm1, track the objects oid1, oid2 and record all time points at which either oid1 or oid2 or their siblings have changed between f_t and t_t. Also use special data structure that manages valid identifiers of the objects for each of the time points.
2. For each of the time points, create an object of type GeometryRelation and use its methods to compute topological relationships, intersection, union and distance between the relevant pair of objects which are valid for the time point.
3. Display or store the results for the given duration.

```
End
```

D. Framework Testing

Framework testing is performed to determine whether the framework provides the intended functionality and also to evaluate the usability of the framework. The only way to do this is to reuse it. So this boils down to developing applications that use the framework.

To evaluate the usability of spatiotemporal data mining framework, the test application based on the framework is developed for discovering spatiotemporal topological relationships and spatiotemporal frequent itemsets. The results are found to be satisfactory. But the framework implementation and testing need to be done for other spatiotemporal data mining tasks such as clustering, classification, characterization and discrimination.

E. Test Results

The results of test application to discover spatiotemporal topological relationships are given below. Given two objects 45 and 83, and two timestamps as input, spatiotemporal relationships among the given objects over the specified period of time are indicated in the following output. The object changes are tracked by creating a new object in database for each change to its geometry.

Obj1	Obj2	intersects	contains	equals	touches	disjoint	overlaps	From time	To time
45	83	0	0	0	0	1	0	T1	T2
45	85	0	0	0	1	0	0	T3	T4
45	95	0	0	0	0	0	1	T5	T6
54	95	0	0	0	0	1	0	T7	T8

T1=2000-01-08 01:10:15 T2=2000-01-08 09:10:15
T3=2000-01-08 09:15:15 T4=2000-01-09 01:10:15
T5=2000-01-09 01:15:15 T6=2000-01-10 01:10:15
T7=2000-01-10 01:15:15 T8=2000-03-10 01:10:15

CONCLUSIONS

In this paper, object oriented frameworks are described along with their classification. Various phases of the framework development are elaborated. The framework development methodology is applied to spatiotemporal data mining. The requirements of the spatiotemporal data mining are analyzed and suitable architecture for object oriented framework is identified and described using layered and model-view-controller architectural patterns. The framework structure is represented using class diagrams. The generic design for spatiotemporal database is also discussed. The framework is applied to generate applications for discovering spatiotemporal topological relationships and association patterns. The results of the topological relationships application are discussed. However, the framework needs to be extended to support other spatiotemporal data mining applications for association analysis, cluster analysis and classification.

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Ontology Languages For The Semantic Web An Updated Review

C. Ramesh[1], Dr. K. V. Chalapati Rao[2] and Dr. A. Goverdhan[3]
[1] CVR College of Engineering, Department of CSE, Ibrahimpatan, R.R.District, A.P., India
Email: hmcr.ramesh@gmail.com
[2] CVR College of Engineering, Department of CSE, Ibrahimpatan, R.R.District, A.P., India
Email: chalapatiraokv@gmail.com
[3] JNTUH College of Engineering, Department of CSE, Jagityala, Karimnagar, A.P., India
Email: govardhan_cse@yahoo.co.in

***Abstract*—The phenomenal growth of content on the Web has made it difficult to locate, organize, and retrieve information. One way to cope with this problem is to automate these tasks. But because of the complexity of natural-language processing, we still do not have machines that can understand and analyze the content on the Web as humans do. To handle this problem, many new research initiatives and commercial enterprises have been set up to enrich available information with machine processable semantics. Such support is essential for "bringing the Web to its full potential". Tim Berners-Lee, known as the inventor of the World Wide Web (WWW), has a vision for the future of the World Wide Web, which he calls "The Semantic Web", which aims to provide an intelligent access to heterogeneous and distributed information, enabling software products (agents) to mediate between user needs and the information sources available. Ontologies have proven to be an essential backbone technology in realizing the vision of Semantic Web. This paper summarizes ongoing research in the development of Ontology Languages for realizing the Semantic Web to its full potential.**

***Index Terms*—WWW, Semantic Web, Ontology Languages, Ontology, Semantic Web development tools.**

I. INTRODUCTION

The World Wide Web, the largest repository of information ever assembled, continues to grow at exponential rate. It contains information on almost every imaginable subject, and this information is instantaneously available to anyone with an internet connection. However, it is difficult for machines to process and integrate this information meaningfully. Semantic Web [1], envisioned by Tim Berners - Lee, is the initiative taken by W3C to solve the problems in meeting the challenge faced by current Web.

The full vision of the Semantic Web has yet to be fully realized, but there has been considerable progress in the development and use of standards, languages, technologies and applications. Ontologies have proven to be an essential element for representing and sharing knowledge across agents in various areas, such as natural language processing, bioinformatics, formal languages and e-commerce [2]. Ontologies are corner stone in realizing the vision of Semantic Web. In recent years, several ontology languages have developed for realizing the Semantic Web. A summary of the recent approaches for the development of ontology languages for the Semantic Web is the focus of our paper.

The rest of the paper is organized as follows: in section II, an overview of Semantic Web and the role of Web ontology languages is presented and requirements for Ontology languages are explained; in Section III the recent developments in Ontology languages for the Semantic Web are presented; Section IV describes RDF; Section V describes Semantic Web development tools and at end, the conclusion and future enhancements are discussed.

II. OVERVIEW OF SEMANTIC WEB AND THE ROLE OF ONTOLOGY LANGUAGES

A. Semantic Web

Semantic Web is the next stage in the evolution of the Web [3], where information is given well-defined meaning, enabling better coordination among computers and people. Currently information found on the Web is mainly for human consumption and is not machine-understandable. It is quite difficult to automate things on the Web and the enormous volume of information on the Web makes it even more difficult to manage it manually.

Semantic Web is not a replacement for the Web, but extension to the current Web and it is about making the Web more understandable by machines [4]. The impact of the Semantic Web, when it is realized, will be of enormous use, both for people and business, because it will achieve interoperability of information between web applications (agents, web services, etc.). Fig.1 presents the layered architecture of Semantic Web.

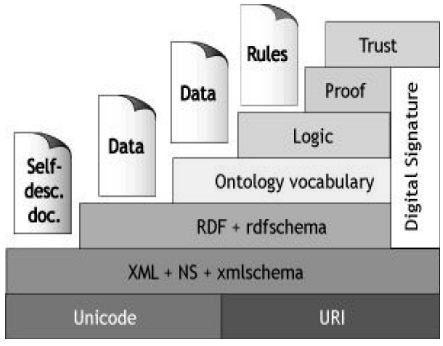

Figure1. Semantic Web Architecture

B. The Role of Ontology Languages

Although the notion of ontologies is independent of the web, ontologies play a special role in the architecture of the Semantic Web. The key challenge of the Semantic Web is to ensure a shared interpretation of information. Related information sources should use the same concepts to reference the same real world entities or at least there should be a way to determine if two sources refer to the identical entities, but possibly using different vocabularies. Ontologies and ontology language are the key enabling technology in this respect. An ontology, by its most cited definition in AI, is a shared, formal conceptualization of a domain, i.e. a description of concepts and their relationships [5]. Ontologies are domain models with two special characteristics, which lead to the notion of shared meaning or semantics:

1. Ontologies are expressed in formal languages with well-defined semantics.
2. Ontologies are built upon shared understanding within a community, both of people and software agents.

Ontologies come in different flavors; from flat lexicons with very few relationships to very expressive ontologies, which attempt to capture every possible aspect of the domain and have broad support for axioms [6]. Web ontology languages allow us to formally express ontologies. The expressiveness of an ontology is limited by the ontology language, which is used for the specification of the ontology. Many ontology languages have been developed, both with limited and with high expressivity. We put our focus on the development of Ontology languages for the Semantic Web.

C. Requirements for Ontology Languages

Ontology languages allow users to write explicit, formal conceptualizations of domains models. In recent years, several markup languages have been developed for realizing the Semantic Web.

The main requirements[1] of an Ontology language are [7]:

(1) Have a compact syntax.
(2) Be highly intuitive to humans.
(3) Have a well-defined formal semantics.
(4) Be able to represent human knowledge.
(5) Include reasoning properties.
(6) Have the potential for building the knowledge bases.
(7) Have a proper link with existing Web standards to ensure interoperability.

Unlike some existing markup languages, specifically HTML, a Semantic Web language must describe meaning in a machine readable way. Therefore an Ontology language needs not only to include the ability to specify vocabularies but also the means to formally define it in such a way that it will work for automated reasoning.

III. RECENT APPROACHES FOR THE DEVELOPMENT OF SEMANTIC WEB ONTOLOGY LANGUAGES

In this section some recent Ontology languages, particularly needful for the development of Semantic Web are presented, namely eXtended Markup Language, Resource Description Framework, Simple HTML Ontology extensions, Ontology interchange language, DAML, Web Ontology Language.

A. eXtended Markup Language

The eXtended Markup Language (XML) was the first language to separate the markup of Web contents from the Web presentation, facilitating the representation of task-specific and domain specific data on the Web. It provides a uniform framework for exchanging data between applications. Document Type Definition (DTD) and XML Schemas, were introduced, to enforce constraints on which tags to use, how they should be nested within a document. An XML Schema is a defined as grammar or definition language that constrains conforming XML documents to a specific vocabulary and a specific hierarchical structure. Unfortunately XML lacks semantics, software agents cannot be guaranteed to determine the intended interpretation of its tags. It is designed to describe the structure of the document, not the content.

B. Resource Description Framework

RDF[2], developed by the W3C for describing web resources, allows the specification of the semantics of data based on XML in a standardized, interoperable manner. It also provides mechanisms to explicitly represent services, processing and business models, while allowing recognition of non explicit information. RDF is becoming a widely recognized language and a representation formalism, that can serve as a worldwide interlingua for information interchange. The RDF description model uses object –attribute –value triples also known as statement. Its goal is to add formal semantics to the web and provide a data model and syntax convention for representing the semantics of the data in a standardized manner. It provides a means of describing the relationships among resources in terms of the named properties and values. RDF has significant advantages over XML. The object – attribute structure provides natural semantic units because all objects are independent entities. RDF played an important role as a basis for DARPA Agent Markup Language (DAML), whose layers of logic are built on the top of the basic RDF framework [8]. The descriptive power of RDF is minimal that in practice, it is always used in combination with RDF Schema. RDF Schema is a simple extension of RDF defining a modeling vocabulary with notion of classes and properties.

1.http://w3.org/DesignIssues/Logic.html

2 .http://w3.org/TR/REC-rdf-syntax/

IV RDF AND RDF SCHEMA LIMITATIONS

Though RDF and RDF Schema form the basis for building Semantic Web, together they still lacked sufficient expressive power. For example, they cannot define: *(1)* the properties of properties, *(2)* necessary and sufficient conditions for class memberships, or *(3)* equivalence and disjointness of classes. In addition, the only constraints expressible are domain and range constraints on properties. As a result, the semantics have remained weakly specified.

A. Simple HTML Ontology Extensions

Giving the authors the ability to embed knowledge directly into HMTL pages, making it also simple for user agents and robots to retrieve and store knowledge, was the goal of the so- called *Simple HTML Ontology Extensions* (SHOE). This approach allows authors to add semantic content to web pages, relating the content to common Ontologies that provide contextual information about the domain [9]. Most web pages with *SHOE* annotations tend to have tags that categorize concepts, therefore there is no need for complex inference rules to perform automatic classification [10]. This approach extends HTML with a set of object – oriented tags to provide structure for knowledge acquisition. It associates meaning with content by committing web pages to existing ontologies. These ontologies permit the discovery of implicit knowledge through the use of taxonomies and inference rules, allowing information providers to encode only the necessary information into their web pages. An ontology tag delimits the machine – readable portion of the ontology. Some other tags[3] complement the definition of Ontologies. SHOE focuses on the problem of maintaining consistency as the ontologies evolve. In "Ref. [11]" the use of SHOE in a real world internet application is described. Tools for annotating pages, information gathering tasks and querying are provided.

B. Ontology Interchange Language

Though RDF Schema is quite simple compared to a full-fledged knowledge representation languages, it lacks sufficient expressive power. Hence to specify the meaning of data more precisely, richer languages are necessary.

OIL(Ontology Inference Layer or Ontology Interchange Language), was developed in the Onto Knowledge project[4] with an aim to combine the best features of frame and DL(Description Logic) based knowledge representation systems, while at the same time maximizing compatibility with emerging web standards. It is compatible with the RDF syntax [12]. OIL has a frame-like syntax, which facilitates tool building, yet can be mapped onto an expressive description logic (DL), which facilitates the provision of reasoning services. OIL, built on top of RDF(S) has following layers: Core OIL groups the OIL primitives that have a direct mapping to RDF(S) primitives; Standard OIL is the complete OIL model, using more primitives than the ones defined in RDF(S); Instance OIL adds instance of concepts and roles to the previous model; and Heavy OIL is the layer for future extensions of OIL. OilEd is one of the popular ontology editing tool in OIL.

C. The DARPA Agent Markup Language

The DARPA Agent Markup Language (DAML) is a US government – sponsored endeavor aimed at providing the foundations for the next Web evolution, the Semantic Web. DAML [13] consists of two portions, the ontology language and a language for expressing constraints and adding inference rules. It also includes mappings to other Semantic Web languages such as SHOE, OIL, KIF, XML and RDF. Building on top of the RDF and RDFs and with its root in description logics, the Ontology Language (DAML+ OIL) [14] has a well defined model - theoretic semantics as well as an axiomatic specification that determines the language intended interpretations. This makes it an unambiguously computer interpretable language, thus making it amenable to agent interoperability and automated – reasoning techniques. The Inference Language (DAML-L) is a logical language with well defined semantics and the ability to express at least propositional Horn clauses, which enable compact representation of constraints and rules for reasoning. The language ties the information on a page to machine-readable semantics and allows communities to extend simple ontologies for their own use. In addition, it provides mechanisms for the explicit representation of services, processes and business models so as to allow non- explicit information to be recognized [15]. DAML + OIL and DAML – L together provide a markup language for the Semantic Web with expressive power and a well-defined semantics for reasoning. The DAML family of markup languages enables web service providers to develop semantically grounded, rich representations of web services that a number of different agent architectures and technologies can exploit to a variety of different ends [16].

D. Web Ontology Language (OWL)

Built on top of RDFS, the OWL provides a more expressive vocabulary along with a formalism based on predicate logic and descriptive logic. It uses RDFS/ XML – based syntax[5]. It is regarded as a W3C standard ontology language for Semantic Web. It is compatible with an early ontology languages, including SHOE, DAML + OIL, and provides the engineer with more power to express semantics. It includes four concepts that form the basis of an OWL document: *(1)* classes, *(2)* relationship between classes, *(3)* properties of classes, and *(4)* constraints on relationships between classes and properties of classes. Reasoning engines can make use of these to carry out logical inferences and derive knowledge. OWL is considered one of the fundamental technologies underpinning the Semantic Web, and has attracted both academic and commercial interest.

E. Three species of OWL:

The W3C has defined OWL to include three different sublanguages (OWL FULL, OWL DL, WL Lite) in order

3. http://cs.umd.edu/projects/plus/SHOE/ontologies.html
4. http://ontoknowledge.org/OIL
5. http://w3.org/ TR/owl-features

to offer different balances of expressive power and efficient reasoning.

OWL Full: The entire language is called OWL Full and it uses all the primitives and allows their combination with RDF and RDFS. OWL Full supports maximum expressiveness and the syntactic freedom of RDF with no computational guarantees. For example, in OWL Full a class can be treated simultaneously as a collection of individuals and as an individual in its own right.

OWL Full allows an ontology to augment the meaning of the pre-defined (RDF or OWL) vocabulary. It is unlikely that any reasoning software will be able to support complete reasoning for every feature of OWL Full. The advantage of OWL Full is that it is fully upward compatible with RDF, both syntactically and semantically: any legal RDF document is also a legal OWL Full document, and any valid RDF/RDF Schema conclusion is also a valid OWL Full conclusion. The disadvantage of OWL Full is that the language has become so powerful as to be undecidable, dashing any hope of complete (let alone efficient) reasoning support.

OWL DL: OWL DL supports those users who want the maximum expressiveness while retaining computational completeness (all conclusions are guaranteed to be computable) and decidability (all computations will finish in finite time). OWL DL includes all OWL language constructs, but they can be used only under certain restrictions (for example, while a class may be a subclass of many classes, a class cannot be an instance of another class). OWL DL is so named due to its correspondence with description logics.

The advantage of this language is that it permits efficient reasoning support. The disadvantage is that we loose full compatibility with RDF. An RDF document will in general have to be extended in some ways and restricted in others before it becomes a legal OWL DL document. Conversely, every legal OWL DL document is still a legal RDF document.

OWL Lite: OWL Lite is the restricted subset of OWL DL. It supports the users primarily needing a classification hierarchy and simple constraints. For example, while it supports cardinality constraints, it only permits cardinality values of 0 or 1. It has a lower formal complexity than OWL DL. The advantage of this language is that, it is both easier to grasp (for users) and easier to implement (for tool builders).The disadvantage is of course a restricted expressivity.

V. SEMANTIC WEB DEVELOPMENT TOOLS

The unique needs of Semantic Web requires tools for ontology development[6], content generation and content analysis [17]. In particular, we need the following elements:

- Editors and semi-automatic construction tools to build new ontologies.
- Annotation tools to link unstructured and semi-structured information sources with meta data.
- Reasoners for reasoning support.
- Reusing and Merging Ontologies: Ontology library systems.
- Ontology Environments to create new ontologies by reusing existing ones.

In the following, we will briefly describe examples for these technologies.

A. Common Editors Used For Building Ontologies

- ✓ DAG-Edit provides an interface to browse, query and edit vocabularies with a DAG data structure.
- ✓ Protégé[7] is the most widely used tool for creating ontologies and knowledge bases.
- ✓ SMORE[8]
- ✓ WebOnto is a java applet coupled with a Web server that allows users to browse and edit knowledge models.
- ✓ OilEd
- ✓ OntoStudio[9] is the most widespread commercial modeling environment for creating and maintaining ontologies.

B. Annotation tools

The best known tools around annotation and authoring are:

- Annotea
- Annozilla

C. Reasoning Service

Inference engines process the knowledge available in the Semantic Web by deducing new knowledge from already specified knowledge.

- Jena[10] provides a programmatic environment for RDF, RDFS and OWL, SPARQL and includes a rule-based inference engine.
- The FaCT (Fast Classification of Terminologies) can be used to automatically derive concept hierarchies. It is a Description Logic (DL) classifier that makes use of the well-defined semantics of OIL.
- RACER and Ontobroker are other examples of Reasoners.

D. Ontology Merging

Ontology mapping enables interoperability among different sources in the Semantic Web. It is required for combing distributed and heterogeneous ontologies. Ontology mapping transforms the source ontology into the target ontology based on semantic relations.

Glue and OntoMorph are some of the popular ontology mapping tools.

E. Ontology Libraries and Environments

Examples of Ontology library systems are:

- Web Onto
- Ontolingua ontology library

6. http://w3.org/wiki/SemanticWebTools

7. http://protégé.stanford.edu/
8. http://mindswap.org/2004/SMORE
9. http://ontoprise.de/en/products/ontostudio/
10. http://jena.sourceforge.net/

- DAML Ontology library
- SHOE
- Ontology Server
- IEEE Standard Upper Ontology
- (IEEE), Sesame24, OntoServer25, and ONIONS.

CONCLUSIONS

Semantic web, a vision of Tim Berners – Lee, aims at providing intelligent access to distributed information, so as to enable users to obtain more directly the information needed. This is achieved through appropriate structuring of the information in various sources, with sets of inference rules facilitating automatic reasoning. The current state of the art in the field of ontologies and ontology languages, that form the backbone for extracting semantic content of information, has been reviewed in this paper. An overview of the current Semantic Web technologies is also a highlight of our paper. The field is wide open and is currently an active area of research, with potentially, for significant advances.

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Activity Driven Teaching Model for Software Project Management Course

S. Suguna Mallika
CVR College of Engineering, Department of CSE, Ibrahimpatan, R.R.District, A.P., India.
Email: suguna.kishore@gmail.com

***Abstract*—The objective of this paper is to introduce a cognitive learning methodology for the course Software Project Management. The industry realizes every year the need to train its managers in software project management and invests in the training costs though it a known fact that almost all the managers have undergone a course on Software Project Management either at their graduate level or post graduate level. On the other hand the teachers who teach software project management in class find it extremely challenging in sustaining the interest of the students all through the coursework. One obvious reason for this is the lack of real time exposure to live environments in which the industry operates and of course lack of experience of students in the area of management.**

In an attempt to bridge this gap at least to a certain extent an activity driven teaching model has been proposed in this paper. This paper is aimed at stressing the importance of exposing the students to live case studies and thereby encouraging them in resolving some of the issues posed by the case study. The solutions can be discussed with the students thereof which would lead them realizing the standard practices explained theoretically in the prescribed text book. In this paper one such activity conducted to the students and their responses and how those responses could be traced back to the concepts explained in the text book has been illustrated.

An activity driven teaching model for SPM not only sustains the interest of the students with active interaction from them but also reduces the burden on the heavy training costs incurred by the industry in training the future managers.

***Index Terms*—SPM, Teaching methodology, cognitive learning.**

I. INTRODUCTION

SPM is a course designed at the Bachelors level with an intension to enhance the employable skills of the students and bridge the hiatus between industry and institution. The concepts narrated in the course help in making the student aware of the contemporary industry standards and unlearn the myths of project management. Though the course is aimed at throwing light on some of the most important aspects of management, as it needs a lot of practical knowledge which the students lack the overall teaching effect could become ineffective. An attempt has been made to try and make teaching SPM more effective and interesting by engaging an activity driven model. One of the activities conducted to present a concept called Barry Boehm's Staffing Principles has been presented in this paper as an example for illustrating the effectiveness of the model.

II. COGNITIVE LEARNING THEORY

Bruner said anybody can learn anything at any age, provided it is stated in terms they can understand. Cognitivism is currently the predominant perspective within which human learning is described and explained. Contemporary cognitivism emphasizes mental processes and proposes that many aspects of learning may be unique to the human species. Cognitivism has affected educational theory by emphasizing the role of the teacher in terms of the instructor's effectiveness of presentation of instructional material in a manner that facilitates students' learning (e.g., helping students to review and connect previous learning on a topic before moving to new ideas about that topic, helping students understand the material by organizing it effectively, understanding differences in students' learning styles, etc.) [2]

III. ACTIVITY DRIVEN TEACHING MODEL

Institutions that teach software are responsible for producing professionals who will build and maintain systems to the satisfaction of their beneficiaries. [3]

A. Training Goal

To impart concepts of Software Project Management through a more practical approach by getting the students involved in the activities and recording their opinions. There are several concepts which are to be driven as part of the

course curriculum. Software Project Management by Walker J. Royce is the book being followed for course curriculum. At a more mundane level, teaching software engineering also involves making the students familiar with practical techniques that have proved to be productive and are a key part of the trade.[3,4].

B. Training Model

This is an activity driven model encouraging active participation from the students. There is a topic called Barry Boehm's Staffing Principles for effective Project management in this course. The 5 principles given by Boehm called the Boehm's principles are as follows:

1. Use Fewer and Better people
2. Principle of Job Matching
3. Principle of Career Progression
4. The Principle of Team Balance
5. The Principle of Phase Out.

Instead of discussing these principles directly in the class, a teaching case has been given and students were encouraged to participate in the activity with their thoughts and suggestions as outcome of the activity.

C. TEACHING CASE

Your Project has been working on a new library management application for 8 months. A key individual in the project (one who is technically competent and contributed significantly to the project) is making himself unpopular with the rest of the team members by constantly referring to her importance in the success of the project. Several team members have mentioned to you that this attitude of his is beginning to annoy people so much that they are looking ways to avoid working with him. You feel that this situation has the potential to affect the success of your project.

Q1. What action would you take with the key individual himself?
Q2. What action would you take with the rest of the team?
Q3. How might you prevent similar situations from occurring?

D. TEAM ORGANIZATION

The entire class has been divided into 4 groups each group comprising of 15 students. Every group is encouraged to identify a group leader who is technically called the "Team Leader" for further communication. The Team Leader was the Single Point of Contact with that group. His responsibilities included collating different opinions of his team members and jotting down an optimal solution based on the team's opinions. A time slot of 20 minutes was awarded for all the groups to have a discussion and then a final discussion on the case happened for 15 minutes. All the opinions discussed were written as points on the board. After the points were noted down they were correlated to the theory explained in the text book. The students were left with a practical experience thereby making it interesting to simulate and enact several principles of Project Management.

IV. RESULT ANALYSIS

Table 1.0

Sno	Q	Team A	Team B	Team C	Team D
Q1	What action would you take with the key individual himself?	Appreciate the key individuals contributions to the project in a one-to-one meeting (Assuming that he is feeling that his efforts not being given the deserving acclaim)	Negotiate with the key individual and try to understand his interests with respect to career progression (lack of recognition might be reason for his outburst)	Counsel the key individual and tell him the importance of collective performance and team work.	The key individual should be made mentor for two other team members with whom his camaraderie works.
Q2	What action would you take with the rest of the team?	The other team members should be assigned tasks which match their skill set and encourage them to demonstrate tangible results.	The other team members' aspirations should be individually noted down and assignments should be given which motivate them.	Responsibilities should be divided among the team members equally and individual team members are encouraged to contribute to the team.	The other team members' ideas should be encouraged and implemented to boost them up and make them feel on par with the key individual.

Q3	How might you prevent similar situations from occurring?	The team should be taken out for team outings to improve the interpersonal relationships.	The other team members should be nominated for technical trainings and their competency levels should be increased to that of the project requirements.	The team should be exposed to various team building activities like outings, group lunches; organization level competitions etc. to improve interpersonal relations.	Each member is strong at one or the other aspects and each person should be made a single point of contact for some initiatives within the team.

From the above suggestions and conclusions made by the various groups, concepts of Barry Boehm's Staffing Principles could be illustrated practically to the pupils. If similar activities can be planned for imparting the other concepts like drawbacks of classical models, improvements in the modern project management practices etc, then students are left with an enriched experience of software management concepts which will make them industry-ready.

CONCLUSIONS

An Activity driven approach not only makes the class interesting but also makes the students empathize with certain practical situations in the industry and encourage them to think proactively against amicable solutions. All students are intrinsically motivated to self actualize or learn. Similar practical situations can be picked up as cases of discussion for illustrating the importance of concepts like Identification of Metrics, Change Indicators, understanding the workflows et al. Situations of the sort heard of or imaginative can be created to make the students think and analyze situations and come up with their own thoughts which not only makes teaching SPM interesting but also helps the students visualize some of the real world scenarios.

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A Survey on RCF Based Data Dissemination Techniques for VANETs

E.Suneetha[1] and S.Bharathi Priya[2]
[1]CVR College of Engineering, Department of CSE, Ibrahimpatan, R.R.District, A.P., India
Email: suneethaeluri9@gmail.com
[2]CVR College of Engineering, Department of CSE, Ibrahimpatan, R.R.District, A.P., India
Email: bharathipriya.cs@gmail.com

Abstract—**Vehicular Ad hoc Networks (VANETs) are the commercial version of Mobile Ad hoc Networks (MANETs) having very high mobility in which every vehicle acting as a host as well as router and forwards the packets to other vehicles. VANET forms decentralized networks, which enable plethora of important applications and services ranging from life safety applications to infotainment applications. High mobility in vehicular networks causes rapid topology changes and frequent disconnections. Due to this, data dissemination is a challenging task for researchers. Most of the data dissemination technique follows the iterative approach of Relay, Carry and Forward(RCF) in which road side units periodically pours the data packets to the moving vehicles, it buffers the data packet until a new vehicle enters into its vicinity and forwards the packet. This procedure establishes multi-hop communication to reach the destination. All these techniques have to consider about the delay and delivery ratio constraints with available bandwidth. The Performance of these techniques was highly affected by traffic density and data set size. In this paper, various data dissemination techniques and their performances, issues were analyzed thoroughly.**

***Index Terms*—Vehicular *Ad hoc* networks, data dissemination, Road side units, Packet delivery ratio, Traffic density, Data set size.**

I. INTRODUCTION

Intelligent Transportation Systems (ITS) have been deployed in the U.S., Europe and Asia. Existing ITS deployments are "Infrastructure heavy" in that they rely on roadside sensors, cameras, networks, etc. While such systems provide substantial benefit, deployment is very costly. In order to support ITS, vehicles are equipped with computing and communication capabilities, where every vehicle node acts as a host as well as router and forwarding the messages to other mobile nodes. This forms Vehicular Ad hoc Networks (VANETs) [5], the high mobility of vehicles causes rapid topology changes. Hence MANETs [5] protocols are not suitable for vehicle communication.

VANETs can be envisioned as a "Self-Organized networks" where communication is performed between Vehicle-to-Vehicle(V2V) and Vehicle-to-Road side unit (V2R). The roadside unit (RSU) is typically a data center with specialized wire-less interface, it maintains list of messages that has to be propagated to the vehicles on the road. At every intersection data packets are transferred to the RSU and the RSU delivers the data packet to the vehicles that can transfer this packet to the destination with minimum delay.

Vehicular Networks provides plethora of applications and services ranging from the life safety application to infotainment applications. For Example, Vehicular networks are considered as the perfect way to bring more comfort to the passengers and more safety to human life, by providing emergency warnings like accidents, speed limit, traffic condition, road conditions and any obstacles on the road etc. These are considered as critical life safety applications in which delay is not tolerable(Non-delay tolerant applications) [4].Emergency messages are short, that have delay ,delivery ratio constraints and do not really care about bandwidth. Whereas the infotainment applications like commercial advertisements, informing about stock prices, enquiring about the nearby parking stations, gas filling stations, restaurants etc are delay-tolerant. These services have constraints related to bandwidth [1].

Through these applications, we can see that VANET is very useful for disseminating data from an information source (data center) to many vehicles on the road. Recently researchers have begun to work on various data dissemination techniques to address the issues in the VANETs. Good data dissemination algorithm must address the characteristics of the vehicular network in which it will operate. Let us therefore consider the characteristics of V2V networks. Assume instrumented vehicles are equipped with on-board computing and wireless communication devices, a GPS device enabling the vehicle to track its

geographical-temporal trajectory, a pre-stored digital map, and other sensors reporting crashes, engine statistics, etc. Due to the gradual nature of market penetration, only a fraction of the vehicles on the road will be instrumented Specifically, the term "penetration ratio" is defined as the fraction of vehicles on the road that are instrumented. Only instrumented vehicles participate in the V2V system. In the remaining sections of this paper, the term "vehicles" refers to instrumented vehicles only.

Vehicles exchange information with other vehicles within their short radio range and ad hoc wireless networks are used to propagate information. A V2V network is a special type of ad hoc network. Some unique characteristics [16] that differentiate it from other types of ad hoc networks include: (1) predictable, high mobility that can be exploited for system optimization (2)dynamic, rapidly changing topology (due to high mobility) (3)constrained, largely one-dimensional movement due to static roadway geometry (4) potentially large-scale (5) partitioned. The probability of end-to-end connectivity decreases with distance is implicitly assumed for ad hoc networks (6) vehicles are not completely reliable (7) no significant power constraints, unlike sensor and other types of mobile networks where limited battery life is a major concern. These properties make V2V networks different and significantly affect their design.

Above mentioned unique characteristics of the VANETs brings out new research challenges to the research community. First, due to fast vehicle movement, the link topology changes rapidly [16]. As a result, many well-studied structures for efficient data dissemination, such as trees, clustering, and grids, are extremely hard to set up and maintain. Second, the conventional broadcast mechanism for data dissemination may lead to broadcast storm [13] because the network node density is usually quite high in an urban area and extremely dense during rush hours or traffic jams. Third, the vehicle mobility is partially predictable since it is limited by the traffic pattern and the road layout [5]. Data dissemination techniques should address these unique characteristics of the VANET.

In vehicular ad hoc network the delivery is not only single hop but multi hop delivery of data could be done and even the vehicle which is miles away from the destination can also query there request like – traffic condition in the city can be obtained by the vehicles when they are out of city[7]. In these situation vehicle can forward their request to the other vehicles and can receive the response in some seconds or in fraction of minutes. Many data dissemination protocols [1] have been proposed to disseminate information about obstacles information, traffic conditions and mishap on the roads.

In this paper we are presenting some available techniques which are based on pull and push based mechanism. The rest of the paper is organized as follows: Section-II describes several data dissemination techniques in the vehicular ad hoc networks and finally Section-III concludes this paper and explains the future.

II. DATA DISSEMINATION TECHNIQUES

A. Introduction

Data Dissemination is the process of broadcasting the data periodically to the vehicles on the road. Data Dissemination in fixed infrastructure can utilize well-established routing protocol for wired networks. But Data Dissemination techniques for vehicular networks remain as a challenging task to meet the design objectives. Some of the design objective includes low end to end delay, high reliability, low memory occupancy, high packet delivery ratio and maximum dissemination capacity with available bandwidth.

The network traffic density [3] in VANETs is expressed in terms of number of vehicles on the road. Some of the design objectives are highly affected by the high and low traffic density. Normally, in the urban areas where people population is more or in peak hours, the number of vehicles on road is preferable more. During dense traffic conditions, always a vehicle finds a forwarder to deliver the data packet to the nearby RSU or to the intended node to reach the destination[2]. Low traffic and intermediate traffic conditions can be seen in rural areas, during non-rush hours, in high way scenarios or in rural areas, in these circumstances the number of vehicles on the road is likely to be less. Due to this reason there is always frequent disconnections between the vehicles, hence the data cannot be propa-gated/disseminated to the intended node/RSU. This situation arises in sparsely connected networks [3].On the other hand, the high mobility of vehicular networks introduces the opportunities for mobile vehicles to connect with each other intermittently during moving. To deal with disconnection in sparsely connected network [3], the idea of relay, carry and forward [13] is adopted, where the vehicles carry the packet when appropriate route do not exist to forward the packet to the new receiver that moves into vicinity. Through Relay, Carry and Forward, the message can be delivered to the destination without end to

end connection by establishing multi hop communication.

Semantics of data dissemination services [16] and their suitability for ITS applications are mentioned below. Four services that have immediate application are unicast, multicast, any cast and scan. Unicast with *precise* location means a message should be delivered to node *i* in location *l* before time *t*. Unicast with *approximate* location means sending a message to node *i* before time t_1 while that node was last known to be at location *l* with mobility *m* at time t_2. Multicast means disseminating a message to all receivers in region *r* before time *t*. Anycast means disseminating a message to one among a set of possible destinations (e.g., send to any police car) in region *r* before time *t*. Scan is to have a message traverse region *r* once before time *t*. In these services, location *l* and region *r* are used to direct the message to a geographical area. Time *t* is determined by the nature of the message, e.g., when the information becomes obsolete, and serves to avoid the infinite looping of messages in the system. Other services can also be designed as variations or combinations of the above services.

To illustrate an application using these services, consider a vehicle (or a traffic signal controller) wishing to obtain information concerning some remote region. The vehicle/controller needing the information first queries its own proximity (*multicast*) to determine if a near-by vehicle happens to have this information. Any vehicle having such information can respond (*unicast with approximate/precise location*). If no one replies within a certain amount of time, the vehicle/controller sends a query to any vehicle in the remote region (*any-cast*). Receivers in the remote region with this information can respond. The response can be disseminated as *unicast with approximate/precise location,* or *multicast* if caching is desired. This scenario describes a pull approach. A push approach could also be used, e.g., vehicles encountering a crash or traffic congestion may send this information to a region using *multicast*.

Another application is mobile Internet access. Fixed location Internet gateways may be placed along roads. A vehicle wishing to access the Internet first propagates a query through a region for gateways (*scan*). Gateways receiving the query can respond to the requesting vehicle (*unicast with approximate location*). The requesting vehicle picks one responder and begins to interact with it. The communication from the vehicle to the gateway is *unicast with exact location* while the reverse direction is *unicast with approximate location*.

B. Data Dissemination Schemes

Data dissemination is a challenging task because with the available bandwidth, maximum data has to be disseminated over vehicular network. Some of the data dissemination techniques are based on push-based and pull-based mechanisms [6]. In push based data dissemination scheme data is managed by data center which collects the data from outside world and maintains the list of messages that is to be disseminated over network. In this scheme, data dissemination follows simple flooding algorithm [12] where data center periodically broadcast the data to the vehicle which enters into transmission range. Data center includes the header information in to the data packet. Format of the header is given below:

Source id	Source location	Forwarding direction	Packet Generation	Packet Expiration time

Fig. 1 Header format

The pull based dissemination scheme is mainly used by vehicles to query the data for the specific response from data center or from other vehicles. Pull based scheme is used by some specific users. In this scheme the data is managed by the data center and the vehicles which are moving on the road. When the vehicle needs any data query then firstly these vehicles sends beacon message to find the list of neighbor vehicles. These vehicles are already equipped with digital maps, having street level maps and traffic details like traffic density and vehicle speed on roads at different times [1]. The carry and forward mechanism is used to deliver the data in this approach. In this mechanism data packets are carried by the vehicles and when they found another vehicle[s] moving in the direction of destination in its range, it forwards that packet to this vehicle. This mechanism takes tolerable delay to transfer data to the destination.

In this approach data packets are mostly transferred using wireless channels but if the packet has to be transferred through the roads then those roads will be chosen for data transfer through which highly mobile vehicles are moving. Since the vehicular ad hoc network are unpredictable in nature, so optimal path for success-ful routing cannot be computed before sending the packet. So the dynamic path selection [3] is done throughout

the packet forwarding process. Since, pull based mechanism is generally used for making queries and receiving the response. So this whole process is typically divided into two sub processes. a) Requesting data from moving vehicle to fixed location. b) Receiving response from fixed location to moving Vehicle.

Several Data dissemination protocols were proposed by researchers and they are generally classified in to two classes:1) Protocols for safety/emergency applications(e.g Warning messages about road accidents, obstacle on the road) that have delay and delivery ratio constraints 2) Protocols for infotainment applications (e.g. .advertisement applications) that have constraints related to bandwidth.

C. Dissemination for safety applications

Many dissemination protocols have been proposed to perform safety messaging to avoid mishaps. These protocols need to provide low end-to end delay and high delivery ratio constraints [4]. Some of the protocols are specified below:

In [14] Xu *et al* presented Vehicle-to-Vehicle safety messaging in DSRC; this paper explores the feasibility of sending safety messages from vehicle to vehicle in short radio range. Safety messages are time sensitive and these messages should be received reliably with small delays. They have defined the Probability of Reception failure (PRF) as the probability a targeted receiver fails to receive a safety message within given time delay and collision free. To accomplish the above criteria, MAC protocols are used. But this approach needs a fine tuning mechanism to work based on the traffic densities[15].

Another interesting work was proposed a scheme, called Directional Propagation Protocol (DPP) [11] based on clustering algorithm to regroup the vehicles into clusters. In each group a header and trailer is elected as an in-charge for message propagation.DPP consists of 3 modules; a Custody Transfer protocol, an Inter Clustering protocol and Intra-Clustering Routing protocol. It uses store and forward module to handle the network disconnections. Unfortunately, this paper fails to address the procedure for header and trailer election.

In Spatio-Temporal Emergency Information Diss-emination (STEID) [9], the main goal of the work is to quickly disseminate traffic alerts to every vehicle that passes through an emergency zone during the life time of the emergency. To achieve this goal, they proposed hybrid network architecture consisting of WiFi clusters connected through proxy servers and cellular links. As this work is based on cluster formation and maintenance, there is considerable overhead in forming and maintaining cluster for short period of time.

In [8], focuses on the “Enhancement of Multihop Vehicular Broadcast (MHVB)”.The enhancement procedure is carried out in two steps: by changing the shape of the backfire region in the algorithm and by introducing a new dynamic scheduling algorithm which prioritizes the packet transmission based on “processing” of the received packets from other vehicles. This work also includes traffic congestion detection algorithm by counting the number of vehicles surrounding a concerned node and detects the congestion. If it is the case, it expands the interval of transmitting its own information, therefore saving bandwidth and reducing collisions.

D.Dissemination for infotainment applications

The infotainment services (such as delivering announcing advertisements about sale promotions, getting information on the available parking places, and carpooling possibilities, etc.) interest mostly the network operators and service providers. The dissemination protocols used in such class of services have no constraints in terms of delay and delivery ratio (a good delay or delivery ratio is appreciated but not mandatory)[10]. However, they have constraints related to the bandwidth use. In the following section, some of the protocols are discussed with their performance issues.

In [12] Xu et al proposed an Opportunistic diss-emination scheme in which data center periodically broadcast the data which will be received and stored by passing vehicle in the range of the data center. Whenever two vehicles move into the transmission range of each other, they exchange the data. This approach is followed for the user queries on the local database with predefined spatial and temporal boundaries. When the vehicle density is very high, every vehicle exchange their information with other vehicles in its range resulting in MAC layer collisions. This significantly reduces the data delivery ratio.

To mitigate excessive transmissions and conge-stions, KormaZ et al proposed [13] a link layer based protocol refereed as Urban Multihop Broadcast (UMB) protocol for inter-vehicle communication system. UMB is designed to address three problems: 1) Broadcast storm 2) Hidden node 3) Reliability. This protocol does not simply broadcast the data packet to all the neighboring nodes, instead it selects the farthest node in its broadcast direction’s transmission range and assign the duty of forwarding the data and acknowledgement further. Repeaters are installed in

the intersections to disseminate the packet in all directions. Basically this protocol is a segment based where the road portion is segmented into sub segments to select the forwarder. As a result, this protocol can adapt itself to light or heavy traffic condition. In order to decrease the affect of hidden nodes, RTS/CTS handshake mechanisms are employed. Due to the handshaking mechanisms some overhead and delay is introduced for each transmission.

Wu et al [16] presented a MDDV algorithm, based on opportunistic forwarding, geographical forwarding and trajectory based forwarding. In opportunistic forwarding, the sender selects the eligible forwarder based on the predefined knowledge of the neighbors. Trajectory based forwarding is specified extending from source to destination along which a message will be moved geographically closer to the destination (geographical forwarding).Unfortunately, this approach specifies only one forwarding trajectory that may not lead to the destination with minimum delay. To increase the system's robustness and reduce the delay, multiple diverse forwarding trajectories have to be defined.

To resolve the above mentioned problems, Zhao and cao proposed Vehicle Assisted Data Delivery (VADD) for VANETs [3]. Basically this approach deals with pull-based mechanism, which adopts relay, carry and forward strategy. When the data has to be forwarded from one place to another, then this protocol suggests that path selection should be done on the basis of high density of vehicle. Even though distance traversed through this path is more, forwarding delay will be less on this path. Forwarding is based on location (L-VADD) or direction (D-VADD). L-VADD shows better performance than all other VADD protocol when there is no routing loop occurs. When it occurs, performance affects severely and data delivery ratio decreases. Hence Multi-path VADD (M-VADD) and Hybrid VADD) H-VADD is proposed, in which Hybrid probe H-VADD is developed in which both L-VADD and D-VADD protocols are used. Firstly packet is forwarded using L-VADD protocol but as the routing loop occurs the L-VADD protocol is dropped and D-VADD protocol is used.

Another interesting work carried by Zhao and Zhang Zhao, Cao [6] have proposed Data Pouring and buffering scheme for push based data dissemination. The Data Pouring (DP) scheme selects one or some road having high density and mobility of vehicles i.e. axis road (A-road) and data center delivers data not only on that road but on the crossing roads (C-roads) if the vehicles are near to the intersection on C-roads. The Data Pouring Intersection Buffering (DP-IB) mechanism uses relay and broadcast stations which are actually the buffers (IBer) [6]. These IBers are placed at the intersection points and used to store data at the intersections. In the DP-IB scheme the data has been transferred from data center to the buffers present at the intersections by this way the availability of the data is increased at the intersection and the load on the server is reduced and data delivery ratio is increased. IBers periodically rebroadcast data so that vehicles passing through C-road can receive data packets. IBers update themselves with the updated data send by data center. There may be possibility of collision between the new data item send by data center and broadcast data by IBer. To avoid this collision, broadcast period is divided into two parts.

1. Busy period in which IBer can only broadcast data
2. Idle period in which IBer only listen the forwarded data.

The broadcast cycle time at the intersection T_i is used to determine Dissemination Capacity, delivery ratio of DP and DP-IB scheme. This T_i should be less than the time taken by vehicles to go through intersection region i.e. T_i to guarantee that all the vehicles moving from the intersection can receive the broadcast data. The delay in the DP scheme is more because many time receiver cannot receive data packets in a single cycle and in Reliable DP (R-DP) scheme, vehicles uses request to send/clear to send (RTS/CTS) handshakes to reduce collision and hidden node problem but due to this handshake, delay is more as it blocks the flow until it receives the acknowledge of the previous packets and in DP-IB scheme the delay is more as IBer uses only idle cycle to receive the forwarded packets. The delivery ratio of DP is good for very small set of data but as size of data set increases it decreases. The R-DP and DP-IB have very high data delivery ratio for limited data set size but as the data set size increases more the delivery ratio of R-DP falls whereas DP-IB scheme keeps the same delivery ratio.

CONCLUSION

Most of the dissemination protocols do not considered the real condition of vehicular traffic, road condition and obstacles on the road. Some of the protocols need high priority for alerting the vehicles in which packet forwarding delay is not acceptable. On the other hand, several protocols can be used where slight delay is tolerable with limited bandwidth. Performance of the protocols varies

based on data set size, traffic density, data packet size and buffer size. In this work, we have focused on push-based dissemination, where the data can be efficiently delivered from moving vehicles or fixed stations to other vehicles. And also we focused on pull-based data dissemination/access, where a vehicle is enabled to query information about specific targets. Generally speaking, the push-based approach is used to disseminate data that are useful for many people, whereas the pull-based approach is used to query data that are specific for some user. In practice, a hybrid of push/pull can be used to improve the system performance, and this will be studied in our future work.

We hope that this concise work will help to make better understanding to those researchers who are new to applications of VANETs and pave their way for developing new ideas to enhance the working of these networks.

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Evolution of Mobile communication technology and mobile computing

S.Sen Gupta
CVR College of Engineering, Department of ECE, Ibrahimpatan, R.R.District, A.P., India
Email: shubham_rani@yahoo.co.in

***Abstract*—The mobile communication technology has evolved from Analog Systems to sophisticated digital systems. The development of 4G with basic architecture of long term evolution (LTE) will give data speed of higher than 100 Mbits/sec with mobile device. LTE architecture combining the evolved radio network with nonradio system architecture has given the desired speed and flexibility in limited trials.**

***Index Terms*—Mobile computing has also evolved from simple data dissemination, data hoarding and synchronization etc. to flexible Android open platform Open Hand set Alliance (OHA) is making new innovative applications for the mobile devices.**

I. INTRODUCTION

One of many reasons for developing cellular mobile telephone system over a mobile system are limited service capability, poor service performance and inefficient frequency spectrum utilization. The cellular concept is a novel way to ensure high capacity by utilizing the available radio spectrum by frequency reuse. The area covered by a cellular network is divided into cells. A few cells forming a cluster use the entire radio spectrum and the same frequency is used in different clusters, thereby increasing the user capacity with tolerable co-channel interference. After the basic concept common to most cellular network the specific generation of cellular networks and standards are based on specific implementation as years progressed. The first implementation of the cellular concept constitute the first generation (IG). The system such as AMPS in USA and NMT in European countries were analog based. The problem of no use of encryption, inferior call quality and spectrum inefficiency in analog systems were overcome by use of digital technology in the 2nd generation (2G). The digital systems convert speech into digital code to overcome the deficiencies of the IG system. There are several 2G standards followed in different parts of the world, GSM in Europe, DAMPS in USA, PDC in Japan. Global systems for mobile communication (GSM) is extremely popular 2G system – used in over 100 countries. GSM and other 2G standards were primarily used for voice and low speed data. GSM and others started providing data services over laid on the cellular net work. This was meant to be a stop gap arrangement.

A. Evolution of 2G to 3G

The main objective of 2G was voice calls and low speed data with higher coverage and number of users. It evolved into 2.5 G catering to data speed of 64 to 144 kbps with introduction of GPRS (global packet radio system) in the GSM Technology and CDMA 2000 1X in CDMA technology. Basically packet switches for data are parallelly working with circuit switch. In 3G Phase I EDGE was introduced for existing spectrum and WCDMA/WCDMA – E with new spectrum. It caters to the speed of data from 384 kpbs to 3.6 Mb/s. In the CDMA path CDMA 200 / 1 X Do for new and existing spectrum was introduced. In the fully evolved 3G speed of 14 Mb/s was improved through better techniques of digital modulation and orthogonal frequency division multiplexing (OFDM). The architecture of UMTS which forms the basis for 3G has added a new radio access network (UTRAN), and introduced IMS (IP Multimedia Sub System).

II. WIMAX

While Telecom service providers were working for evolution of 2G to 3G through generation partnership project (GPP), the wireless local area network (WLAN) was getting standardized by ISO. It evolved in many directions depending on requirement for wireless personal area network (WPAN) through blue tooth, zigbee, uWB. WLAN for less than 10 m catering to speed of 11-54 M bits/sec was standardized in 802.11 a/b/g (hi-fi) Wireless Metropolitan Area Network (WMAN, <50 KM) catering to speed of 75m bits/sec was standardized by 802.16/d/e which is called Wimax. Wimax Technology provides for world wide interoperability for microwave access, working in 10-60 GHz provides portable and eventually mobile wireless broad band connectivity.

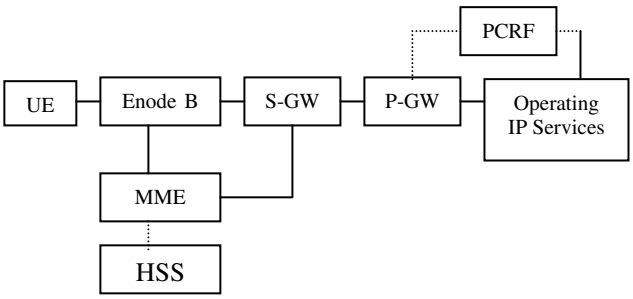
A. Evolution of 3G to 4G

The driving force behind 4G is the effort to develop products for LTE (Long term evolution). The LTE key features include high throughput (> 100 Mbps) low

latency and high Q.O.S (Quality of service) especially for multimedia applications. It is all IP network and provide interoperability with existing network. The LTE key technologies include MIMO: providing for high spectral efficiency, OFDM, Turbo coding, providing minimized requirement of SNR at the receiver. It also includes adaptive modulations to QPSK/16QAM/64 QAM. The LTE advantage include reduced cost per bit, better user experiences, flexible use of existing and new frequency band and open interfaces. It also caters to reasonable terminal power consumption.

LTE supports only packet switched services (IP network). It encompasses the evolution of the universal mobile telecommunication (UMTS) through the evolved UTRAN, it is accompanied by an evolution of the non radio as parts under the system architecture evolution (SAE) which includes the Evolved Packet Core (EPC) network. Together LTE and SAE comprise the evolved packet system (EPS). EPS provides user with IP connectivity to a PDN with a defined Q.O.S, security & privacy.

LTE Architectural overview:



UE: user equipment
Enode B: evolved node B
Radio access network, E-UTRAN of uMTS
S-Gw: serving gateway
P-Gw: PDN gateway
MME: Mobility management entity
HSS: Home subscriber service

Enode B is the Base station equivalent providing radio access.

SGW: All user IP packets are transferred through S-GW which serves as a mobility anchor.

P-GW: Responsible for IP address allocation for the UE as well as Q.O.S. enforcement and flow based charging according to the rules of PCRF.

MME: It process signaling between the UE and core network (CN)

HSS: contains user SAE subscription data such as Q.O.S profile and any access restriction for roaming.

PCRF: It is responsible for policy control decision making as well as constructing the flow based charging functionalities in the P-GW.

B. Mobile Computing:

In this section the mobile computing platform in particular Android O.S will be briefly discussed. The mobile computing requires data dissemination by servers through base station and access points. It also requires mobile IP network (Home agent, Foreign Agent) for packet delivery and hand over, location management, registration etc. Mobile TCP Protocol has been devised to take care of the optimal solution for packet loss, bit error rate through a split TCP network. It also requires hoarding and caching of data from data bases, data synchronization etc.

Android as a platform is becoming very popular and it is expected to cross over iphone sales, symbiotic (Nokia OS platform) by 2012. Open Handset Alliance (OHA) has committed to make deployment of Android platform for every mobile operator.

Android: A software platform and operating system for mobile devices, based on Linux & developed by Google and later by OHA. It allows writing managed code in the Java Language. Unveiling of the Android Platform was announced in Nov, 2007 and OHA was founded.

C. Features:

Android is a software stack for mobile devices that includes an operating system, middle ware and key applications. Its features include application framework enabling reuse and replacement of components, Delvik Virtual Machine, integrated browser, SQL lite structured data storage, Media support for videos, still images formats, GSM Telephony, 3G, Wifi support.

D. Application Frame work:

It provides an open development platform offering developers the ability to build extremely rich and innovative applications. Underlying all applications is a set of services and systems including:

1. A rich and extensible set of views that can be used for building applications.
2. Content provider that enables application to access data from other applications or to share own data
3. A resource manager providing access to non-code resources such as localized strings, graphics and layout files,.
4. A notification manager that enables application to display custom alerts in the status bar.
5. An activity manager that manages life cycle of application and provides a common navigation back stack.

E. Libraries:

Android includes a set of C/C++ libraries used by various components of the Android system. These capabilities are exposed to developers through the Android application framework. These libraries include

system c library, media libraries, surface manager, web browser engine, 2D graphics 3D libraries (open Gl ES 1.0) SQL lite a powerful and light weight relational data base engine.

F. Android run time:

Android includes a set of core libraries that provides most of the functionality available in libraries of the Java programming language.

G. Linux kernel:

Android relies on linux version 2.6 for core system services such as security, memory management. Process management, network stack and driver model. The kernel also act as an abstraction layer between the hardware and rest of the software stack.

CONCLUSIONS

As it has been shown in the trials of 4G that it is going to provide data at a rate higher than 100 Mbits/Sec with mobile devices there is challenge now to imagine innovative applications such as mobile freely distributed databases and components. With the announcement of the Android software stack on the mobile platform and Open Handset Alliance (OHA), a beginning has been made. There is now complete mobile infrastructure of speed and flexibility to deploy innovative architecture of the applications. A day may not be far when the way we live and transact business will see a paradigm shift.

Lifetime Evaluation of Wireless Sensor Networks

Wg Cdr Varghese Thattil (Retd)[1] and Dr. N Vasantha[2]
[1] CVR College of Engineering, Department of ECE, Ibrahimpatan, R.R.District, A.P., India
Email:mailthattil@gmail.com
[2] Vasavi College of Engineering, Hyderabad, A.P., India
Email: vasanthavasantha@rediffmail.com

Abstract—**Wireless Senor Networks (WSN) are coming of in age and are being installed in many applications. Some of the common monitoring applications are seismic, volcano eruption, tsunami, structural, intruder detection, health, habitat etc. Most of these applications of WSN are event driven wherein the system should be able to sense an occurrence of an event at an unknown future instant of time when it occurs. If the WSN system fails to detect the event at the time of occurrence the entire deployment of WSN fails to achieve its purpose. WSN has a specified life time and therefore in order to continue the operation of monitoring; it is essential to know the operational life period of WSN system. Knowledge of this will help in scheduling and planning the required redeployment. WSNs are highly resource constrained systems and most of the research in the WSN has been carried out to improve the performance under high resource constraints. The estimation of useful life of Wireless Sensor Network can be carried out by preparing a fault model of the WSN system. The system fault model can be used to predict the system survivability. The paper discuses the WSN fault model.**

Index Terms—**Wireless Sensor Networks, Quality of Service, Fault model**

I. INTRODUCTION

As the Internet has revolutionized our life via the exchange of diverse forms of information readily among a large number of users, Wireless Sensor Networks (WSNs) is expected to revolutionize to provide "ambient intelligence" where many different devices will gather and process information from many different sources to both control physical processes and to interact with human users. WSNs will also be equally significant by providing information regarding the physical phenomena of interest and ultimately being able to detect and control them or enable us to construct more accurate models of the physical world. With the recent advances in the Micro electromechanical Systems (MEMS) Technology, sensors are becoming smaller and affordable. More and more applications are being introduced using WSNs to monitor environment, industrial process, battlefield, seismic, health, habitat etc.

While a lot of research has been done on some important aspects of WSNs such as architecture and protocol design, energy conservation, routing, localization etc.; not much work has been carried out to generate a system model for WSN and thus estimate the survivability of the WSN system. This is mainly because WSNs are very different from traditional networks. In the Internet, the network and transport layer protocols ensures end-to-end reliability where as in the case of WSNs this will not be optimal because of the unique constraints like energy, memory, computational power etc. Further sensor networks as a whole has a specific task to be carried out depending upon the application and therefore the WSN system models will be application specific. These models then can be utilized to carry out various performance evaluations.

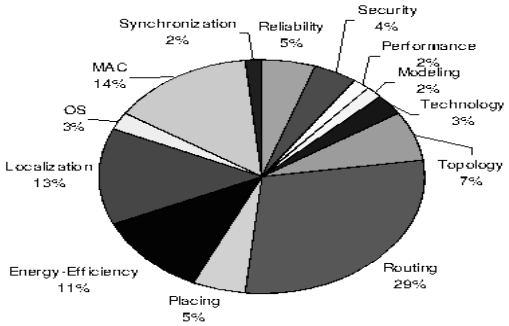


Figure 1. Classification of areas of research in WSN

Figure 1 shows a classification of remarkable papers on WSNs, published on several leading IEEE and ACM journals and conference proceedings [1]. As one could expect, our study evidences that the 67% of the research efforts have been carried into routing protocols (29%), MAC protocols (14%), localization strategies (13%), and energy efficiency (11%). Only the 5% of the considered literature is related to WSNs reliability issues, and none of them explicitly addresses fault forecasting issues. The reliability of wireless networks has been addressed primarily in the context of quality of service (QoS). The main considerations have been routing and the overhead taking care of energy consumption and broken communication paths. However, a survey of literature shows that hardly any attempt has been made to estimate whether the WSN, as a system will be able to detect an event if it occurs within a specified period of time, if so with what confidence level.

In order to study and address Quality of Service (QoS) issues in service-oriented systems, we need a model of the system in question. Such a system-model allows us to study important properties of the system. Systems can be modelled at various levels of abstraction, ranging from abstract mathematical frameworks such as stochastic processes or queuing networks to system testbeds, i.e. physical systems equipped with measurement and experimentation infrastructure.

Ideally, models at different abstraction levels should be used, as different models can often complement each other. A queuing-network model of a system, for instance, may be used to efficiently study a large space of parameters, and thereby arrive at general conclusions. A testbed-model of the same system, in contrast, enables measurements under realistic conditions, which serve to validate the more abstract model, and to improve the quality of the conclusions by providing realistic model parameters.

Irrespective of their abstraction level, all system-models allow us to study properties of the system. When studying QoS issues we are particularly interested in the behaviour of the system under various common faults or disturbances. For instance, in a queuing-network model we may compute job completion times, while in a testbed we may measure response-times. Fault-models are considered as parameters to a system model that influence the modelled system's QoS.

In order to use a system-model to study the effect of faults on a system, we must be able to introduce models for these faults into the system-model. Since with some model classes the system-model may change significantly when a model for a fault is introduced into it; we required to obtain the same measures with the same interpretation from the system-model, regardless of the employed fault-model. That is, using the terminology of functional and non functional behaviour, we require that the system-model maintains the same functional behaviour and the same system structure when we change the fault-model. This clear distinction between the fault-model and the system-model is common in fault-injection experiments for dependability benchmarking, where one explicitly describes a fault-load that the system is subjected to.

Fault Models: Many different types of faults have been defined, some having orthogonal properties [2]. For example, failstop behavior implies that the faulty system ceases operation and alerts other processors of this fault. Crash faults, on the other hand, assume that the system fails and looses all of its internal state, e.g. the processor is simply down. One speaks of omission faults when values are not delivered or sent, e.g., due to a communication problem. If outputs are produced in an untimely fashion, then one speaks of a timing fault. Transient faults imply temporary faults, e.g. glitches, with fault free behavior thereafter. If transient faults occur frequently, one speaks of intermittent faults. This set of fault types is by no means complete and serves only as a basic introduction. The definition of faults seems to change with the application domain. For instance, fault models suitable for computer dependability may not necessarily match the behavior of network and computer security applications.

The behavior of the faults with respect to other processors can be described in simpler models which have been used with in replication and agreement algorithms. Specifically, fault models have been considered whose main behavior types are benign, i.e., globally diagnosable, symmetric (faulty values are seen equal by all non-fault processes) and asymmetric or malicious, i.e., there are no assumptions on the fault behavior [3].

The faults are generally divided into following three types:

Bernoulli Trials: Fault is described as a Bernoulli-distributed random variable. That is, the occurrence of the fault is defined by a probability p. The typical examples for this type are fault-models that reflect service availability/unavailability,

General Random Variables: Fault occurrence in this case is described by a random variable with a distribution that is more general than Bernoulli. The distribution is described by a distribution function (cumulative distribution function, CDF), a complementary CDF (CCDF) or a probability density function (PDF).

Stochastic Processes: A stochastic fault is a fault whose occurrence or non-occurrence is predicted by one or more random variables. It is not possible to show the occurrence or non-occurrence of a stochastic fault by a logical argument based on the design of the component. That is, we cannot apply fault prevention. What we can do with a stochastic fault is apply the laws of mathematical probability to predict its likelihood.

II. FAILURES IN WIRELESS SENOR NETWORKS

Wireless sensors Network may have many nodes deployed with each node having different sensors. Each service running on node is expected to periodically send the measurements of its sensors to an access point. If the camera in one of the sensor node stops scanning and if the node has not been designed to detect it and overcome the situation; it has reached an erroneous state. The sensor node thus not able to send the accurate data to the access point causing a failure at the node as observed from the access point. Here the defect in the camera is a fault, the nonavailability of scanning is the incorrect state and Access point observing the stationary camera is the failure.

Sources of Faults in WSNs: Data delivery in sensor networks is inherently faulty and unpredictable. Failures in wireless sensor networks can occur for various reasons [4].

1. Sensor nodes are fragile, and they may fail due to depletion of batteries or destruction by an external event. In addition, nodes may capture and communicate incorrect readings because of environmental influence on their sensing components.
2. As in any ad hoc wireless networks, links are failure-prone, causing network partitions and dynamic changes in network topology. Links may fail when permanently or temporarily blocked by an external object or environmental condition. Packets may be corrupted due to the erroneous nature of communication. In addition, when nodes are embedded or carried by mobile objects, nodes can be taken out of the range of communication.
3. Congestion may lead to packet loss. Congestion may occur due to a large number of nodes' simultaneous

transition from a power-saving state to an active transmission state in response to an event-of-interest.

4. Faults also occur because of the multihop nature and mobility of the nodes which can cause link failures

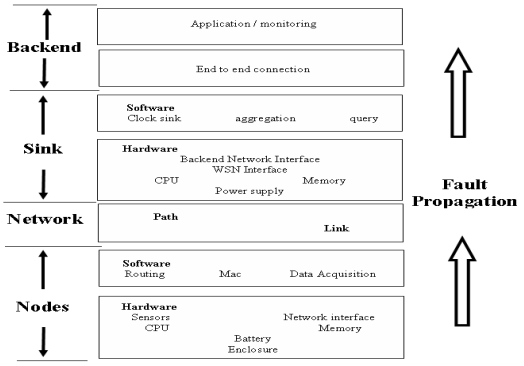


Figure 2. Fault propagation in WSN

Faults in Wireless Sensor Networks can occur at several protocol layers of the system. Effect of the fault in a particular layer can propagate to other layers in the system. Faults normally propagate from the nodes through the network to the sink. The figure 2 shows how the fault propagates through various protocol layers and components. It can be seen that in a sensor node; the sensors, processor (CPU), memory, Network interface, battery, enclosure for the node all of them can initiate a fault. Another source of faults in sensor node is software programmes that carry out routing, data acquisition, Medium Access Control etc. In the network layer the faults can be due to parameter variations in link, path, environment, location, etc.

Power management in wireless networks is an essential factor for their smooth function. Wireless nodes, especially sensors, use small batteries for energy supplies that in many cases cannot be replaced. Therefore, energy conservation is a vital factor in a sustained network lifetime.

The battery: lifetime determines how long one can use a device. Battery modeling can help to predict, and possibly extend this lifetime. Battery models are combined with a workload model to create a more powerful battery model. WSN devices rely on battery energy to work. The energy stored in these batteries is limited. So, it is important to use this energy as efficiently as possible, to extend the battery lifetime. The lifetime of the battery as the time one can use the battery before it is empty. Note that, for rechargeable batteries, this is not the same as the time one can use the battery before it stops working properly.

The battery lifetime mainly depends on the rate of energy consumption of the device. However, lowering the average consumption rate is not the only way to increase battery lifetime. Due to nonlinear physical effects in the battery, the lifetime also depends on the usage pattern. During periods of high energy consumption the effective battery capacity degrades, and therefore the lifetime will be shortened. However, during periods without energy consumption the battery can recover some of its lost capacity, and the lifetime will be lengthened.

Energy consumption of wireless devices has been studied using performance models. These models describe the various states a device can be in, and the energy consumption rate in these states. However, typically these models only take the energy consumption into account and do not deal with the effects of the usage pattern on the battery lifetime. To be able to do this we have to extend the model, by combining it with a battery model.

In stochastic models of the battery it is described in an abstract manner where the discharging and the recovery effect are described as stochastic processes.

III. FAULT SCENARIOS IN WIRELESS SENOR NETWORKS

The node faults can be classified into two types: *permanent* and *potential*. The permanent fault completely disconnects the sensor node from other nodes and brings eternal impact on the network performance like in the case of hardware faults within a component of a sensor node. A permanent fault once activated remains effective until it is detected and handled. The impact of this failure is usually measured when assessing the network performance. On the other hand, a potential fault usually results from the depletion of node hardware resource, i.e. battery energy. Such fault might cause the node sudden death, and eventually threaten the network life time. When the battery depleted, a node is useless and cannot share in sensing or data dissemination. Potential failure can be detected and treated before it causes the sudden death of a node e.g. sensor node with low residual energy can be send to sleep mode before it completely shuts down and disrupt network operation. Faults can be further classified into: *node level fault* and *network level fault*. Node level fault represents the potential and permanent failure of a node while "network level" describes the network faults caused by either potential or permanent failure of one or a set of sensor nodes. These are shown in figure 3.

Individual node level fault usually results from: application software misbehaviour, hardware failure and external impact of harsh environmental conditions (direct contact with water causing short circuit, node crash by a falling tree etc). The network level faults are as a result of either the potential or permanent failure, and are usually related to the network connectivity, and sensor coverage rate.

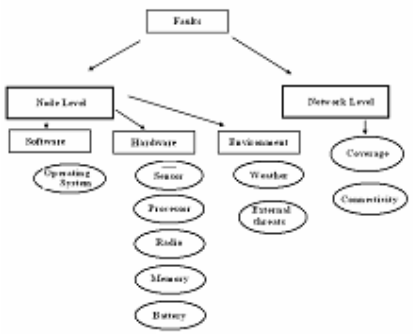


Figure 3. WSN Fault scenario

Nodes measure some physical quantities close-by them and transmit the information to the base station. Nodes can both transmit and receive information. The final target of the information transmitted by nodes is the base station.

IV. MODELLING TOOLS

Performance and dependability modeling is an integral part of the design process of many computer and communication systems. A variety of techniques have been developed to address different issues of modeling. For example, combinatorial models were developed to assess reliability and availability under strong independence assumptions; queuing networks were developed to assess system performance; and Markov process-based approaches have become popular for evaluating performance with synchronization or dependability without independence assumptions. Finally, simulation has been used extensively when other methods fail.

In order to harness full strength of any software modeling tool to solve for measures of interest of stochastic discrete event one must first understand what the modeling process is. That is once specification of the real system is known; one must know how to specify the model in a particular formalism. That requires knowledge of both the system to be modeled and also the formalism in which the system is to be specified. Petri nets are widely used to model and analyze the system behavior which provides graphical representation of the system state changes. The modeling requires knowledge of probability measure, conditional probability, continuous random variables, discrete random variables, PDF (probability density function), CDF (cumulative density function), Stochastic processes, including Markov processes, continuous time Markov chains (CTMC), discrete time Markov chains (DTMC), state transition rate matrices, generator matrices etc.

As solving models became more and more complex; different formalisms (or formal languages for expressing models) were also developed. Each of this formalism has its own merits. Some formalisms afford very efficient solution methods; like BCMP [5] queuing networks admit product-form solutions, Other formalisms, such as Stochastic Petri Networks (SPN) were developed provide a simple elegance in their modeling primitives, while superposed generalized stochastic Petri nets (SGSPNs) and colored GSPNs (CGSPNs) [6] yield state-space reductions. A number of extensions, such as stochastic activity networks (SANs) [7], were developed for compactly expressing complex behaviors.

Along with formalisms, modeling tools also have been developed. A tool is generally built around a single formalism and one or more solution techniques, with simulation sometimes available as a second solution method. Some of the tools developed are DyQN-Tool+ which uses dynamic queuing networks as its high-level formalism; GreatSPN which is based on GSPNs, UltraSAN, which is based on SANs, TANGRAM-II, which is an object- and message-based formalism for evaluating computer and communication systems. While all of these tools are useful within the domains for which they were intended, they are limited in that all parts of a model must be built in the single formalism that is supported by the tool. Thus, it is difficult to model systems that cross different domains and would benefit from multiple modeling techniques [8].

Performance and dependability modeling software tools have become increasingly powerful in recent years. Engineers have the ability to model increasingly complex systems using only a moderate amount of computing resources. However, despite the technological advances in system modeling, there remain several obstacles hindering the prediction of system behavior. Two facts contribute to these obstacles: the fact that system models have grown in both scale and intricacy of detail, and the fact that modeling software tools do not provide the appropriate feedback to the engineer during the design process.

As system models become more elaborate, the number of variables that can be parameterized increases rapidly. Difficulties arise from having such a large number of model parameters. The main problem with modeling large systems is in deciding how to make the best use of the computing resources available. The first step in optimizing use of available resources is reducing the number of model parameters to vary. Varying model parameters that do not contribute to the reward variables being measured wastes experimentation time. Selection of the parameters to vary requires detailed knowledge of the underlying model, and often relies on the designer's intuition and experience with similar systems. Another way to optimize use of computing resources is to reduce the number of values assigned to the model parameters. Increasing the number of values for a particular model parameter requires more experiments if all values are to be tested. If there are several parameters being varied, then the number of experiments needed to test each combination can grow to an unmanageable number. The engineer should focus on a range of parameter values over which the reward variables are expected to change significantly. Again, the art of modeling requires detailed knowledge of the model, which is best gained from previous experience. Unfortunately, software tools cannot automatically grant an engineer intuition, but they can

provide valuable information that, over time, can be used to develop a knowledge base useful for solving future problems.

The second problem contributing to the engineer's difficulty with efficiently predicting system behavior is the fact that today's modeling tools do not provide the engineer with the necessary feedback during the design process. The *design space* consists of all possible system configurations. Each configuration consists of unique values assigned to each system parameter. The experimentation process is often iterative, consisting of several sets of experimental runs, each producing results requiring analysis. This process ends when the desired system configuration is obtained.

In general, it is desirable to minimize the amount of experimentation time needed to determine the desired configuration. After running a set of experiments, the engineer may find that the results do not meet the desired specification. Further experimentation is necessary to find which model parameter values are acceptable. It would be useful if the modeling software could analyze the results and provide information suggesting which parameter values to choose for future runs. This iterative feedback would help the engineer to efficiently arrive at a desired model configuration. Without such feedback, the engineer may incorrectly guess which values cause the model to converge to the desired specification, resulting in a waste of experimentation time. The feedback obtained during this efficient navigation of the design space can also be used to reveal less expensive model configurations that meet the specifications, rather than exceed them.

CONCLUSIONS

The paper has brought out various issues concerned with the system modeling with special reference to wireless sensor networks. The system modeling is essentially required for the estimation of the survivability of mission critical applications. It can be seen that a modeling engineer not only need to have in depth knowledge of the system under consideration but also very good understanding of statistical and probability measures. The modeling normally uses stochastic processes, including Markov processes, continuous time Markov chains (CTMC), discrete time Markov chains (DTMC), state transition rate matrices, generator matrices etc. Once a satisfactory model of the system is arrived at it is to be verified with test bed or other statistical data and accordingly the system model is modified till a final system model is arrived at.

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SMART ANTENNAS FOR WIRELESS COMMUNICATION SYSTEMS

Anantha Bharathi
CVR College of Engineering, Dept of ECE, Ibrahimpatan, R.R.District, A.P., India
Email:bharathig8@gmail.com

***Abstract*—One of the most important challenges with respect to wireless access is the limited capacity of the air interface which is due to the fact that the available transmission bandwidth is finite. Since the number of wireless subscribers is still growing rapidly and the desire for higher data rates is rising – a more efficient use of frequency resources is inevitable to meet future capacity needs. Spatial filtering using adaptive or smart antennas has emerged as a promising technique to improve the performance of cellular mobile systems. This paper presents an overview of smart antennas, including types of smart-antenna systems, and the reasons for their having gained popularity, key characteristics, challenges and benefits, in the context of current and with a view towards future generation multiple input multiple output (MIMO) systems.**

***Index Terms*-smart antennas; mobile communication; adaptive arrays; space division multiple access; MIMO.**

I. INTRODUCTION

Future mobile and wireless applications will require significantly higher data rates and significantly reduced costs per transmitted bit as compared to third generation systems. These requirements on data rate, link quality, spectral efficiency, and mobility cannot be met with conventional single antenna systems. Therefore, antenna arrays and related techniques have been identified as a major area of research.

This paper provides an overview of smart antennas for wireless communications beyond the third generation. Smart antenna systems consist of multiple antenna elements at the transmitting and/or receiving side of the communication link, whose signals are processed adaptively in order to exploit the spatial dimension of the mobile radio channel. Depending on whether the processing is performed at the transmitter, receiver, or both ends of the communication link, the smart antenna technique is defined as multiple input single-output (MISO), single-input multiple-output (SIMO), or multiple-input multiple-output (MIMO). Exploitation of the spatial dimension can increase the capacity of the wireless network by improving link quality through the mitigation of a number of impairments of mobile communications, such as multipath fading and co-channel interference, and by increasing the data rate through the simultaneous transmission of multiple streams by different antennas. Until now, in the design of second- and third generation wireless systems, smart antenna capability was considered as an add-on feature. Adoption of smart antenna techniques in future-generation wireless systems would require the smart antenna feature to be an inherent part of the system design in order to provide the expected beneficial impact on efficient use of the spectrum, enhancement of the quality of service, and realization of reconfigurable, robust, and transparent operation across multi-technology wireless networks.

The paper is organized as follows.

Section 2 presents an insight into smart-antenna systems, using the human auditory system as an analogy. Section 3 discusses challenges in mobile communication system. Section 4 shows how smart antennas can improve the performance of mobile communication systems. Section 5 introduces the different types of smart-antenna systems.

Finally the deployment of Smart antennas in future wireless systems and the implementation issues associated with it are discussed.

II. SMART ANTENNA ANALOGY

The functionality of many engineering systems is readily understood when it is related to our human-body system [1].

Therefore, to give an insight of how a smart-antenna system works, let's imagine two persons carrying on a conversation inside a pitch-dark room (refer to Figure l). The listener among the two persons is capable of determining the location of the speaker as he or she moves about the room because the voice of the speaker arrives at each acoustic sensor - the ear - at a different time. The human signal processor - the brain - computes the direction of the speaker from the time differences or delays received by the two ears. Afterwards, the brain adds the strength of the signals from each ear, so as to focus on the sound of the computed direction. Furthermore, if additional

speakers join in the conversation, the brain can tune out unwanted interferers, and concentrate on one conversation at a time. Conversely, the listener can respond back to the same direction as the desired speaker by orienting his or her transmitter - his or her mouth -towards the speaker.

Electrical smart-antenna systems work the same way, using many antennas instead of the ears, and a digital signal processor instead of the brain (refer to Figure l). Therefore, after the digital signal processor receives the time delays from each antenna element, it computes the direction-of-arrival (DOA) of the signal of interest (SOI). It then adjusts the excitations (the amplitudes and phases of the signals) to produce a radiation pattern that focuses on the signal of interest SOI, while tuning out any signal not of interest (SNOI).

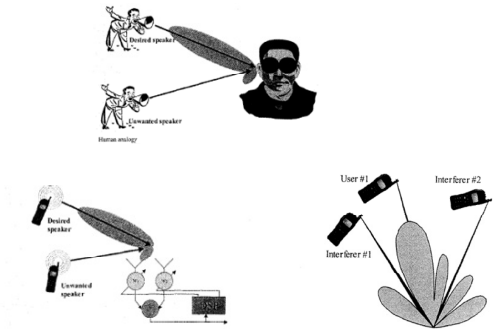

Figure 1. A smart antenna analogy.

III. PROBLEMS IN MOBILE COMMUNICATIONS

Multipath propagation, defined as the creation of multiple signal paths between the transmitter and the receiver due to the reflection of the transmitted signal by physical obstacles (Figure 2), is one of the major problems of mobile systems [2].

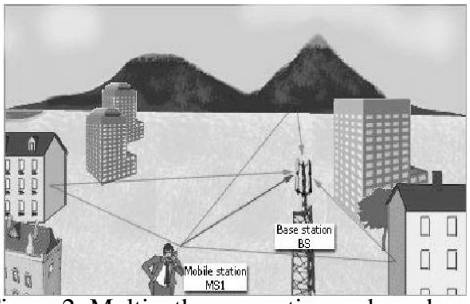

Figure 2. Multipath propagation and co-channel

It is well known that the delay spread and resulting intersymbol interference (ISI) due to multiple signal paths arriving at the receiver at different times have a critical impact on communication link quality. On the other hand, co-channel interference is a major limiting factor on the capacity of wireless systems, resulting from the reuse of the available network resources (e.g., frequency, time) by a number of users.

IV. SMART ANTENNA SYSTEMS

Many refer to smart-antenna systems as smart antennas, but in reality, antennas are not smart: it is the digital signal processing, along with the antennas, which make the system smart. Although it might seem that smart-antenna systems are a new technology, the fundamental theory of smart antennas is not new. Smart-antenna systems are basically an extension of cell sectoring in which the sector coverage is composed of multiple beams [3]. This is achieved by the use of antenna arrays, and the number of beams in the sector (e.g., a sector of 120") is a function of the array geometry. Because smart antennas can focus their radiation pattern toward the desired users while rejecting all unwanted interference, they can provide a greater coverage area for each base station. Moreover, because smart antennas have a higher rejection of interference - and therefore, a lower bit error rate (BER) - they can provide a substantial capacity improvement. These systems can generally be classified as either switched-beam or adaptive-array systems.

A. switched-beam system

A switched-beam system is a system that can choose from one of many predefined patterns, in order to enhance the received signal. It is obviously an extension of cell-sectoring, as each sector is subdivided into smaller sectors. As the mobile unit moves throughout the cell, the switched-beam system detects the signal strength, chooses the appropriate predefined beam pattern, and continually switches the beams as necessary. The overall goal of the switched-beam system is to increase gain, according to the location of the user. However, since the beams are fixed, the intended user may not be in the center of the main beam. If there is an interferer near the center of the active beam, it may be enhanced more than the desired user [4].

B. Adaptive-Array Systems

Adaptive-array systems, provide more degrees of freedom, since they have the ability to adapt the radiation pattern to the RF signal environment in real time.

In other words, they can direct the main beam toward the pilot signal or signal of interest (SOI), while suppressing the antenna pattern in the direction of the interferers or signals not of interest (SNOIs). To put it simply, adaptive-array systems can customize an appropriate radiation pattern for each individual user. This is superior to the performance of a switched-beam system, as is shown pictorially in Figure 3 (and

discussed in [5]). This figure shows that not only is the switched beam system not able to place the desired signal at the maximum of the main lobe, but it also shows this system's inability to fully reject the interferers. Because of the ability to control the overall radiation pattern in a greater coverage area for each cell site, adaptive- array systems greatly increase capacity. In the presence of a low-level interference, both types of smart antennas provide significant gains over conventional sectored systems. However, when a high-level interference is present, the interference rejection capability of the adaptive systems provides significantly more coverage than either the conventional or switched-beam system [6]. Adaptive-array systems can locate and track signals (users and interferers), and can dynamically adjust the antenna pattern to enhance reception while minimizing interference, using signal processing algorithms.

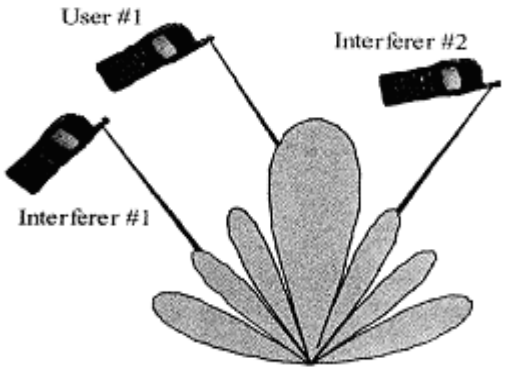

Figure 3(a). switched beam scheme

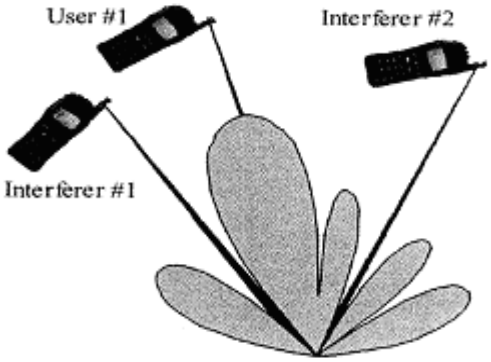

Figure 3(b). adaptive array scheme

A functional block diagram of such a system is shown in Figure 4.

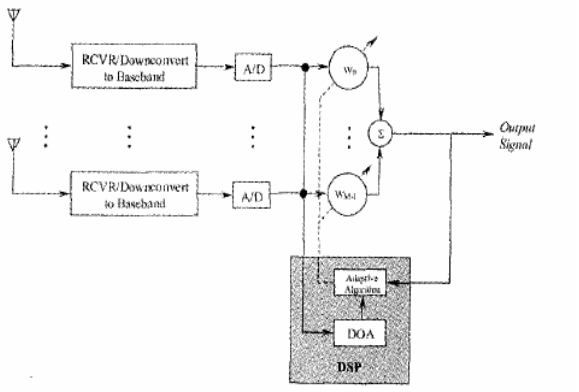

Figure 4. A functional block diagram of such a system

This figure shows that after the system down-converts the received signals to baseband and digitizes them, it locates the signal of interest using the direction-of-arrival (DOA) algorithm. It continuously tracks the signal of interest and signals not of interest by dynamically changing the weights (amplitudes and phases of the signals). Basically, the DOA algorithm computes the direction of arrival of all signals by computing the time delays among the antenna elements. Afterwards, the adaptive algorithm, using a cost function, computes the appropriate weights that result in an optimum radiation pattern. Because adaptive arrays are costly as digital signal processing is involved.

C. Spatial Division Multiple Access

Space Division Multiple Access (SDMA) can be used to multiply the capacity given by conventional multiple access techniques such as FDMA, TDMA or CDMA. However, the actual capacity gain which can be achieved with SDMA is highly dependent on the SDMA channel assignment and on the considered scenario (propagation, user distribution, traffic, mobility).

The final phase in the development of cellular radio systems will be SDMA [7,8]. SDMA is among the most sophisticated utilizations of smart-antenna technology: its advanced spatial-processing capability enables it to locate many users, creating a different sector for each user, as shown in Figure 5. This means that more than one user can be allocated simultaneously to the same physical communications channel in the same cell, with only an angular separation. This technology dramatically improves the interference-suppression capability while it greatly increases the frequency reuse, resulting in increased capacity and reduced infrastructure cost. Basically, capacity is increased not only through inter-cell frequency reuse, but also through intra-cell frequency reuse.

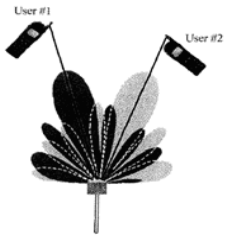

Figure 5. An adaptive array system with SDMA

.D. Smart Antennas Benefits

The principle reason for the growing interest in smart antenna systems is the capacity increase. In densely populated areas, mobile systems are normally interference-limited, meaning that the interference from other users is the main source of noise in the system. This means that the signal-to-interference ratio (SIR) is much larger than the signal-to-noise ratio (SNR). In general, smart antennas will increase the SIR by simultaneously increasing the useful received signal level and lowering the interference level.

Smart antennas at base stations can be used to enhance mobile communication systems in several ways:

- increased BS range
- less interference within the cell
- less interference in neighboring cells
- increased capacity by means of SDMA

CONCLUSIONS

This paper gives a general overview of smart antennas. Problems in wireless communications and how they are overcomed using smart antennas is discussed. Even higher spectral efficiencies can be achieved if antenna arrays are not only used at the base station but also at the mobile to create multiple-input–multiple-output systems. The achievable spectral efficiency, however, depends on the propagation and interference environment. If a rich scattering environment is available, an enormous spectral efficiency can be obtained via spatial multiplexing.

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A NOVEL APPROACH TO INTEGRATE MEASURING INSTRUMENTS ONTO SINGLE SoC

T. Esther Rani[1] and Dr.Rameshawa Rao[2] and Dr.M.Asha Rani[3]
[1]CVR College of Engineering, Department of ECE, Ibrahimpatan, R.R.District, A.P., India
Email: estherlawrenc@gmail.com
[2]Osmania University, Department of ECE, Hyderabad, A.P., India
Email: rameshwar_rao@hotmail.com
[3]JNTUniversity, Department of ECE, Hyderabad, A.P., India
Email: ashajntu1@yahoo.com

***Abstract*—In this paper a novel proposal of SoC (System-on-Chip) design approach is presented for the measurement, analysis, storage and display of physical and electrical quantities. The proposed System will be interfaced with sensors to perform the function of transducers. The LCD screen provides the display of both analog and digital data. At the circuit design level, transmission gates are used along with bulk-Silicon, through which the system occupies 80% less area and offers 60% more performance with very high rate of accuracy. This is an integrated form of all measuring instruments, Analyzers and recorders etc. The size of the system is so compact that it is comparable to the size of palm top computers or cell phones and operates with low power and high speed.**

***Index Terms*—SoC, measurement, analysis, LCD display, Low-power, Compact**

I. INTRODUCTION

Instrumentation is a technology of measurement which serves not only science, but all branches of engineering, medicine and almost every human endeavor. The knowledge of any parameter largely depends on the measurement. The in-depth knowledge of any parameter can be easily understood by the use of measurement, and further modifications can also be obtained. Whatever may be the nature of application, intelligent selection and use of measuring equipment depends on a broad knowledge of what is available and how the performance of the equipment renders itself for the job to be performed. But there are some basic measurement techniques and devices that are useful and will continue to be widely used also. There is always a need for improvement and development of new equipment to solve measurement problems.

The major problem encountered with any measuring instrument is the error. Therefore, it is obviously necessary to select the appropriate measuring instrument and measurement method which minimizes error. To avoid errors in any experimental work, careful planning, execution and evaluation of the experiment are essential. Instruments rarely respond instantaneously to changes in the measured variables. Instead, they exhibit slowness or sluggishness due to such things as mass, thermal capacitance, fluid capacitance or electric capacitance[2]. In addition to this, pure delay in time is often encountered where the instrument waits for some reaction to take place. Such industrial instruments are nearly always used for measuring quantities that fluctuate with time. Here, the proposed instrument has no large massive components to be considered in the construction of the device. So, error is almost minimized.

The dynamic and transient behavior of the instrument is as important as the static behavior. The dynamic behavior of an instrument is determined by subjecting its primary element or sensing element to some unknown and predetermined variations in the measured quantity [1]. The proposed system has good speed of response and fidelity. Lag and dynamic error are almost minimized. Accuracy, precision, resolution and sensitivity of this design will be very high as this particular design is being realized with the minimum size transistors which results in minimum size of the instrument operated by low power and offers high speed. All the potential divider blocks of the design for the range selection are built by using transmission gates. With the transmission gates 15kΩ to 60kΩ resistors are built using minimum size transistors. By operating the transistors in the resistive region, the resistance can be improved[6]. The power supply to different blocks of the system is by using a battery.

A. Mixed–Signal Hardware Description Languages:

Both Verilog-AMS and VHDL-AMS have been defined and simulators that support these languages are emerging. These languages are expected to have a big

impact on the design of mixed signal systems because they provide a single language and a single simulator that are shared between analog, digital, and eventually system designers. It will be much easier to provide a single design flow that naturally supports analog, digital and mixed signal blocks, making it simpler for these designers to work together [3].

For example, blocks like ADCs, DACs, PLLs, ΣΔ converters, discrete time filters (switched capacitor), etc, are easily and very efficiently modeled using the analog event –driven features of the AMS languages.

II. SoC Design

A. Processor:

The use of microprocessors as an integral part of measuring instruments has given rise to a whole new class of instruments, called intelligent instruments.

B. Memory:

The basic advantage of digital operation is the storage capability, the stored waveform can be repetitively read out, thus making transients appear repetitively and allowing their convenient display on the LCD screen.

C. I/O Interfacing:

The inclusion of interfacing and a microprocessor provides a complete system for information acquisition, analysis and output [4].

The system is provided with LCD to display the readings of voltage, current, pressure, resistance, capacitance and inductance by using multi meter circuit. The wave forms can also be displayed on the screen along with the operation that is selected from the keypad. A keypad is provided for the selection of internal device, to store the values, digits to be used on calculator, zoom operations of the signal displayed and the process of data.

D. Measuring Instruments:

Digital meters, on the other hand, offer high accuracy, have high input impedance and are smaller in size. They give an unambiguous reading at greater viewing distances. The output available is electrical (for interacting with external equipment), in addition to a visual readout.

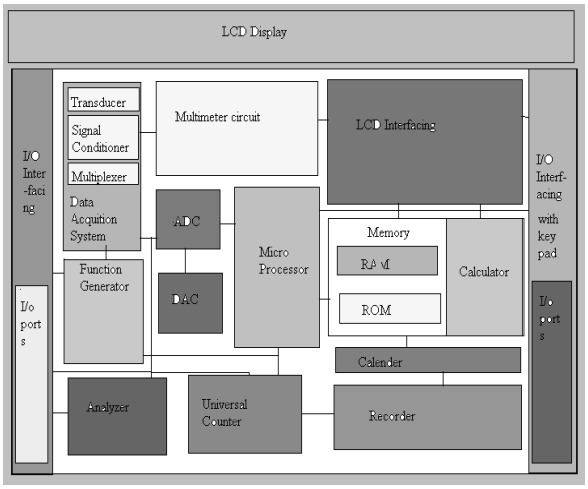

Fig 1: The proposed System architecture

E. Passive Devices

The passive devices like Resistor, Capacitor and Inductor can be placed on the chip.

An n-well resistor can be formed as the n-well resistivity may vary by several tens of percent with process. With typical sheet resistivities of about 1kΩ/□, n-well resistors can prove useful where their absolute value is not critical. The metal layers available in CMOS technologies exhibit sheet Resistance on the order of 70mΩ/□ (for bottom layers) to 30mΩ/□ (for top layers). Thus, for resistor values common in analog design, metal layers are rarely used [5].

Capacitors prove indispensable in most of today's analog CMOS circuits. Several parameters of capacitors are critical in analog design. Non-linearity (voltage dependence), parasitic capacitance to the substrate, series resistance, and capacitance per unit are (density). In CMOS technologies modified for analog design, capacitors are fabricated as poly-diffusion, poly-poly, or poly-metal structures. The idea is to grow or deposit a relatively thin oxide between two floating conductive layers, thereby forming a dense capacitor with moderate bottom-plate parasitic (about 10 to 20%) [5].

Challenges in industrial control and Instrumentation are autonomy & co-ordination, accuracy, repeatability, intelligence, noise & interference, high performance and wide voltage ranges. All the specifications can be met by employing different design methodologies for different blocks.

F. Analogue to Digital Converter (ADC)

All digital meters employ some kind of analog to digital (A/D) converters (often dual slope integrating type) and have a visible readout display at the converter output. The input signal is compared with an internally generated voltage which is increased insteps starting from zero.

G. Universal Counter

All measurements of time period and frequency by various circuits can be assembled together to form one complete block, called a universal Counter timer.

H. Function Generator

A function generator produces different waveforms of adjustable frequency. The common output waveforms are the sine, square, triangular and saw tooth waves. The frequency may be adjusted, from a fraction of a Hertz to several hundred kHz. The various outputs of the generator can be made available at the same time. Function generator consists of signal generator, amplifier or attenuator and filter.

I. Wave Analyzers

Wave analyzers are useful for measurement in audio frequency only. But, for measurements in RF range and above, special analyzers working on the principle of heterodyning are used which are called heterodyne wave analyzers. In this wave analyzer, the input signal to be analyzed is heterodyned with the signal from the internal tunable local oscillator in the mixer stage to produce a higher frequency. Spectrum analyzer provides a display of the frequency spectrum over a given frequency band. Spectrum analyzers use either a parallel filter bank or a swept frequency technique [7].

J. Recording

Recording is often carried out in order to perverse the details of measurement at a particular time. The information is fed directly to the processor for processing and control. Most of the critical parameters which influence the performance of the process or equipment have to be recorded for taking necessary action from time to time.

III. TRANSDUCERS

The sensing or detector element is that part of transducer which responds to a physical phenomenon. The transducer can be Resistive, Inductive, capacitive, electro-magnetic, Photo-emissive, photo-resistive, potentiometric, thermo-electric or Frequency generating [7]. Advantages in semiconductor technology have brought about high accurate, highly integrated miniaturized sensors that have transformed the way environmental and feed back control information is acquired and used in the industrial and instrumentation market.

IV. I/O PORTS

The design quality of these circuits is a critical factor that determines the reliability, signal integrity, and inter chip communication in a system environment. Package is the first protection and I/O frame containing input output circuits is the second protection to the device. Any external hazards such as Electro Static Discharge (ESD) and noises should be filtered out before propagating to the internal circuits. As the system contains mixed signal design, i.e. some of the blocks like calculator, calendar, Processor and memory are completely digital and can be implemented using CMOS circuits. Function Generator, Analyzer and signal conditioner are the blocks which need to be implemented using analog signal design. So, for proper level shifting is to be provided for the good communication between the internal blocks of the design.

V. LIQUID CRYSTAL DISPLAY (LCD)

The purpose of liquid crystal display is to display both digital and analogue information. The rapid growth of electronic handling of numerical data has bought with it a great demand for simple systems to display the data in a readily understandable form. Display devices provide a visual display of numbers, letters, and symbols in response to electrical input, and serve as constituents of an electronic display system. The function of Oscilloscope is replaced by the LCD with the controls on the keypad provided.

VI. RESULTS

The following blocks of proposed SoC are implemented by using Cadence tools in 0.18um Technology. The area and power of the corresponding blocks are listed in the table1 given below. The results are generated by Encounter® RTL compiler, with the technology library osu018_stdcells.

The processor of the system is considered as 16-bit so that it is useful for the data acquisition processing also [4]. Arithmetic and logic blocks of calculator are implemented in ALU. The selector switch is realized by using a 16x1 Multiplexer [2]. The LC oscillator designed for function generator is operating up to 3 GHz and consumes a 1874.4 pW of power at 3.3V power supply [5].

Table 1: Results of the blocks in the proposed system

S.No	Block	No. of Stand Cells	Area (nm^2)	Total Power (leakage+ dynamic) (uw)
1.	CPU	2176	74358	1212.603
2.	ALU	188	6628	61.749
3.	Selector switch	31	906	75.757
4.	ADC	-	$23190x10^6$	100

CONCLUSIONS & FUTURE SCOPE

The system is flexible and capable of being expanded for future requirements, at the same time it is reliable and not has a down time greater than 0.1%. The provided LCD to the device is monochrome. The interfacing can be done for color display. More number of transducers can be included in this system and the Data acquisition system design can be still more sophisticated.

ACKNOWLEDGEMENT

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Energy Aware Performance Comparison of Routing Protocols for Mobile Ad Hoc Networks

Humaira Nishat
CVR College of Engineering, Department of ECE, Ibrahimpatan, R.R.District, A.P., India
Email:huma_nisha@yahoo.com

Abstract— **Mobile nodes in an ad hoc wireless network are battery operated. Thus, it is essential to find energy conserving mechanisms and protocols that optimize the use of battery power in order to increase the lifetime of the network. When finding routes, energy aware routing increases the network lifetime. In this paper, I have considered three routing protocols DSDV, DSR & AODV for mobile ad hoc networks and evaluated the energy performance metrics in all the four modes- transmitting, receiving, idle and sleep along with other metrics such as residual energy, throughput, packet delivery fraction and end-to-end delay. I have observed that idle energy consumption is responsible for a large portion of the overall energy consumption in the wireless interfaces of the mobile nodes. Finally, by the observation I have concluded that DSR offers the best combination of energy consumption, residual energy of nodes and delay while AODV gives better packet delivery fraction and DSDV gives more throughput.**

Index Terms— **AODV, DSDV, DSR, delay, energy consumption, packet delivery fraction, throughput**

I. INTRODUCTION

Mobile ad hoc networks [MANETs][1] are wireless networks in which mobile nodes communicate with each other using multi-hop wireless links without any infrastructure support. Nodes are free to move, therefore the network experiences rapid and unpredictable topology changes [2]. Developing routing protocols for MANETs has been an extensive research area in recent years, and many proactive and reactive protocols have been proposed from a variety of perspectives [3], [4], [5]. These protocols try to satisfy various properties, like distributed implementation, efficient energy utilization, throughput optimization, fast route convergence and freedom from loops. Since the nodes are powered by battery, development of energy efficient protocols is needed. When a node exhausts its available energy, it ceases to function and the lack of mobile hosts results in breakdown of network, thereby affecting the overall communication performance.

All the layers of communication are coupled in power consumption and solutions addressing the power saving issue include transmission power control aware routing and low power modes at the physical layer, MAC layer and at the network layer. Routing protocols may balance power consumption at nodes according to their routing decisions. In the present work, we measure and compare the energy consumption behavior of three routing protocols- DSDV, AODV and DSR along with other performance metrics.

The rest of the paper is organized as follows:

Section 2 presents the related work focusing the various energy efficient routing protocols. Section 3 deals with the three routing protocols DSDV, DSR & AODV. Section 4 gives the simulation setup. In section 5 we present our simulation results and finally section 6 concludes the paper.

II. RELATED WORK

A large number of recent studies focus on mobile ad hoc networks [MANETs] [6]. Several studies have dealt with measuring energy consumption in the wireless interfaces of mobile nodes [7], [8] to determine the exact sources of energy consumption in the wireless interfaces. In order to address the energy efficiency issues within ad hoc networks, it is essential to understand the energy model which represents the power consumption behavior in the ad hoc network node wireless interfaces [9]. In AFECA [Adaptive Fidelity Energy Conservation Algorithm], nodes sleep based on the size of their neighborhoods [10]. When number of neighbors is more, then node enters into sleep state without disconnecting the network. [10] provides different sleep patterns for mobile nodes based on their residual energy and quality of service. Techniques to combine power management and power control for wireless cards is presented in [11]. In power conserving algorithm [12], a node enters into the doze state if it overhears RTS/CTS for data transmission. In power saving mode of 802.11 [13] when a node transmits or receives an ad hoc traffic indication (ATIM) frame during an ATIM window, it must be in active mode during the entire beacon interval that results in a much higher energy consumption. [14], [15] compare energy consumption of various reactive and proactive routing protocols under similar traffic. This paper presents a comparison analysis of three routing protocols considering energy consumption as the basic metric and tells which protocol is best suited for increasing the lifetime of the network.

III. DESCRIPTION OF ROUTING PROTOCOLS FOR MOBILE AD HOC NETWORKS

A. Destination Sequenced Distance Vector (DSDV)

Destination Sequenced Distance Vector Routing (DSDV)[19] is a table-driven routing scheme for ad hoc mobile networks based on the Bellman-Ford algorithm. It was developed by C. Perkins and P.Bhagwat in 1994. The main contribution of the algorithm was to solve the

routing loop problem. The stations periodically transmit their routing tables to their immediate neighbors. The routing table updates are sent either in "full dump" or in "incremental update". A full dump sends the full routing table to the neighbors and could span many packets. When the network is relatively stable, incremental updates are sent to avoid extra traffic. DSDV is quite suitable for creating ad hoc networks with small number of nodes. As it requires a regular update of its routing tables, it uses more battery power and a small amount of bandwidth even when the network is idle.

B. Ad Hoc On-Demand Distance Vector Routing (AODV)

AODV[20] is an on demand algorithm, meaning that it builds routes between nodes only as desired by source nodes. It uses traditional routing tables, one entry per destination. AODV builds routes using a route request / route reply query cycle. When a source node desires a route to a destination for which it does not already have a route, it broadcasts a route request (RREQ) packet across the network. Nodes receiving this packet update their information for the source node and set up backwards pointers to the source node in the route tables. In addition to the source node's IP address, current sequence number, and broadcast ID, the RREQ also contains the most recent sequence number for the destination of which the source node is aware. A node receiving the RREQ may send a route reply (RREP) if it is either the destination or if it has a route to the destination with corresponding sequence number greater than or equal to that contained in the RREQ. If this is the case, it unicasts a RREP back to the source. Otherwise, it rebroadcasts the RREQ. Nodes keep track of the RREQ's source IP address and broadcast ID. If they receive a RREQ which they have already processed, they discard the RREQ and do not forward it. As the RREP propagates back to the source, nodes set up forward pointers to the destination. Once the source node receives the RREP, it may begin to forward data packets to the destination.

A route is considered active as long as there are data packets periodically traveling from the source to the destination along that path. Once the source stops sending data packets, the links will time out and eventually be deleted from the intermediate node routing tables. If a link break occurs while the route is active, the node upstream of the break propagates a route error (RERR) message to the source node to inform it of the now unreachable destination(s). After receiving the RERR, if the source node still desires the route, it can reinitiate route discovery.

C. Dynamic Source Routing (DSR)

The key feature of DSR [18] is the use of source routing. That is, the sender knows the complete hop-by hop route to the destination. These routes are stored in a route cache. The data packets carry the source route in the packet header. When a node in the ad hoc network attempts to send a data packet to a destination for which it does not already know the route, it uses a route discovery process to dynamically determine such a route. Route discovery works by flooding the network with route request (RREQ) packets. Each node receiving a RREQ rebroadcasts it, unless it is the destination or it has a route to the destination in its route cache. Such a node replies to the RREQ with a route reply (RREP) packet that is routed back to the original source. RREQ and RREP packets are also source routed. The RREQ builds up the path traversed so far. The RREP routes itself back to the source by traversing this path backwards. The route carried back by the RREP packet is cached at the source for future use. If any link on a source route is broken, the source node is notified using a route error (RERR) packet. The source removes any route using this link from its cache. A new route discovery process must be initiated by the source, if this route is still needed. DSR makes very aggressive use of source routing and route caching.

IV.SIMULATION SETUP

I have used network simulator (NS-2.34) for the work. NS2 is a discrete event driven simulator [16],[17] developed at the University of Berkeley and the Virtual Inter Network Testbed (VINT) project 1997. I have used Ubuntu 9.04 linux environment. NS2 is suitable for designing new protocols, comparing different protocols and traffic evaluations. It is an object oriented simulation written in C++, with OTCL interpreter as a frontend.

My simulation setup is a network with randomly placed nodes within an area of 1000m*1000m for a simulation time of 100 second. The parameters used for carrying out simulation are summarized in table1.

TABLE.I

Parameter	Value
Routing Protocols	DSDV,AODV& DSR
MAC Layer	802.11
Terrain Size	1000m*1000m
No. of Nodes	10,20,30,40,50
Packet Size	512B
Initial Energy	1000Joules
Idle Power Consumption	1.0W
Rx Power Consumption	1.0W
Tx Power Consumption	1.0W
Transition Power Consumption	0.2W
Simulation Time	100s
Traffic Source	TCP

The goal of this simulation is to evaluate the performance differences of the three routing protocols in terms of energy consumption, throughput, delay and packet delivery fraction using TCP as traffic source.

A. Performance Metrics

Average Energy Consumption: It is the average energy consumed by all nodes in transmitting, receiving, idle and sleep mode.

Average Residual Energy: It is the average remaining energy of each node in a network by the end of simulation.

Packet Delivery Fraction: It is the ratio of the number of packets received by the destination to the number of data packets generated by the source.

Average End-to-End Delay: It is the average time taken by the data packets to propagate from source to destination across a MANET. It includes all possible delays caused by buffering during routing discovery latency, queuing at the interface queue and retransmission delays at the MAC propagation and transfer times.

Throughput: It is the ratio of successfully transmitted data packets per second in the network during the simulation.

V. SIMULATION RESULTS

Here I present a comparative analysis of the performance metrics of the three routing protocols DSDV, AODV and DSR using TCP traffic source for varying number of nodes 10, 20, 30, 40 & 50.

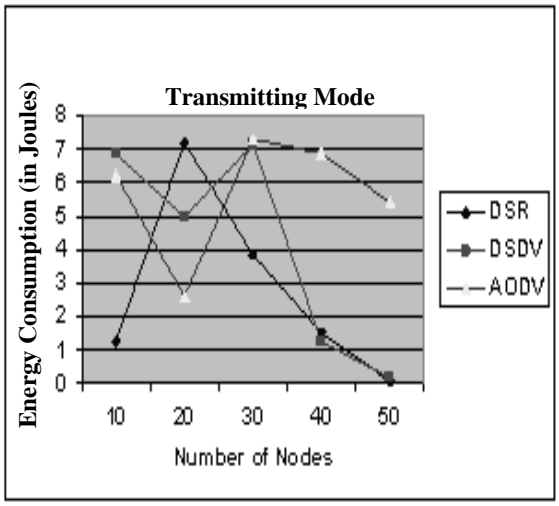

Figure 1.Energy consumption (in Joules) in transmitting mode

Energy consumption in transmitting mode in case of DSR for a network size of 10 is very less compared to that of AODV & DSDV, but as the size grows to 20, energy consumption increases. At this stage AODV gives the least energy consumption. But as the size grows further to 30, 40 & 50, DSR performs better than the other two.

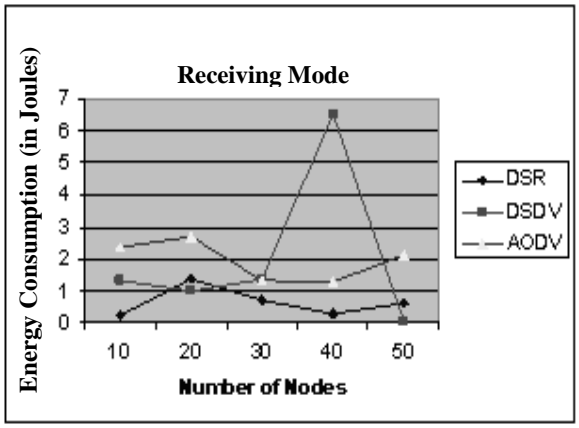

Figure 2. Energy consumption in receiving mode

The amount of energy consumed in receiving mode is almost same as the energy consumed in transmitting mode. From figure 2, it is clear that the energy consumed by DSR is less and is almost constant for a variable network size.

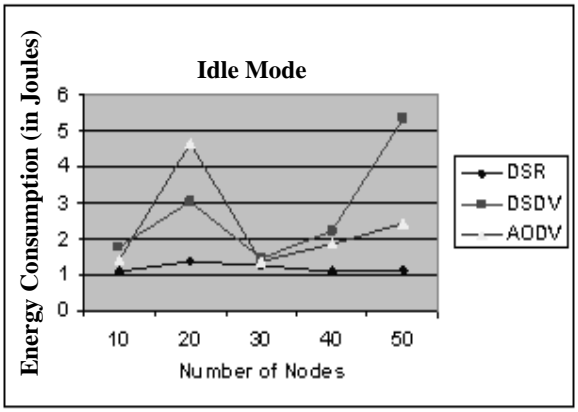

Figure 3. Energy consumption (in Joules) in idle mode

In the idle mode the nodes does not actually communicate but consumes a considerable amount of energy. The amount of energy consumed in idle mode approaches the amount that is consumed in the receiving mode by the destination node. From figure 3, it is clear that energy consumed by nodes in the idle mode is more for AODV & DSDV than DSR and constitutes almost one-third of the energy consumption.

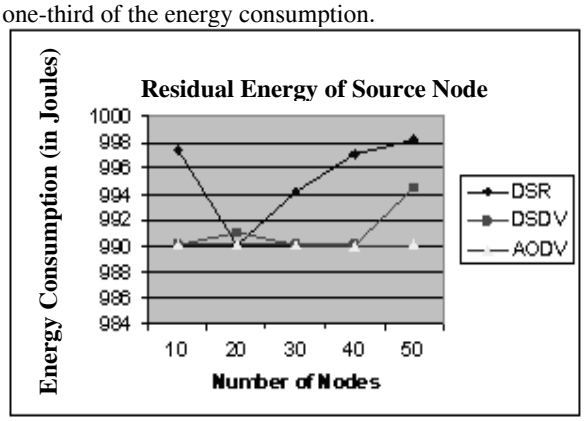

Figure 4. Residual energy (in Joules) of source node

From figure 4, it is clear that the residual energy of source node is far more for DSR than AODV or DSDV. Also as the size of network increases, residual energy of source node increases for DSR. AODV gives the least amount of remaining energy. Hence, DSR outperforms both DSDV and AODV.

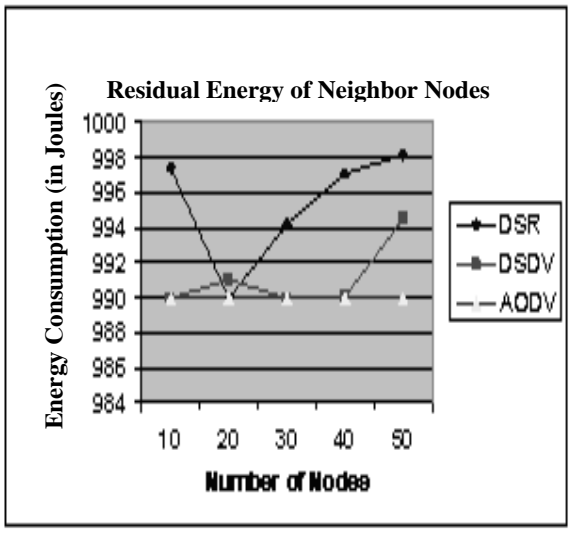

Figure 5. Residual energy (in Joules) of neighbor nodes

Figure 5, gives the amount of energy remaining with the neighbor nodes and destination node at the end of simulation. For the same network setup with three protocols, it is clear from figure 5 that DSR gives the maximum amount of residual energy and AODV the least. Hence, DSR outperforms DSDV and AODV.

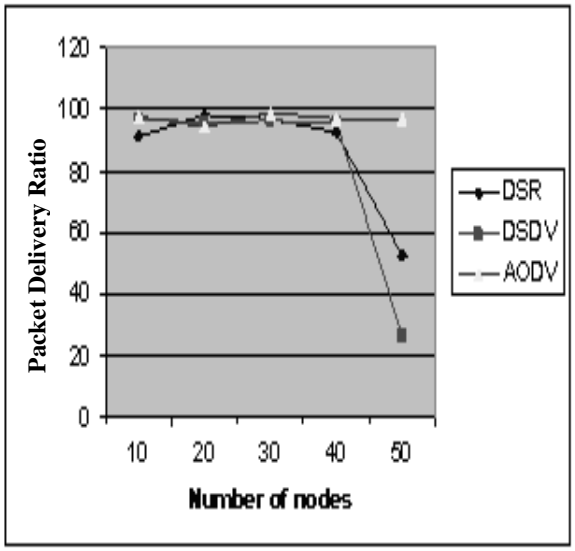

Figure 6. Packet delivery ratio vs number of nodes

Packet delivery fraction is same for all the three routing protocols for a network size of 10, 20, 30 & 40 nodes. But as the network size increases to 50, AODV outperforms both DSR and DSDV. Among DSR & DSDV, DSR gives better PDF.

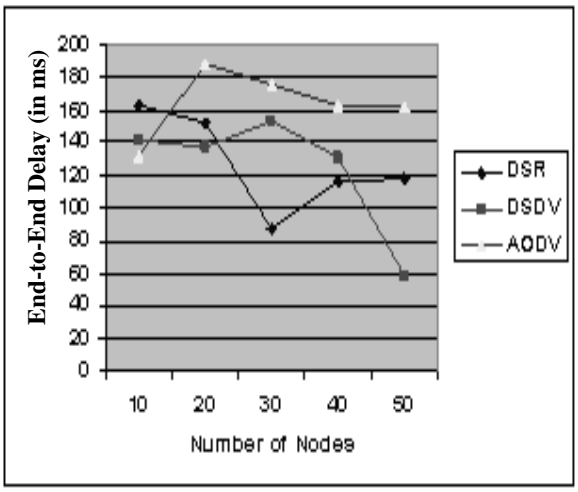

Figure 7. End-to-end delay (in milliseconds) vs number of nodes

End-to-End delay is the average time a packet takes to traverse the network. Initially, the end-to-end delay of AODV is less compared to DSR & DSDV with 10 nodes but with the increased network size the end-to-end delay decreases for DSR thereby outperforming both AODV and DSDV.

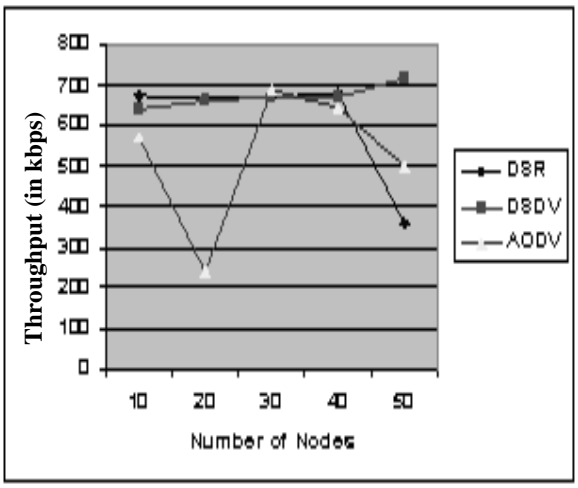

Figure 8. Throughput (in kbps) vs number of nodes

Based on the simulation results, it is clear that the throughput value of DSR & DSDV is almost constant and more compared to AODV. For a network size of 50, DSDV gives better throughput performance than DSR and AODV.

CONCLUSIONS

In this work I have analyzed the energy consumption behavior of both proactive and reactive routing protocols-DSDV, DSR & AODV for ad hoc networks using network simulator. I have evaluated and showed how the different modes (transmitting, receiving, idle and sleep) of energy consumption affect the energy usage of mobile devices. I found that the amount of energy consumed in idle mode i.e., due to overhearing by neighboring nodes

is equal to the amount of energy consumed by a destination node in receiving mode. Also, due to the caching strategy used by reactive routing protocols such as DSR, DSR is more likely to find a route in the cache and hence resorts to route discovery less frequently than AODV and DSDV resulting in more residual energy. There is no energy consumption by nodes in the sleep mode. Overall, the energy consumed by nodes in all modes is very less for DSR than AODV. Also the residual energy is more for DSR than the other two routing protocols.

This paper also compares the performance of the three protocols in terms of PDR, throughput & delay. From the simulation results I conclude that DSR gives better combination of energy consumption, residual energy and delay among the three protocols. AODV gives more packet delivery fraction and DSDV gives better throughput. Future work will focus on new algorithms and approaches to extend the lifetime of nodes in a network.

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Real Time Systems Design for Safety Critical Applications

Rinku R. Dhruva
CVR College of Engineering, Department of ECE, Ibrahimpatan, R.R.District, A.P., India
Email: rinku_dhruva@yahoo.com

***Abstract*—This paper studies and suggests few of the famous techniques employed in various applications in different domains, and generalise the guidelines for designing and developing Real Time Systems in safety critical applications.**

I. Introduction

Today's electronic systems infiltrate more and more our daily life. We put our lives in the hand of complex electronic systems. For instance, during a flight with a modern aeroplane, where a severe failure of the electronic flight control system may lead to a catastrophe, we completely rely on the proper functioning of the electronic system.

In the industry, it is an upward trend to replace mechanical and hydraulic control systems by electronic control systems. An example of the automotive industry: in the model year 2001, electronics were accounted for 19% of a mid-sized automobile's costs. It is estimated that in the year 2005, 25% of the total costs of a mid-sized automobile will be accounted for electronic parts, and possibly 50% for luxury models. This includes costs for so-called 'by-wire systems', which will replace traditional mechanical and hydraulic braking and steering systems in cars of the near future (model years 2005–2007).

In a by-wire system, braking or steering relies on the correct behavior of the electronic system. A failure of the electronic system may cause a severe hazard that will endanger human life or the environment. The design, development, production, and maintenance of such a by-wire system is a complex and difficult undertaking, and system failures during operational use have to be prevented by all possible technical means. The difficulties are mainly caused by the complexity of these electronic systems, mass production, and stringent dependability (e.g., safety) requirements imposed by authorities. Among others, a validation of the system's behavior in all stages of the system's life-cycle is a necessary and important technical mean to have confidence that the system under consideration behaves safe in its environment.

A. Real-time system:

A real-time system has to interact with its environment in real-time. The correctness of a real-time system depends not only on the logical result of the computation but also on the time at which the results are produced [1] (see also [2, p. 18–19]). The point in time by which the result must be produced for the temporal behavior of the response to be correct is called deadline.

The paucity of material on safety critical systems has lead to widespread misunderstanding of the various terms used to discuss safety. The most basic term is safety. Safety is defined to be freedom from accidents or losses. An accident is an event in time in which an undesirable consequence occurs, such as death, injury, equipment damage, or financial loss.

A safety-critical system in a system, which may contain electronic, mechanical, and software aspects, that presents an opportunity for accidents to occur. For many people, safety-critical systems are only those that present the opportunity for injury or loss of life, but this omits from consideration other systems which might benefit from the techniques and approaches common in safety analysis. Therefore, it is better to designate a safety critical system to be any system in which the cost of use of a system due to an accident is potentially high. Hazard is the effect of safety failure.

For example, the FDA[2] uses major (irreversible injury or death), moderate (injury), and minor (no injury) levels of concern for device safety. The German standard DIN 19250 identifies 8 categories, along with required safety measures for each category while the more recent IEC 61508 [3] identifies 4 safety integrity levels (SILs): catastrophic, critical, marginal, and negligible, although the text notes that the severity of system-presented hazards is actually a continuum.

The risk of a hazard is defined to be the product of the probability of the occurrence of the hazard and its severity:s.

Riskhazard = probabilityhazard x severityhazard

Being shocked by your car battery is relatively high but when combined with the low severity, the overall risk is low. Similarly, while the consequences of an abrupt release of the kinetic energy of a commercial aircraft are quite severe, its probability is low " again resulting in a low risk. The various standards also identify different risk levels based on both the severity of the hazard and its likelihood of occurrence.

In the process of system design, hazards must be identified and safety measures must be put in place to reduce the risk.

II. Systems Approach

System safety engineering has historically demonstrated the benefits of a "systems" approach to safety risk analysis and mitigation. When a hazard

analysis is conducted on a hardware subsystem as a separate entity, it will produce a set of unique hazards applicable only to that subsystem. However, when that same subsystem is analyzed in the context of its physical, functional, and zonal interfaces with the rest of the "system components," the analysis will likely produce numerous other hazards which were not discovered by the original analysis. Conversely, the results of a system analysis may demonstrate that hazards identified in the subsystem analysis were either reduced or eliminated by other components of the system. Regardless, the identification of critical subsystem interfaces (such as software) with their associated hazards is a vital aspect of safety risk minimization for the total system. When analyzing software that performs, and/or controls, safety-critical functions within a system, a "systems approach" is also required. The success of a software safety program is predicated on it. Today's software is a very critical component of the safety risk potential of systems being developed and fielded. Not only are the internal interfaces of the system important to safety, but so are the external interfaces.

III. The Hardware Development Life Cycle

A. *Figures and Tables*

The typical hardware development life cycle has been in existence for many years. It is a proven acquisition model which has produced, in most instances, the desired engineering results in the design, development, manufacturing, fabrication, and test activities. It consists of five phases. These are identified as the concept exploration and definition, demonstration and validation, engineering and manufacturing development, production and deployment, and operations and support phases. Each phase of the life cycle ends, and the next phase begins, with a milestone decision point (0, I, II, III, and IV). An assessment of the system design and program status is made at each milestone decision point, and plans are made or reviewed for subsequent phases of the life cycle.

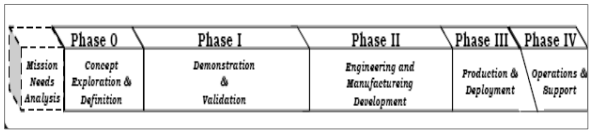

Figure 1. Hardware Development Life Cycle

The one shown in Figure identifies and establishes defined phases for the development life cycle of a system and can be overlaid on a proposed timetable to establish a milestone schedule.

IV. The Software Development Life Cycle

The system safety is critically depend on the software life cycle being used by the development activity. In the past several years, numerous life cycle models have been identified, modified, and used in some capacity on a variety of software development programs. The important issue here is to recognize which ever model is being used, but decide how to correlate and integrate safety activities with the chosen software development model to achieve the desired outcomes and safety goals. Several different models will be presented to introduce examples of the various models.

Figure2 is a graphical representation of the relationship of the software development life cycle to the system/hardware development life cycle. The model is representative of the "Waterfall," or "Grand Design" life cycle. While this model is still being used in numerous projects, other models are more representative of the current software development schemes currently being followed, such as the "Spiral" and "Modified V" software development life cycles. It is important to recognize that the software development life cycle does not correlate exactly with the hardware (system) development life cycle. It "lags" behind the hardware development at the beginning but finishes before the hardware development is completed. It is also important to realize that specific design reviews for hardware usually lag behind those required for software.

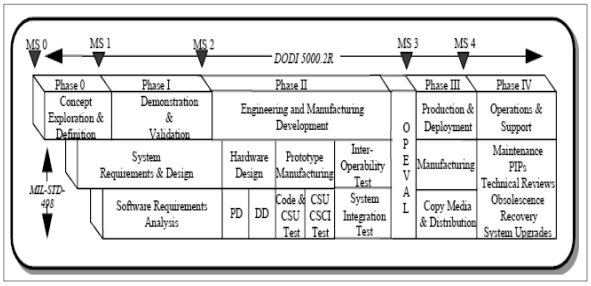

Figure 2. Relation between Software and Hardware Development Life Cycle

A. *Grand Design, Waterfall Life Cycle Model*

The Waterfall software acquisition and development life cycle model is the oldest in terms of use by software developers. Grand Design places emphasis on up-front documentation during early development phases, but does not support modern development practices such as prototyping and automatic code generation. Another limitation to the model is that after a single pass through the model, the system is complete. Therefore, many integration problems are identified much too late in the development process to be corrected without significant cost and schedule impacts. In terms of software safety, interface issues must be identified and rectified as early as possible in the development life cycle to be adequately corrected and verified. Figure 3 is a representation of the Grand Design, or Waterfall, life cycle model. The Waterfall model is not recommended for large, software-intensive, systems. This is due to the limitations stated above and the inability to effectively manage program risks, including safety risk during the software development process. The Grand Design does, however, provide a structured and well-disciplined method for software development.

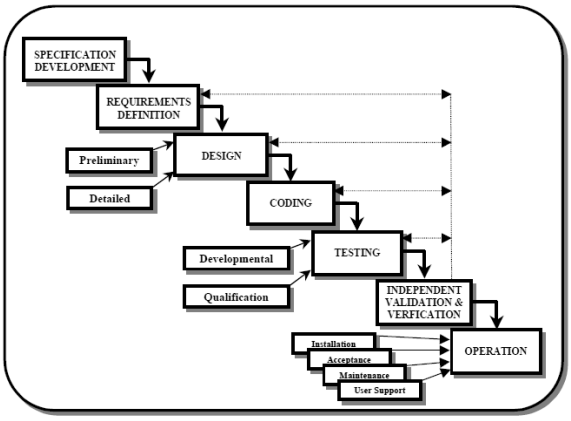

Figure 3. Grand Design, Waterfall LIFE Cycle Model

B. *Modified V Life Cycle Model*

The Modified V software acquisition life cycle model is another example of a defined method for software development. It is depicted in Figure 4. This model is heavily weighted in the ability to design, code, prototype, and test in increments of design maturity. The left side of the figure identifies the specification, design, and coding activities for developing software. It also indicates when the test specification and test design activities can start. For example, the system/acceptance tests can be specified and designed as soon as software requirements are known. The integration tests can be specified and designed as soon as the software design structures are known. And, the unit tests can be specified and designed as soon as the code units are prepared. The right side of the figure identifies when the evaluation activities occur that are involved with the execution and testing of the code at its various stages of evolution.

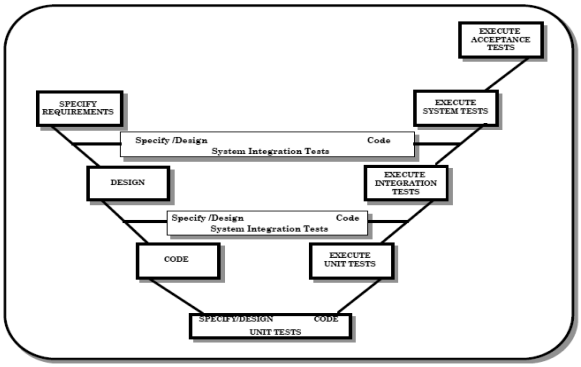

Figure 4. V Life Cycle Model

C. *Spiral Life cycle Model*

The Spiral acquisition life cycle model provides a risk-reduction approach to the software development process. In the Spiral model, Figure 5, the radial distance is a measure of effort expended, while the angular distance represents progress made. It combines features of the Waterfall and the incremental prototype approaches to software development. Spiral development emphasizes evaluation of alternatives and risk assessment. These are addressed more thoroughly than with other strategies. A review at the end of each phase ensures commitment to the next phase or identifies the need to rework a phase if necessary. The advantages of Spiral development are its emphasis on procedures, such as risk analysis, and its adaptability to different development approaches.

This model represents a "demonstration based" process that employs a top-down incremental approach that results in an early and continuous design and implementation validation. Advantages of this approach are that it is built from the top down, it supports partial implementation; the structure is automated, real and evolved; and that each level of development can be demonstrated. Each build and subsequent demonstration validates the process and the structure to the previous build. Hence, Spiral Life-cycle model is more appropriate for safety-critical systems design.

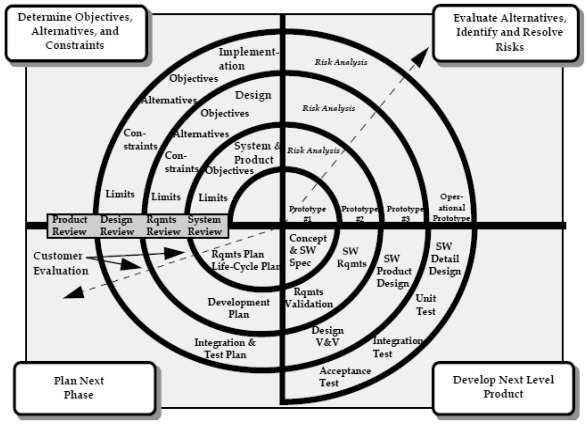

Figure 5. Spiral Life Cycle Model

V. INTEGRATION

The life cycle process of system development was instituted so managers would not be forced to make snap decisions. A structured life cycle, complete with controls, audits, reviews, and key decision points, provides a basis for sound decision making based on knowledge, experience, and training. It is a logical flow of events representing an orderly progression from a "user need" to finalize activation, deployment, and support.

The elements contributing to a credible and successful software safety engineering program will include the following:

- A defined and established system safety engineering process,
- A structured and disciplined software development process,
- An established hardware and software systems engineering process,
- An established hardware/software configuration control process, and
- An integrated SSS Team responsible for the identification, implementation, and verification of

safety-specific requirements in the design and code of the software.

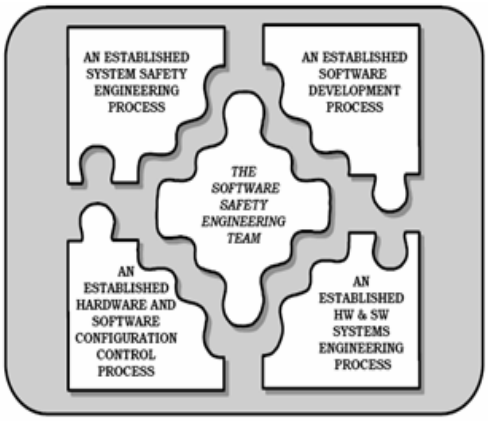

Figure 6. Software Safety Engineering Program

VI. Redundancy for Fault-tolerant Design

Fault tolerant design, also known as fail-safe design, is a design that enables a system to continue operation, possibly at a reduced level (also known as graceful degradation), rather than failing completely, when some part of the system fails. The term is most commonly used to describe computer-based systems designed to continue more or less fully operational with, perhaps, a reduction in throughput or an increase in response time in the event of some partial failure. That is, the system as a whole is not stopped due to problems either in the hardware or the software.

Redundancy is the duplication of critical components of a system with the intention of increasing reliability of the system, usually in the case of a backup or fail-safe.

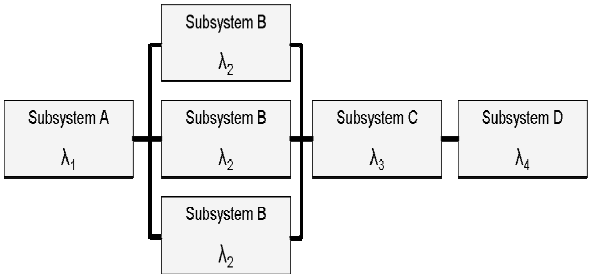

Figure 7. Redundancy in System

A. Replication

Replication is the process of sharing information so as to ensure consistency between redundant resources, such as software or hardware components, to improve reliability, fault-tolerance, or accessibility [4]. It could be data replication if the same data is stored on multiple storage devices, or computation replication if the same computing task is executed many times. A computational task is typically replicated in space, i.e. executed on separate devices, or it could be replicated in time, if it is executed repeatedly on a single device.

A lockstep fault-tolerant machine uses replicated elements operating in parallel. At any time, all the replications of each element should be in the same state. The same inputs are provided to each replication, and the same outputs are expected. The outputs of the replications are compared using a voting circuit. A machine with two replications of each element is termed dual modular redundant (DMR). The voting circuit can then only detect a mismatch and recovery relies on other methods.

In many safety-critical systems, some parts of the control system are triplicated, which is formally termed triple modular redundancy (TMR). A machine with three replications of each element is termed triple modular redundant (TMR). The voting circuit can determine which replication is in error when a two-to-one vote is observed. In this case, the voting circuit can output the correct result, and discard the erroneous version. After this, the internal state of the erroneous replication is assumed to be different from that of the other two, and the voting circuit can switch to a DMR mode. This model can be applied to any larger number of replications.

VII. Testing, Verification and Validation

Systems are called safety-critical if their malfunction represents a severe threat to human lives or to the environment. Following Laprie's terminology[3], dependability is the capability of a system to deliver the specified application services during its period of operation. Laprie identified four attributes which characterise the dependability of a system:

(1) A safe system cannot assume states that are regarded as "catastrophic" from the point of view of the application. This means that the system will only perform transitions into states satisfying the specified invariants, perform calculations that are correct with respect to the specification and output data fulfilling the desired integrity constraints. Safety does not guarantee that a desired calculation and the corresponding output will always be produced. This aspect is covered by the following two attributes:
(2) Reliability is a characteristic specifying the probability that a system will deliver its service for a given period of time.
(3) Availability is a measure reflecting the probability that the system will be available at a certain point in time.
(4) Finally, Security reflects the capability of the system to protect the application against damage arising from accidental or malicious human interaction.

Design, execution and evaluation of tests for safety-critical systems require considerable effort and skill and consume a large part of today's development costs. Due to the growing complexity of control systems it has to be expected that their trustworthy test will become unmanageable in the future if only conventional techniques requiring a high degree of human interaction during the test process are applied. For these reasons methods and tools helping to automate the test process gather wide interest both in industry and research communities.

CONCLUSIONS

This paper tried to touch the fundamental points to be taken care while designing a safety-critical real time system. With the advent growth in technology and tools in future the designers can eliminate most of the hazards at design stage itself, and improve the system reliability and safety, if understand these concepts.

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Motion Estimation Algorithm For Video Compression

A.Anitha
CVR College of Engineering, Department of ECE, Ibrahimpatan, R.R.District, A.P., India
Email:aniravi08@gmail.com

Abstract—**In this paper, two motion estimation algorithms have been implemented and performance features of these two tested. These algorithms are full search and fast search methods. Parameters such as number computation, speed and PSNR have been compared to evaluate performance Implementation has been done using Matlab.**

***Index Terms*—Block matching, motion estimation, motion vector, video compression.**

I. Introduction

Motion estimation plays an important role in any video compression system, since it can achieve significant compression by exploiting the temporal redundancy existing in a video sequence. In motion estimation the current image is divided into Macro Blocks (MB) [1].

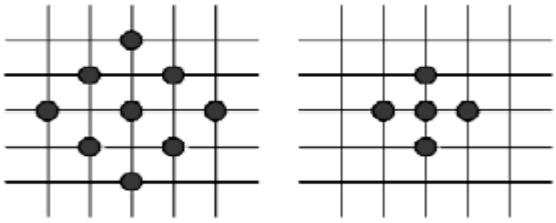
Most of the algorithms have been proposed for motion estimation use from BMA_based (Block Matching Algorithms) bases methods. In these methods, motion estimation is performed for a N×M blocks of current frame, It is done by checking entire N×M blocks from search area situated in the reference frame(s) and calculating the difference between the current block and other reference blocks and finally choosing the block that has the most similarity to the earlier block in the current frame. The difference between the two blocks as residual (motion compensated residual) and the distance between them as motion vector, are coded and transmitted. This is represented as error J_m

II. Full Search method

In this method, all possible modes are checked. By performing the motion estimation for every block and calculating the R-D criterion for all of them, block sizes that are used are determined. Firstly motion estimation for macroblock (16×16 block) is performed and j_m is calculated. The macroblock is then divided into 16×8 and 8×16 blocks and for each of them, motion estimation and j_m is calculated. The sum of calculated j_m of blocks in each mode, is the j_m of that mode. This splitting process is continued till a 4×4 block is obtained. From this four state, a mode that has minimum value of j_m is choosen. If the selected mode is 8×8, breaking process of each block is continued like the previous. The smallest possible block size is 4×4 and afterward the breaking procedure is terminated [3].

III. Method of fast search

Macro Block determination using (fast search) [2] algorithm, fast motion is estimated with modified diamond search for variable block sizes. Motion vector field adaptive search technique (MVFAST) uses a different initial search point and search patterns with selective application of large diamond search (LDS) and small diamond search (SSD) according to the characteristics of motion activity assessed by the similarity of motion vector field among contiguous blocks. LDS pattern is illustrated in Figure 1.



(a) LDSP (b) SDSP

Figure. 1 Diamond search patterns

The search center is modified dynamically by estimating the error and choosing the block error with minimum as the subsequent search center. If the minimum error occurs at the search center of LDSP, then the search pattern is switched from LDSP to SDSP, and the position having the minimum error in SDSP is decided as the motion vector. Otherwise, a new center of LDSP is placed at the point that yields the minimum distortion in the previous step, and all points on the new LDSP are tested again. This process is iteratively repeated until the minimum error falls on the search center [4].

IV. IMPLEMENTATION RESULTS:

Figure 2(a)

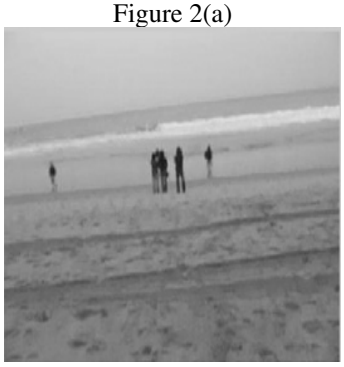


Figure 2(b)

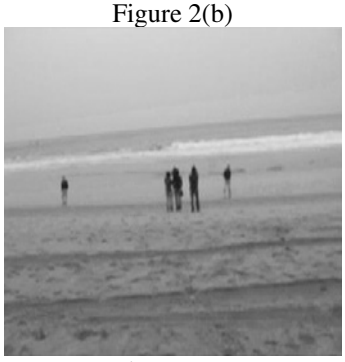


Figure 2(c)

Figure 2(d)

Figures 2(a) to Fig 2(d) are the four successive frames of the input video:

Figure 3(a)

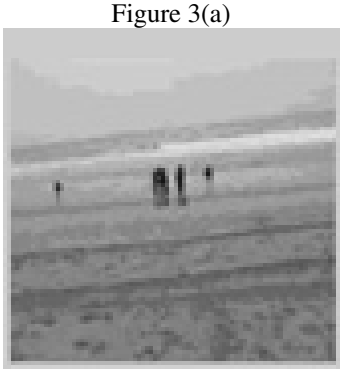


Figure 3(b)

Figure 3(c)

Figure3 (d)

Figures 3(a) to Fig 3(d) are the four successive frames of the recovered output video:

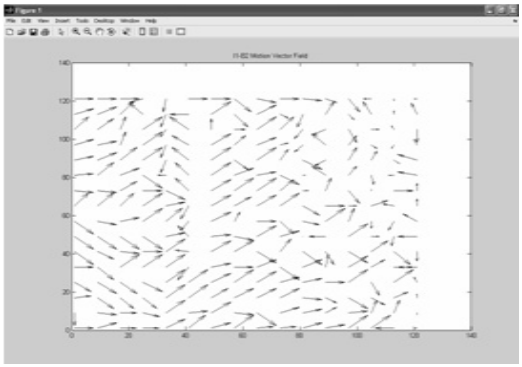


Figure 4. Motion Vector generated by Full Search Algorithm:

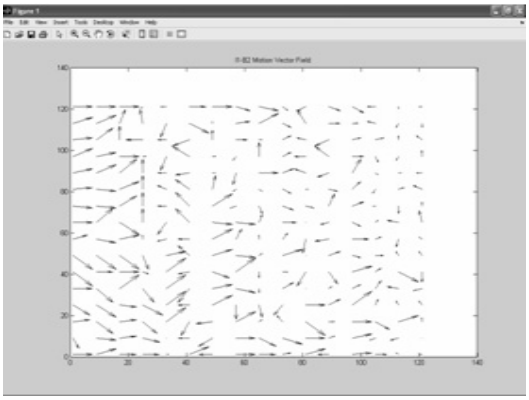


Figure 5. The Motion vector generated by Diamond search algorithm:

Table1:Performance comparison of two algorithms when MB=8:

ME scheme	TCP*	Time sec	PSNR* dB
Full search algorithm	408608	40.922	82.5406
MVFAST	43259	11.359	82.5882

*TCP: total check points, PSNR: peak signal to noise ratio

CONCLUSIONS

MVFAST search algorithm improves time by 29.563 sec and peak signal to noise ratio by 0.0476 dB as compared to with full search algorithm**.** Hence it is concluded that this method is better.

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Numerical Solution of Oscillatory Motion of Dusty Visco-Elastic Fluid Through Porous Media

Dr. Rafiuddin[1] and M.V.Ramana Murthy[2]
[1]CVR College of Engineering, Department of H & S, Ibrahimpatan, R.R.District, A.P., India
Email: rafiuddin2008@gmail.com
[2]Osmania University, Department of Mathematics, Hyderabad, India
Email: mv_rm@rediffmail.com

***Abstract*— The solution of oscillatory motion of dusty visco-elastic fluid through porous media by finite element method is obtained; expressions for the velocity of fluid, dust and skin friction are also obtained. The effects of various parameters on above are shown graphically and discussed.**

***Index Terms*—Oscillatory motion, Dusty - Water's liquid B, Porous medium.**

I. INTRODUCTION

Dusty fluids find applications in such diverse fields as the transportation of sediment by water and air, the centrifugal separation of particulate matter from fluids, fluid-droplet sprays, dust collection, nuclear reactor cooling, acoustics, environmental pollution, batch settling, rain erosion and guided missiles, among others.

The constitutive equation for the rheological equations of state for a memory fluid (Walter's liquid B model) given by Walter (1960, 1962).Grover (1968) studied the motion of an incompressible viscous fluid bounded by two infinite plates, the upper one is fixed and the other executing a simple harmonic oscillation in its own plane. Siddappa and Shanker Hegde (1972) have extended the Grover's work for oscillatory motion of visco-elastic fluid given by Rivlin-Ericksen constitutive equation. Sattar and Ahmed (2007) obtained the numerical solution of Non-Newtonian fluid. Rafiuddin et al. (2006) derived the exact solution of oscillatory motion of a memory fluid through porous media with a horizontal force. Ramu et al. (2010) presented the numerical solution of the above problem.

The aim of the present investigation is to study oscillatory motion of dusty visco-elastic fluid (Walter's liquid B' model) through porous medium which is bounded by two infinite parallel plates.

II. FORMULATION OF THE PROBLEM

Consider the oscillatory motion of a dusty visco-elastic fluid bounded by two infinite parallel plates through a porous medium. Let the direction of motion of the fluid be along the x-axis, which is chosen along the lower plate and the y-axis be perpendicular to it. Let (u, v, w) be the velocity components of the fluid. For the present study, v = w = 0**.** The velocity of the oscillating plate at any instant is taken as $u = Re\,(u_0 e^{-i\omega t})$, where 'Re' represents the real part. For convenience we drop the expression 'Re', but we take the real part of the final result. The equation of motion governing the dusty visco-elastic flow is of the form

$$\frac{\partial u}{\partial t} = \alpha\frac{\partial^2 u}{\partial y^2} + \frac{KN_0}{\rho}(v_p - u) - \beta\frac{\partial}{\partial t}\left(\frac{\partial^2 u}{\partial y^2}\right) - \frac{\alpha u}{\gamma} \tag{2.1}$$

$$\frac{\partial v_p}{\partial t} = \frac{K}{m}(u - v_p) \tag{2.2}$$

and the equation of continuity is

$$\partial u/\partial x = 0 \tag{2.3}$$

The equation will now be made dimensionless by introducing the non-dimensional quantities.

$$y' = \frac{y}{y_0}, \quad u' = \frac{uy_0}{\alpha}, \quad t' = \frac{\alpha t}{y_0^2}$$
$$\tau = \frac{m\alpha}{Ky_0^2}, \quad \gamma' = \frac{\gamma}{y_0^2}, \quad v_p' = \frac{y_0 v_p}{\alpha}, \quad s = \frac{\beta}{y_0^2} \tag{2.4}$$

Substituting in (2.1) & (2.2) dropping the dashes for simplicity, we get

$$\frac{\partial u}{\partial t} = \frac{\partial^2 u}{\partial y^2} - \left(\frac{1}{\tau} + \frac{1}{\gamma}\right)u - s\frac{\partial}{\partial t}\left(\frac{\partial^2 u}{\partial y^2}\right) + \frac{v_p}{\tau} \tag{2.5}$$

$$\tau\frac{\partial v_p}{\partial t} = (u - v_p) \tag{2.6}$$

Eliminating v_p from (2.5) making use of (2.6), we get

$$\frac{\partial^2 u}{\partial t^2} = \frac{\partial^2}{\partial y^2}\left(\frac{\partial u}{\partial t}\right) + \left(\frac{1}{\tau}\right)\left(\frac{\partial^2 u}{\partial y^2} - s\frac{\partial}{\partial t}\left(\frac{\partial^2 u}{\partial y^2}\right)\right) - \frac{\partial u}{\partial t}\left(\frac{1}{\tau} + \frac{1}{\gamma}\right) - s\frac{\partial^2}{\partial t^2}\left(\frac{\partial^2 u}{\partial y^2}\right) - \frac{u}{\tau\gamma} \tag{2.7}$$

Where
K– stock's coefficient of resistance (6πaμ) for spherical dust particles,
a – average radius of dust particle,
μ – viscosity of the fluid,
l– mN_o/ρ mass concentration of dust particle,
ρ – density of fluid,
m –average mass of dust particle,
N_o– number of dust particle per unit volume,
β–kinematic visco-elasticity
τ – m/K relaxation time,
α – kinematic viscosity,
γ –permeability parameter,
y_o –characteristic velocity,
s – visco-elastic parameter.

III. SOLUTION OF THE PROBLEM

Let the lower plate execute simple harmonic oscillations in its own plane whereas the upper plate is fixed .In this case the boundary conditions are

$y = 0$, $u = u_o e^{-i\omega t}$,
$y = 2y_o$, $u = 0$ (3.1)

Where $2y_0$ is the clearance distance between the vibrating plate and fixed plate.

Introducing dimensionless frequency ω′given by $\omega' = \omega y_o^2/\alpha$ and using (2.4), the boundary conditions in (3.1) in dimensionless form reduces to

$y = 0$, $u = e^{-i\omega t}$,
$y = 2$, $u = 0$ (3.2)

To solve the equation (2.5), we assume the solution of the form

$u = f(y) e^{-i\omega t}$ (3.3)

Now applying the boundary conditions (3.2) to (3.3), we get

$y = 0$, $f(y) = 1$,
$y = 2$, $f(y) = 0$ (3.4)

Substituting (3.3) into (2.5), we have

$f''(y) + mf(y) = 0$ (3.5)

Where

$$m = \frac{(-1 + \omega^2\tau\gamma) + i\omega[(l+1)\gamma + \tau]}{\gamma[(1 + \omega^2\tau s) - i\omega(\tau - s)]} \quad (3.6)$$

The equation (3.5) is an ordinary differential equation with boundary conditions (3.2) through finite element method using Galerkin method, the solution of (3.5) is given by

$$f(y) = \frac{1}{2}(2 - y) + a(y^2 - 2y) \quad (3.7)$$

The velocity distribution is given by (3.3)
The real part of the velocity of the fluid is given by

$$u(y) = \left[\frac{1}{2}(2 - y) + C_1(y^2 - 2y)\right]\cos\omega t + D_1(y^2 - 2y)\sin\omega t \quad (3.8)$$

Skin friction at the lower plate is given by

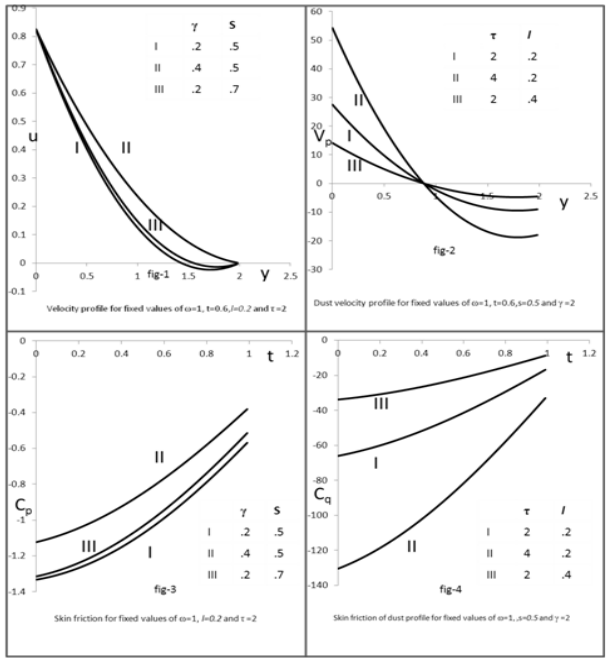
$$C_p = \left(\frac{\partial u}{\partial y}\right)_{y=0} = -\left(\frac{1}{2} + 2C_1\right)\cos\omega t - 2D_1\sin\omega t \quad (3.9)$$

Dust velocity is given by

$$V_p = \frac{\tau}{l}\left[\sin\omega t\left\{-\omega\left(1 - \frac{y}{2}\right) - C_1\omega(y^2 - 2y) - 2D_1 - 2C_1 s\omega + \left(\frac{l}{\tau} + \frac{1}{\gamma}\right)(y^2 - 2y)D_1\right\} + \cos\omega t\left\{D_1\omega(y^2 - 2y) - 2C_1 + 2D_1 s\omega + \left(\frac{l}{\tau} + \frac{1}{\gamma}\right)\left\{\left(1 - \frac{y}{2}\right) + (y^2 - 2y)C_1\right\}\right\}\right] \quad (3.10)$$

$$C_q = \left(\frac{\partial V_p}{\partial y}\right)_{y=0} = \frac{\tau}{l}\left[\sin\omega t\left\{\omega\left(2C_1 + \frac{1}{2}\right) - 2D_1\left(\frac{l}{\tau} + \frac{1}{\gamma}\right)\right\} - \cos\omega t\left\{\left(\frac{l}{\tau} + \frac{1}{\gamma}\right)\left(\frac{1}{2} + 2C_1\right) + 2D_1\omega\right\}\right] \quad (3.11)$$

Where the constants are not given for the sake of brevity



DISCUSSION AND CONCLUSIONS

From fig-1 it is found that as permeability parameter (γ) and visco-elastic parameter (s) increase, fluid velocity (u) increases and from fig-2 we see that mass concentration (*l*) increases dust velocity (V_p) decreases and V_p increases with relaxation time (τ) , from the middle of the plates the trend is opposite for both. From fig-3 it is observed that skin friction (C_p) increases with permeability parameter and visco-elastic parameter. Skin friction in fig-4 for the dust case (C_q) increases with mass concentration and decreases with relaxation time.

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RENEWABLE ENERGY POTENTIAL AND SUSTAINABLE DEVELOPMENT IN PRESENT SCENARIO OF GLOBALIZATION

Somya Tiwari[1] and Dr.Shuchi Tiwari[2]
[1]Ansal Institute of Technology, Department of Mechanical Engineering, Gurgaon, India
Email: tiwarisomya@yahoo.com
[2]CVR College of Engineering, Department of H & S, Ibrahimpatan, R.R.District, A.P., India
Email: shuchitiwari1@gmail.com

***Abstract*—An energy resource that is renewed by nature and whose supply is not affected by the rate of consumption is often termed as renewable energy. The need to search for renewable, alternate and non-polluting sources of energy assumes top priority for self-reliance in the regional energy supply. This demands an estimation of available energy resources spatially to evolve better management strategies for ensuring sustainability of resources. With the rising population need for energy increases. To meet the requirement we have to find out renewable energy potential. If we continue to use non renewable resources there will be nothing left for future generation. Rising international concern about global warming and the rapid development of the renewable energy industry over recent years has led to a need for sustainable development in renewable energy in present scenario of globalization.**

***Index Terms*—Hence, this paper focuses on mapping of renewable energy (solar, wind, bio energy and small hydro energy) potential and findings of recent developments.**

I. INTRODUCTION

Worldwide survey of 132 nations indicated that, the nations ranked high on sustainable development, tend to have higher usage of the renewable energy. Energy is essential for economic and social development of a region or a country. However, consumption of fossil fuels is the major cause of air pollution and climate change. Improving energy efficiency and de-linking economic development from energy consumption (particularly of fossil fuels) is essential for sustainable development. [2]

The central idea presented in this paper is review and study of different sector of energy and current sustainable development in each sector globally .For which infrastructure development is required to achieve sustainable development in the renewable energy sector in the era of globalization. For which first a look on different sources of renewable energy available.

A. Why Renewable Energy?

Renewable energy including biomass, geothermal, hydropower, solar, wind, tidal, and wave offers tremendous benefits for meeting global energy needs.[1] Building on a foundation of hydropower, biomass combustion, and geothermal power pioneered during the industrial revolution in the late 1800s, new forms of renewable energy began to be developed and commercialized, including solar, wind, and several forms of advanced bio energy.[3]

II. DIFFERENT SOURCES OF RENEWABLE ENERGY [10]

A. Solar Energy:

The sun is our most powerful source of energy. Sunlight, or solar energy, can be used for heating, lighting and cooling homes and other buildings, generating electricity, water heating, and a variety of industrial processes. Most forms of renewable energy come either directly or indirectly from the sun. For example, heat from the sun causes the wind to blow, contributes to the growth of trees and other plants that are used for biomass energy, and plays an essential role in the cycle of evaporation and precipitation that makes hydropower possible.[7]

B. Wind energy:

Wind is the movement of air that occurs when warm air rises and cooler air rushes in to replace it. The energy of the wind has been used for centuries to sail ships and drive windmills that grind grain. Today, wind energy is captured by wind turbines and used to generate electricity.[10]

C. Hydro power:

Water flowing downstream is a powerful force. Water is a renewable resource, constantly recharged by the global cycle of evaporation and precipitation. The heat of the sun causes water in lakes and oceans to evaporate and form clouds. The water then falls back to Earth as rain or snow, and drains into rivers and streams that flow back to the ocean. Flowing water can be used to power water wheels that drive mechanical processes. And captured by turbines and generators, like those housed at many dams around the world, the energy of flowing water can be used to generate electricity.[7]

D. Biomass energy:

Biomass has been an important source of energy ever since people first began burning wood to cook food and warm themselves against the winter chill. Wood is still the most common source of biomass energy, but other sources of biomass energy include food crops, grasses and other plants, agricultural and forestry waste and residue, organic components from municipal and industrial wastes, even methane gas harvested from community landfills. Biomass can be used to produce electricity and as fuel for transportation, or to manufacture products that would otherwise require the use of non-renewable fossil fuels.[6]

E. Hydrogen:

Hydrogen has tremendous potential as a fuel and energy source, but the technology needed to realize that potential is still in the early stages. Hydrogen is the most common element on Earth for example, water is two-thirds hydrogen but in nature it is always found in combination with other elements.

Once separated from other elements, hydrogen can be used to power vehicles, replace natural gas for heating and cooking, and to generate electricity.

F. Geothermal Energy:

The heat inside the Earth produces steam and hot water that can be used to power generators and produce electricity, or for other applications such as home heating and power generation for industry. Geothermal energy can be drawn from deep underground reservoirs by drilling, or from other geothermal reservoirs closer to the surface.[7]

G. Ocean Energy:

The ocean provides several forms of renewable energy, and each one is driven by different forces. Energy from ocean waves and tides can be harnessed to generate electricity, and ocean thermal energy—from the heat stored in sea water—can also be converted to electricity. Using current technologies, most ocean energy is not cost-effective compared to other renewable energy sources, but the ocean remains and important potential energy source for the future.

III. Global Scenario of Energy consumption

In 2008,total worldwide energy consumption was 474 exajoules (474×1018J) with 80 to 90 percent derived from the combustion of fossil fuels .This is equivalent to an average annual power consumption rate of 15 terawatts (1.504×1013W). Not all of the world's economies track their energy consumption with the same rigor, and the exact energy content of a barrel of oil or a ton of coal will vary with quality.

In 2009, world energy consumption decreased for the first time in 30 years (-1.1%) or 130Mtoe, as a result of the financial and economic crisis (GDP drop by 0.6% in 2009).This evolution is the result of two contrasting trends. Figure 1 shows the factors affecting demand for renewable energy climate change ,environmental issues ,energy security ,consumer demand increased reliability and local economic development specifically for United States ,Europe ,Japan and developing countries in the category high ,medium and low. Oil remained the largest energy source (33%) despite the fact that its share has been decreasing over time. Coal posted a growing role in the world's energy consumption: in 2009, it accounted for 27% of the total.

Figure 1 Key Market Drivers for Renewable Energy

[11]

	Factors Affecting Demand for Renewable Energy					
	Climate Change[1]	Environ-mental Issues	Energy Security	Consumer Demand	Increased Reliability	Local Economic Development
Europe	●	●	●	◑	○	◑
Japan	◑	●	●	◑	○	○
United States	◑	◑	●	◑	◑[2]	◑
Developing Countries	○	○	◑	●	◑	●

1. Government vs. individuals
2. Region specific

● High ◑ Medium ○ Low

IV. Indian scenario of Energy consumption

Coal is the predominant energy source (58%) in India, followed by oil (27%), natural gas (7%), lignite (4%), hydropower (3%) and nuclear power (0.22%). Energy consumption patterns in the Indian residential sector vary widely not only among the rural and urban areas but also across various income classes in urban areas. Approximately 86.1% rural households in India use fuel wood and dung cakes for cooking, 3.5% rural households use LPG for cooking, 50.6% of rural households use kerosene and 48.4% use electricity as a

primary source of lighting. The annual average fuel wood consumption is around 270–300 million tones, kerosene consumption is about 10.5 million tones out of which 60% is in rural areas. India's present energy scenario calls for the effective management of all available resources in order to attain national objectives. A well-balanced fuel mix, in which all energy resources are appropriately utilized, is essential for sustainable development.[5]

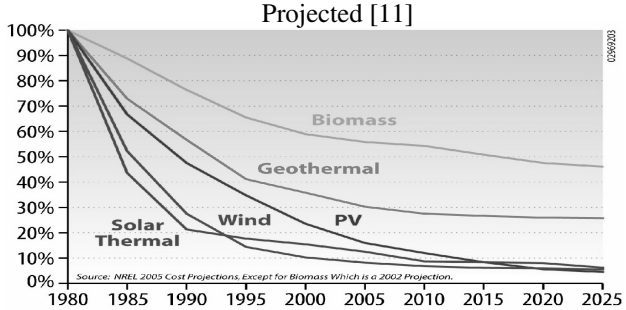
V. GLOBAL SCENARIO OF RENEWABLE ENERGY POTENTIAL AND RECENT DEVELOPMENT [11]

Renewable energy potential can be utilized by using modern technology by installing different plants and wind turbines ,solar panels set up for generation of electricity . Main requirement is in the field of electricity. Table number 1 presenting Top Countries with Installed Renewable Electricity by Technology (2009) in different sectors of renewables wind, Solar PV and Biomass. Figure 2 showing Renewable Energy Electricity Generation Costs as Percentage of 1980 Levels: Historical and Projected. It shows from 1980 to 2025 for Biomass ,Geothermal, wind, PV and solar thermal in the percentage of 0 to 100%.

Table 1 Top Countries with Installed Renewable Electricity by Technology (2009) collect data for 2011

Geothermal	wind	Solar PV	Biomass
1.U. S.	1.U. S.	1.Germany	1.U.S.
2.Philippines	2.China	2.Spain	2.Brazil
3.Indonesia	3.Germany	3.Japan	3.Germany
4.Mexico	4.Spain	4.U.S.	4.China
5.Italy	5. India	5.Italy	5.Sweden

Figure 2 Renewable Energy Electricity Generation Costs as Percentage of 1980 Levels: Historical and Projected [11]



Top Countries with Installed Renewable Electricity (2009)

1. China.
2. U.S.
3. Brazil.
4. Canada.
5. Japan.

Here summery for different renewable sources potential and installations.

A. Wind:

In the United States, installed wind energy capacity increased almost 14 times between 2000 and 2009**.** In the United States, wind experienced record growth in 2009 and nearly 10 GW of new capacity was added. Texas led the United States in wind installations in 2009, installing more than 2,292 MW of wind capacity. In 2009, China surpassed the United States as the world leader in annual installed wind capacity, with more than 13.8 GW added.

B. Solar:

Solar energy electricity generation has nearly quadrupled between 2000 and 2009, but still represents a very small part of overall U.S. electricity generation. Countries with aggressive solar policies such as Germany, Spain and lead the world in solar photovoltaic (PV) deployment. Similarly U.S. states with aggressive solar incentives lead the United State in installations.

U.S. manufacturers currently have a small share of the world PV market**.** China is the market leader with nearly 40% of the global PV cell production.

A number of concentrating solar power (CSP) plants came online in 2009, including 12 MW in the United States and 120 MW in Spain.

C. Geothermal:

U.S. geothermal energy generation has remained relatively stable from 2000 to 2009, with the past 10 years experiencing an average of 1.2% growth.

Geothermal energy generates power for between 5 and 10 cents / kilowatt-hour.

The United States leads the world in installed geothermal electricity capacity and generation, with most of that power installed in California.

As a base-load source of energy, geothermal is distinct from other renewables such as wind and solar, because it can provide electricity 24 hours a day, 365 days a year.

D. Bio power:

Bio power generation has remained steady during the past seven years, and currently accounts for 38% of all renewable energy generated in the United States (excluding hydropower). Biomass electricity primarily comes from wood and agricultural residues that are burned as a fuel for cogeneration in the industrial sector (such as in the pulp and paper industry).

E. Hydropower:

Hydropower capacity has remained constant between

2000–2009, with generation fluctuation depending on water supply. Hydropower remains the largest source of renewable energy generation, and an important component of the energy mix; primarily large-scale hydropower accounts for 6.9% of U.S. electricity generation.

F. Advanced Water Power:

U.S. interest in advanced water power such as tidal, river and ocean current, and ocean wave energy is just beginning to grow, with many prototype projects in testing stages and permits being filed at the Federal Energy Regulatory Commission (FERC).

One wave and two tidal plants came online in 2009 in New South Wales, Canada, and the United Kingdom.

VI. INDIAN SCENARIO OF RENEWABLE ENERGY POTENTIAL AND RECENT DEVELOPMENT

Renewable energy resources, which the country has in abundance, such as solar, wind, biomass, small hydro energy, etc., can effectively meet energy demand and are environmentally benign. About 3700 MW of power-generating capacity based on renewable energy sources has been installed in the country so far. This constitutes about 3.5% of the total installed capacity.

Review in India - Integrated energy planning was recognized as an essential element of development planning in India as early as the sixties. The Government of India constituted the Energy Survey of India Committee (ESIC) in 1963 to study ''the present and prospective demands and supplies of energy, both total and in respect of constituents of energy on a national, regional and sectoral basis''. The study was expected to provide the Government with the basic material for development planning in the field of energy up to 1981.

The Fuel Policy Committee (FPC) was appointed by Government of India in 1970 to prepare an outline of the national fuel policy for the next 15 years.

The Working Group on Energy Policy (WGEP) was another expert group constituted by the Government of India in 1977. WGEP was required to outline the national energy policy for the next 5, 10 and 15 years. The report of WGEP was finalized in 1979. WGEP made detailed projections of the demand for both commercial and noncommercial forms of energy up to the end of the century and suggested a number of corrective policy measures to manage the energy demand.

The Advisory Board on Energy (ABE) was set up in 1983 on the eve of formulation of the Seventh Five-Year Plan. In addition to several important recommendations on the technical, financial and institutional aspects of energy, the ABE also made detailed projections of energy demand in different regions till 2004 under assumptions of different macro-economic scenarios.

Table No 2 showing actual installed renewable base plants in India for different renewable sources like wind-form, wind-pumps, small hydro, bio mass gasifires and solar PV.

Table 2 Actual installed renewable based plants in India

Source	Units	Installed
Windfarms	MW	557
Windpumps	Nos	3289
Small Hydro	MW	122
Biomass Gasifiers	X 10 6	2.12
Solar PV	KW	825

CONCLUSIONS

Today, these renewable energy technologies are the fastest growing energy technologies (particularly wind and solar) and are cost competitive in a variety of grid, off-grid, and remote applications worldwide. They utilize locally available resources, off setting the need for costly fuel imports; are environmentally beneficial, without the harmful emissions of conventional energies; provide diversification to a country's energy mix; and create local job and income opportunities. Sustainable development of a region depends on the health of renewable energy resources like water, vegetation, livestock, etc..

The benefits of this sustainable development world power solution are proven:

- Decreased pollution from fossil and nuclear fuels
- Reduced hunger and poverty in developing nations
- Increased trade, cooperation and world peace
- Enables health care, communications and access to clean water
- Stabilized population growth.

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FORENSIC SYSTEMS ENGINEERING

Dr. B. B. Jayasingh
CVR College of Engineering, Department of IT, Ibrahimpatan, R.R.District, A.P., India.
Email: bbjayasingh9@rediffmail.com

***Abstract*-Forensic Engineering, to the average engineer, would mean the activity of the Expert Witness who investigates engineering matters involved in legal proceedings. Legal proceedings, although served by forensic engineering, can make only a limited contribution to engineering safety. It is therefore crucial that forensic engineers promote engineering safety by finding ways to share lessons learnt from failures with the engineering community whilst at the same time serving the purposes of the courts. The paper presents the meaning to encompass the investigation of all computer engineering failures; not just restricted to those ending up in Court. Educating for the future is the title of the paper, where advice is offered as to how the engineering professions should promulgate the knowledge gained from the investigation of structural failures.**

***Index Terms*—Forensics, Forensic Computing, Forensic Systems Engineering, computer Forensics, Cyber Forensics, Software Forensics.**

I. INRODUCTION

Twenty-first century engineers, driven by sustainability and technology, are pushing sciences to new limits by creating leaner structures with modern materials using state-of-the-art design and novel construction techniques. They operate in a changing global climate of increased intensity, natural hazards and manmade disasters. Managing and mitigating higher risks may be considered a challenge in engineering new structures and also a threat in assessing the vulnerability of existing infrastructure, especially in the underdeveloped world; a timely launch of Forensic Engineering.

Legal proceedings, although served by forensic engineering, can make only a limited contribution to engineering safety. It is therefore crucial that forensic engineers promote engineering safety by finding ways to share lessons learnt from failures with the engineering community whilst at the same time serving the purposes of the courts. In systems engineering the technical approach is known as a 'hard' system (e.g. structures), and the managerial approach is a 'soft' system (e.g. people). Although much of the focus of forensic engineering is on hard system failure, a forensic 'systems' engineer should facilitate integration of both approaches by seeking to understand and tackle any sources of complexity. For example, a forensic engineer needs to appreciate that the hard system failure is embedded in a soft system failure and cooperate in the investigation of the soft system failure.

Forensic systems engineering [1] is the discipline investigating the history of Information Technology failures. It therefore focuses on the post-mortem analysis and study of project disasters. The work involves a detailed investigation of the project, the environment, decisions taken, politics, human errors and the relationship between subsystems. The work draws upon a multidisciplinary body of knowledge and assesses the project from several directions and viewpoints. The concept of systems is a central tool for understanding the delicate relationships and their implications in the overall project environment.

Forensics highlights the central role of risk management and decision making, leading to **a** new perception of their importance in the development of sound and reliable software systems. In the long-run the field of forensics will help in understanding what it is that software engineers do, before one can start learning (or teaching) how to do it better.

Forensic computing (FC) starts with the fact of abuse having occurred and attempts to gather the evidence needed by investigators to identify the culprits. Moreover, FC must be able to deal with the use of the infrastructure by authorized users for unauthorized or illegal activities. It is already well known that most computer-related crime is carried out not by highly skilled external attackers, but by insiders who have easy access to IT systems.

The primary value of the study of failures, is in feeding knowledge back into the engineers. Detailed analysis of failures pinpoints areas for future research, which are essential rather than accidental, as they result from observed shortcomings of contemporary approaches. We observed the newly developed technology of forensic science has given rise to digital forensic. Digital forensics is categorized into three parts such as computer forensics, cyber forensics and software forensics. Computer forensics is the collection, analysis, examination and presentation of information held in or retrieved from computer hard disks in such a way that it can be used as potential legal evidence. It

deals with the stand alone computer related crimes. To deal with network/internet related crimes there is a different forensics method referred as cyber forensics [2]. Finding the author of a program code is called software forensics. Thus forensic science encompasses the principles and techniques that help identify evidence at a crime scene.

II. COMPUTER FORENSIC

Computer forensics deals with extracting evidence from the computer itself, or the field of extracting hidden or deleted information from the computer disk is called computer forensics. Computer forensics is that branch of forensic science, which is harnessed to identify, locate, preserve, and extract digital information from a computer system to produce clinching evidence of a crime in the court of law, in an effective manner.

Computer forensics is the study of computer security breaches and their consequences. Computer forensics involves the "preservation, identification, extraction, documentation, and interpretation of computer media for evidentiary and/or root cause analysis [3]. Detection of computer crime and thereafter examination of computer evidence is an emerging field in forensic science today, for which skills need to be developed. Such evidence is required in economic offences, espionage, sabotage, data communication network, terrorism, murder, drugs trafficking, cellular frauds, child pornography etc.

The basic methods of recovering unrecoverable data are described in [4]. The forensic analysis tools are used for recovering hard-disk information. Forensic tools analyze hard disks or hard-disk images from a variety of different operating systems and provide an Explorer-style interface so that one can read the files. The international important forensic tools are here in this paper [5].

The investigator needs to know the rudimentary basics about the computer's hardware and software, operating system, and underlying file system. The professional investigator needs to be comfortable with both Windows and Unix/Linux, including the command line interfaces of both; how each operating system moves, manipulates, and "deletes" files; and how to examine areas of the storage media beyond the file structure, such as unallocated space, file slack, and a host of other areas [3], "The operating system sees all, but it may not tell you about it." The analyst even needs to know how to properly power down and power up a computer, as well as how to disconnect peripherals and network connections, without destroying any of the information on the computer.

Computer evidence is very fragile. Evidence present in a hard disk of a computer can be deleted overwritten or altered in some other manner, unrecoverable or contaminated. Thus, it is essential to isolate a computer involved in a crime as quickly as possible. However, a trained forensic specialist to avoid damage must perform the act of isolating the computer correctly. Unlike the other branches of forensic science, computer forensics did not have time to establish itself as the related technology is changing at a very high speed. But certain procedures and tools have been developed that enable the investigator to analyze the digital evidence.

Consider that many operating systems, such as Linux and Windows 2000, maintain a number of timestamps associated with every file, including the last access date. Using ordinary operating system tools to examine the contents of files will probably cause the last-access date to be changed while specialized analysis tools can examine files without modifying this date. It is important to maintain the integrity of the original data so that you can be sure that the results of the analysis are legally and technically valid.

The heart of the actual forensic analysis, of course, is examining the computer(s) and/or network, recovering all possible information, and reconstructing the activity related to the incident being investigated. One of the most well-known computer forensics tools is the Windows-based analysis software package EnCase, used to perform a thorough analysis of the contents of a system's hard drive. For example, it provides a detailed of the use of EnCase, covering the entire process from media acquisition to analysis to reporting.

There are also tools that end users might employ for defense of their own system, including anti-virus software, IDS, and firewalls. But end users might also deploy tools that make forensics difficult, such as file scrubbers that really do delete files and purge the browser cache, and encryption and steganography software that make the examination of file contents next to impossible without a crypto key. Corporate policies may or may not prohibit use of these tools on a corporate computing resource, but these anti-forensics tools are well known to criminals as well as benign users.

III. CYBER FORENSICS

Cyber Forensics is the branch of digital forensics, which refers to the scientific compilation, examination, exploration and presentation of information held on or retrieved from computer networks in such a way that it can be used as potential legal evidence**.** In other words**,** Cyber Forensics deals with forensic analysis of evidence in computer networks. Computer and Network Forensics (CNF) techniques [6] are used to find out evidence from a variety of computer/network crimes. The ultimate goal of computer and network forensics is to provide sufficient evidence to the law enforcement

agencies where the criminal perpetrator can be prosecuted.

With the rapid expansion of Internet infrastructure, government agencies as well as business organizations of all dimensions are enthusiastic about getting connected to the World Wide Web. The worldwide connectivity has made it possible to provide different kinds of services electronically. This has raised a vital issue of confidentiality and security while transacting over the network. For example, a customer may not like his/her personal details (name, credit card number, job etc.) are disclosed to others, even accidentally when visiting a web server. An effective way of handling such issues is to adopt a mechanism that guarantees secured transaction and at the same time provides all the flexibility. Agent technology is being advocated as a suitable means to fulfill requirements of flexibility, adaptability, autonomy, pro-activeness in such problem areas.

The forensic investigation of cyber crimes involves the identification of the source of communication. First, the person who initiated the communication is to be identified i.e. to trace the communication trail from the victim to the originator. Technically this is a complicated task, as the rapidly changing communication technologies would help the criminal to hide his identity. Such hurdles in the path of the investigating agency encourage the cyber criminals to continue their nefarious designs.

A . Challenges of Cyber Forensics

In a networked environment, the evidence capture and preservation generally occurs after an intrusion or abnormal behavior is detected, so that the abnormal or suspicious activity can be preserved for later analysis [7]. Since relevant information is available in packet headers, try to capture message packets for analysis. In the network environment, there are three kinds of challenges against cyber crimes defined by the law enforcement agencies of the World. Firstly, the technical challenges, which has the ability of law enforcement agencies to find and prosecute criminals operating online environment. Secondly, the legal challenges are due to absence of appropriate laws to combat cyber crimes. Hence the legal laws and legal tools are needed to investigate cyber crimes. Thirdly, The operational challenges, which are the challenges at the ground level. Unlike traditional crimes, the operational canvas of cyber criminals is large both geographically and logically. To successfully detect and gather evidence, a network of well trained, well equipped investigators and prosecutors should work in tandem with great swiftness.

B. Goals of Cyber Forensics

The goal of the cyber forensic includes:

1. The primary goal is to find the evidence against a criminal system in the inter-networked environment, also by assisting the law enforcement agencies in their investigations.
2. The secondary goal of these systems is to reduce investigation time and complexity.

The author [8] provides a broadest coverage of computer and network technology, with special reference to of Windows and Unix systems. In another work, wireless network technologies. [3] have been dealt that provides deeper coverage of computer technology, including the basics of storage media, encryption and steganography, hiding data, and hostile code. The authors also cover Windows and Unix forensics in detail. This provides an excellent introduction to these operating systems for the forensics investigator while assuming no prior knowledge of the operating systems and file systems.[9] also provides detailed coverage of technology that will be of interest to the forensics analyst, covering a long set of tips on how make Windows more secure and private — such as disabling the built-in microphone and not using virtual memory — but doesn't fully explain the underlying rationale for the steps that are recommended. Despite the absence of Unix, it provides detailed and broad coverage of a variety of network and computer technologies. Consistently providing detailed coverage of how data is stored in the memory, registry, and hard drive of computers; modes of data insertion and self-protection, including keystroke logging software, telephone taps, spyware, and even Van Eck radiation; the application and detection of encryption and steganography software; achieving and protecting on-line privacy covering the browser, e-mail, secure protocols, firewalls, and encryption. [10] provide the weakest coverage of technology on Windows discusses how files are stored on the computer with particular emphasis on the Internet Explorer history buffer, cache, and temporary files, the registry, and Event Viewer, while the chapter on Internet abuse primarily describes browsers' cookies, bookmarks, and swap files. A chapter on the tools of the trade covers vulnerability detection tools such as nmap and nessus, protection tools such as BlackICE and swatch, and analysis tools such as The Coroners Toolkit (TCT) and Encase.

C. Policies of Cyber Forensics

It [6] proposes the policies to recover the evidence from computer and network related attacks. In response to any successful attacks the techniques are developed by the try and fix methods of computer and network forensics (CNF). The goal of CNF is to provide sufficient evidence in favor of a criminal to be successfully prosecuted. This paper [6] presents six types of policies in the following categories i.e.

Retaining Information, Planning the Response, Training, Accelerating the Investigation, Preventing Anonymous Activities and protecting the Evidence.

1. The first policy states that to Copy and Retain Application and Local User Files. The illegal copy of user files should not violet the users' privacy that should take care by the company otherwise the evidence may not be admissible to the court. The company has to employ the policy that systematically stores and retains the contents of application and user files as potential legal evidence. As the system logs are vital source of potential evidence the enterprise has to copy and retain computer and network activity logs. The companies that use the network devices like servers and routers have to keep logs of the data packets that flow through them. The packets are of more interest for forensic investigation that is why enterprises should retain network traffic logs.
2. The second policy is to planning the response to an attack has to establish a forensic team includes members from upper management, Human Resources, the technical staff, and outside members. Also to establish an intrusion response procedure of step-by-step guide that employees can follow if an attack is suspected and to formalize the investigative procedure to followed by the computer forensic experts during a forensic investigation.
3. The third policy is to give special training to the response team, investigative team and to all the persons of an enterprise who uses computers. The training is to know the CNF procedures to follow and to use. During a preliminary investigation, the investigative team will use these skills to determine whether an attack actually occurred, and if possible to identify the crime by determining how it was committed and who did it, and find the evidence left behind. In order to do this, the investigative team needs to understand the steps followed by the attacker so that they can be retraced. The team must also know where to find possible evidence. It is essential that forensics investigators be expert in computer and network administration so that they know the technical in's and out's of the target systems.
4. The fourth policy states to accelerate the investigation as quickly as possible through prohibiting personal file encryption as it may not be possible to ever recover the original contents, prohibiting disk scrubbing tools and file shredding software as they wipe out or destroy the information, utilizing data indexes for every packets in a log to minimize the search, utilizing information fusion techniques of IDS for a large volumes of data to store. Additionally, the more time the investigation takes the more the chance that potential evidence will be destroyed or compromised.
5. The fifth policy states to prevent anonymous activities and to protect personal privacy on the Internet. It is difficult to do the investigation if anonymity is allowed. To prevent the anonymity, the Onion routing research project is building an Internet based system that strongly resists traffic analysis, eavesdropping, and other attacks both by outsiders (e.g. Internet routers) and insiders (Onion Routers themselves). It requires date, time, user stamps in file to know what date a file was created, or modified, or deleted, and who did it. The user has to follow the strong authentication policy to access the system but the passwords are vulnerable so the encryption-based authentication is effective. Also to use strong access control mechanisms for limiting use of resources to authorized users.
6. The sixth policy state to protect the evidence from an attacker who tries to destroy the evidence of a crime or an employee tries to erase incriminating data from log files. A cornerstone of effective CNF is to have strong authentication and integrity services that control administrative access to network devices. It is preferable to use the encrypt evidence files and connections to guarantee the security and integrity of the data. Also to apply strong integrity checking technology to show the evidence has not been corrupted.

IV. SOFTWARE FORENSIC

Research in the field of software forensics has been carried out to identify the author of a computer program [11]. Various objective metrics, such as the proportion of blank lines, the proportion of comments, the average length of identifiers and statistics based on those metrics have been proposed to characterize the author of a program with some success. Kilgour et al. [12] proposed the use of other variable measures such as the presence or absence of a feature in an attempt to identify better the authorship of a program. Certain structural features can be used to classify e-mail message authorship. Email messages have macro-structural features, such as the presence or absence of greetings, farewells, signatures and attachments that can be analyzed along with the micro-features of the text contained within them although these are readily falsified. The last one is very new and very little work has been done in this area, though serious efforts are being made to evolve procedures and tools that would stand the test of legal scrutiny. Source code is the textual form of a computer program that is written by a computer programmer in a computer programming language. These programming languages can in some respects be treated as a form of

language from a linguistic perspective, or more precisely as a series of languages of particular types, but within some common family. In the same manner as written text can be analyzed for evidence of authorship, as in [13], computer programs can also be examined from a forensics or linguistics viewpoint [14] for information regarding the program's authorship. The goals of computer program authorship are also often similar to, or even identical to, those encountered in forensic linguistics and computational linguistics.

Once the classification is made that program source code is in fact a type of language that is suitable for authorship analysis, a number of applications and techniques emerge. Similarly, techniques used in forensics for handwriting and linguistic analysis can also, in some cases at least, are transferred in some respect to what is referred to here as *software forensics*. It is assumed that the term software forensics refers to the use of measurements from software source code, or object code, for some *legal* or *official* purpose [15]. This is similar to, but in some respects also distinct from, the use of the term in some literature where the focus tends to be very much on malicious code analysis. The legal or official nature of software forensics requires a high level of objectivity, as well as methods for calculating the degrees of evidence provided and combining that evidence with other sources.

A. Applications

There are four broad areas of application emerge in software forensics that are discussed.

Author identification: The goal here is to determine the likelihood of a particular author having written some piece(s) of code, usually based on other code samples from that programmer. This can also involve having samples of code for several programmers and determining the likelihood of a new piece of code having been written by each programmer. An example of this applied to source code would be ascribing authorship of a new piece of code, such as a computer virus, to an author where the code matches the profile of other pieces of code written by this author.

Authorship discrimination: This is the task of deciding whether some pieces of code were written by a single author or by (some number of) different authors. This can possibly also include an estimate of the number of distinct authors involved in writing a single piece or all pieces of code. It is obviously necessary to distinguish between identifying multiple authors for a series of programs and co-authorship on a single program. This task involves the calculation of similarity between the two or more pieces of code and possibly some estimate of between- and within-subject variability.

Author characterization: This is based on determining some characteristics of the programmer of a code fragment, such as personality and educational background, based on their programming style. An example of this would be determining that a piece of code was most likely to have been written by someone with a particular educational background due to the programming style and techniques used.

Author intent determination: It may be possible to determine, in some cases, whether code that has had an undesired effect was written with deliberate malice, or was the result of an accidental error. Since the software development process is never error free and some errors can have catastrophic consequences, such questions can arise reasonably frequently. This can also be extended to check for negligence, where erroneous code is perhaps suspected to be much less rigorous than a programmer's usual code. This is a much-neglected aspect of source code authorship analysis [15] with no other literature found that mentions its use.

B. Metrics for software forensics

Source code metrics: Expert opinion can, potentially, be given on the degrees of similarity and difference between code fragments. Psychological analysis of code can also be performed, even as a simple matter of opinion. However, a more scientific approach may also be taken (and should be taken) since both quantitative and qualitative measurements can be made on computer program source code and object code. These measurements can be either automatically extracted by analysis tools, calculated by an expert, or arrived at by using some combination of these two methods. Some metrics can obviously only be calculated by an expert, such as the degree to which the comments in code match the actual behaviour of that code.

Object code metrics: While not part of source code analysis itself, some environmental measurements can sometimes also be extracted from executable code such as the hardware platform and the compiler employed for its production. Executable code can also be decompiled; a process where a source program that could then be compiled into the executable is created by reversing the compiling process. Since many source programs can be written to create the same executable there is considerable information loss, but some of the source code metrics can still be applicable.

Metric models of authorship: Once these metrics have been extracted, a number of different modelling techniques, such as cluster analysis, logistic regression, and discriminant analysis, can be used to derive models. The form of the model, the technique used, and the metrics of use all depend greatly on the purpose of the analysis and on the information available. In most respects the particular technique used for the modelling process is less important than the variables selected and their coding.

CONCLUSIONS

The cause of the failure is due to the third party involvement in the system. This paper present various forensic methods that are available in the society by the researchers would be of immense benefit to the engineering profession. It advises all engineers, whether young or old, experienced or just commencing on their careers, to gain an understanding of why failures occur and how they can be forensically analysed.

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Management Studies – Quo Vadis?

Dr.M.S.Bhat
CVR College of Engineering, Dean of Evaluation, Ibrahimpatan, R.R.District, A.P., India
Email: mshrinivasbhat@gmail.com

***Abstract*—Business Management has been the youngest siblings of other areas in Social Sciences such as economics and commerce. It can at best, boast a history of just 100 years. Over these years, the growth, per se, of the subject and the interest of people in the growth of management science has been phenomenal. The Management Studies has spawned a number of functional areas, with each of these spheres of knowledge building a strong foundation and rich edifices for themselves. Management Studies, still, has a great appeal for scholars and practitioners alike, as the potential for exploration and building knowledge base with immense application possibilities to business, does not seem to have exhausted yet. However, it can be stated without any fear of contradiction that Management Sciences ceases to have very little virgin areas for exploration and the pursuit of pure- research, as was the situation two to three decades back. Though the application research still has lot of fascination for the industry, the potential for pure research seems to be tapering. While one may argue that Management Studies being a subject, where practice inevitably precedes theory, the trend is quite normal, it is pertinent to point out that the sustainability of application research is dependent on the infusion of new knowledge from pure research.**

Even in terms of pedagogy, management studies had a great start. Making a clean break from the conventional system of emphasis on didactic method of teaching or catechism, the management studies focused on the learner centric approach by relying on case studies, learning through games, project work, role plays etc. Over a period, this too seems to have become normative, rather than explorative, with every one swearing by these approaches with very little further innovation in the sphere of management education pedagogy.

The question that comes to ones mind in this context is whether the management education moved away from the growth stage of the life cycle to maturity stage with little potential for further growth? Or, are we going to witness another spurt of growth stage after a brief sojourn of maturity stage? The article is intended to raise some of the issues with a view to find hopefully some answers after careful reflection and churning of thoughts.

***Index Terms*—Management studies**

I. Evolution of Business Management Studies as a Discipline of Study

Business Management evolved as field of study owing to the challenges of industrialization and consequent materialization of increasing number of complex ventures.

These were quite distinct from the earlier simple set ups of enterprises which were mostly single proprietorships or single owner run establishments. While the industrialization was as a result of man's mastery in harnessing energy on a large scale to serve the purpose of prime mover in conversion of inputs to outputs, the need for business management arose owing to the resultant necessity for husbanding large amount of capital, manpower and channeling and deploying them appropriately to achieve the useful purpose of mass scale industrial production. Business Management as a field of study, therefore, is basically a logical corollary to the study of technology and its application to the welfare of mankind. Business and commerce has its origin in the social living pattern of man and therefore has a fairly longer history. Nevertheless they were very simple and quite uncomplicated compared to the present modern standards and therefore the study of business organizations did not engage the serious attention of scholars till recently.

Commerce gained a boost with the invention of money. As commerce is concerned with transaction and exchange of goods and services, the spread of commerce was immensely facilitated with the invention of money. All at once, the money served the purpose of medium of exchange, store of value, measure of value and therefore began to represent 'capital' unrivalled. Therefore, when someone spoke about capital among the four factors of production viz. land, labour capital and organization, it effectively meant money. Much of the modern commerce therefore revolves around money and other instruments that represent money.

In the initial stages of development of business organizations, the subject commerce took on the task of building the frame work of theory for business administration. When in the course of time, the subject became too vast; the business management studies branched out and became a full fledged subject on its sheer strength. It can be

A perceptive article based on the perceptions of the author on the topic

mainly traced to the fact that the technology started growing at such a rapid pace, so much so that the conventional understanding of organization as a simple entity for running the enterprise was found inadequate. The dynamics within the organization and the process of organizing itself became complex day by day and continues to be so even now. The study of business organizations still remains the centre piece of management studies though it is by no means exclusive. The contribution of technology to management studies is quite significant on two accounts. In the first place it is the technology which has resulted in modern society with all its complexity and material well being. And a student of business management looks at the society from the perspective business organizations which sustain the present society. Secondly, the technology has also been powerful enabler of organization management.

II. Management Studies- a multi disciplinary and integrative approach

Management Studies has been adopting an integrative approach by and large all these years. What it implies is that it has been a multidisciplinary study making extensive use of concepts from various disciplines. The basic disciplines that have contributed to the study of Management Studies include Operations Research, Statistics, Economics, Commerce, Sociology, Psychology, Anthropology, Information System etc. Apart from directly contributing to the solutions for areas of relevant management problems through their own well established framework, some of these disciplines have helped management studies grow through the process of development of theories based on analogy. When some one mentions that finance is akin to life blood of an organization, it is not just the importance of finance that is underlined. The analogy can be well extended. Just as the flow and pressure of the blood should be well regulated and remain normal for good health, the velocity of finance should be neither too high nor too low. Again the concept of 'feedback' for correction and improvement in functioning, so essential for control process in management, is an analogy from electrical control systems. Any student of management would realize that such examples abound and it is rather impossible to speak of concepts of management without borrowing liberally from other disciplines. And yet, management study retains its distinct identity in view of its objects of study being mainly focused on business organizations and business process.

It will be evident to any student of management studies that at the initial stage of its evolution, the subject offered virgin territory for great deal of exploration and the process of growth has been phenomenal by any account. The process of conceptualization and building theories of management offered great scope for fundamental research and the subject evolved rapidly into a discipline with robust set of formulations and frame work. As is the normal case, when the surge of growth is rapid, one will have lot of plain meat to chew on without any embellishments. These surges of growth have been coming to management studies in many phases. If the earlier phase was marked by scientific management approach largely due to Frederick W. Taylor, subsequent approaches were characterized by human approach, customer driven marketing approach, societal approach etc. When Information Technology invaded every sphere of modern living, management studies realized to its advantage, that there is a great of advantage in adapting Information Technology for Management. And thus was the avenue opened for a host subjects under the broad category of Management Information System. The surge in growth of management studies due to the impact of development in Information Technology has not yet reached the point of saturation and it would be quite some time before it extinguishes completely.

III. Surges of development and growth in Management Studies

In the course of the past eleven to twelve decades of its growth, the management studies have thus encountered great fillips in terms of serious study and research. The contributions from various disciplines thus have come in continuous booster dosages making the subject most sought after one from the point of view of both the students and practitioners. One of the distinguishing features of management studies has been its application to real life situations. The greatest laboratories for management studies have been organizations in the course of their normal working. These practices when benchmarked and distilled, often acquired the status of new principles for emulation and practice by others. Interestingly therefore, management studies was a distinct discipline and blazed a new trail, by *practice* often preceding the *precept* or *theory*. While the plain substance for theory came from good and exceptional practices of top class companies, the embellishments were provided by application researches. It has been thus a productive exertion for both the practitioner and academician and the need for constructive collaboration has been

evident through out, in the case of growth of management studies.

Some of the areas still having enormous appeal for management studies in terms of potential for research and providing newer insights into the subjects are: dynamics of international finance and novel instruments of transactions in this plane, merger and acquisition, its sheer scale and its impact on human resource practices, development in biotechnology, nanotechnology, genome, increasing life expectancy and its effect on human being, society, and consequently on organizations, changing patterns of growth among nations in the world and their effect on business organizations etc. While the management studies still holds a range of areas which is indeed breath-taking and unlikely to be exhausted in the short to medium term future, the ability to throw up huge scoop of knowledge in terms of general utility and application, in comparison to its yesteryears of growth, obviously has come down. This would indeed be as expected in any situation, as there is bound to be law of diminishing return operating in the normal course, unless overtaken by breakthrough or radical developments. Often, these breakthroughs are aided by external circumstances, mostly by way of technology changes, which have the potential to affect our every day existence and the manner in which we live.

IV. Management Studies and application research

Management studies harbours scope for enormous amount of application research as management studies is organization centric and each organization has its own distinctive elements. Organizations invest considerable amount specifically on areas such as marketing research, product development, promotion, advertisement research, test marketing etc. and regularly commission research agencies, to investigate problems having bearings on their organizations. There are other economic variables such as projected growth rate, inflation, balance of payment, interest rates, repo and reverse repo rates, exchange rates, capital market indexes, exchange rate variations, unemployment rates, growth in primary, secondary and tertiary sectors, industry specific variables, overall growth rates, market shares of companies, ad spends, fundamental and technical analysis of market prices of company shares, capital flow across the globe -- all of which require constant monitoring and research for the benefit of decision making at national, industry and corporate levels. If one takes into account the need for building and utilizing the market data bases, the amount of data gathered, analyzed and reported periodically is indeed mind boggling. While this set of activities may not strictly qualify for research from the stand point of view academic contribution, they are very essential for better decision making. Being systematic studies meant to unearth valuable information for the specific application of management decision making, they have certainly the research element ingrained in them.

The application research, thus will no doubt remain, the mainstay of development of management studies. By the very nature of this area, they are unique to each organization and many have them time limitations. They need to be repeatedly carried out for the very sustenance of business and economic activities. This will no doubt foster a research culture across the business organizations and industries enabling management studies to retain its sheen.

V. Scarcity of fundamental or pure research

In any branches of discipline, it is well known fact that the fundamental or pure research is the foundation on which the whole study or the edifice of knowledge is built. The fundamental research therefore is the very fountain of application research. The fundamental research leads to sound exploration of knowledge, often resulting in robust theoretical concepts, or explanation of observed facts, and building a solid framework for future analysis and inferences. While the utility of the fundamental research are never seen to be of immediate consequences, the absence of fundamental research over a long period would imply drain of knowledge resources and ever decreasing base to build on. It is therefore essential that the fundamental or pure research be nurtured and encouraged for its own sake without any reference to immediate utility for the organizations. Often these are sustained only through government institutions or universities and in some cases, by larger private organizations, as small and medium enterprises have no direct stake or interest in this sphere. From the academic perspective, the need for substantial research work of fundamental nature has its appeal, when there is far reaching developments in the business dynamics and organizational atmosphere in general. They seem to arise sporadically, as in the case of waves of Information Technology revolution, or communication revolution, or such other phenomenon. Without some of the extenuating interventions befalling the horizon in the near future, it would appear that the fundamental research in management studies has

reached a plateau. It is at these situations, when, one is inclined to conclude that in the life cycle of a discipline, or branch of study, one has crossed the steep hump of growth and probably reached a more stable state of maturity. This could be again relatively shorter, if a next wave of far reaching environmental interventions, mostly by way of technological changes impact business organizations.

Fundamental or pure research is sine quo non for growth of any subject in the long run. The basic structure to grow on is provided by building blocks of successive doses of theories and models, covering new facet of the subject. Scarcity at this front can impact the growth of the subject to a marked extent. While it may not be appropriate to conclude that the research output in terms of publications in management studies tend to be extensively application oriented, it cannot be denied that conceptual oriented works such as core competency, knowledge management, balanced score card, six sigma practices etc. which have been forthcoming at a regular rate event at not so distant past, are becoming scarcer, making one wonder what would be the next important turn in odyssey of management studies.

VI. Management Studies and pedagogy

The teaching – learning process in management studies shows considerable departure from other disciplines. The classical approach to teaching has relied heavily on dyadic process. The pedagogy varied around the subjects in view of its intrinsic quality of learning. The physical or the natural sciences stressed on the importance of laboratory work involving the well tested sequence of experiment, observation and inference, and social sciences turned to case studies and survey based researches. The study of literature emphasized on seminar, workshops and colloquiums. For the study of engineering and technology, the project work is an essential trait. The management studies embraced all of these pedagogical tools to the maximum advantages. Add to that the effectiveness of management games; the range of tools is indeed vast. This is mainly due to the fact that management studies has been a great amalgamation of subjects from various disciplines, and, because of that, has assimilated pedagogical approaches of various disciplines and even synthesized a mix appropriate for itself. This mix when used properly can make the teaching learning process very rewarding. The adoption of these methods of teaching was relevant and meaningful as some of them originated from the approaches of executive development programmes (EDPs) extensively practiced in business corporations. Business Schools regarded that management graduates being potential future managers, need to be exposed to the same methodology as of executive development programmes. This would no doubt be the right approach, if all the students of management schools were to be people who work or who have worked in an organization and have some experience. Though in the initial stages of development of management studies, the subject attracted predominantly working people, subsequently, it was looked upon as a good career option and increasing number of students without any work experience flocked to business schools. Nevertheless, the elements of pedagogy adopted from management development programmes retained their appeal and continues to be popular now. However, with the increasing usage of these pedagogic approaches into almost all spheres of disciplines, the uniqueness of this mix seems to have lost it's over riding appeal. This would beg an important question, "like the subject management studies finding its level, does the management studies pedagogy too found a plateau, at least for the time being?"

CONCLUSIONS

It would not be easy to find a definite answer for these questions. Even if one succeeds in finding, it would be too simplistic. There have been instances when a subject which was dormant with its growth for a long time started surfacing with renewed interest and found great resurgences. Whenever this occurs, we encounter a spurt of second or third phase of growth along the maturity stage of lifecycle of the subject. For the management studies and its pedagogy, we have witnessed spectacular growth stage with the subject bearing rich fruits both for the management student and practitioners. Even if one were to agree that the steepness of growth curve has moderated or in the worst case, has flattened, signifying maturity phase, it can be safely inferred that, soon one can await the 'second coming' or resurgence of second phase of growth with all its glory.

ACKNOWLEDGE

Que sera sera: All the above discussions do not in any way diminish the importance people attach to the subject of management studies. Notwithstanding the fact that the fast and steep trajectory of growth witnessed in management studies has slowed down a bit, the subject of management studies remains fascinating and is eagerly sought after by great number of students at

post graduate level. Obviously it is due to the fact that the free market economy considered as the basis for economic growth of the nation is propelled by Business Corporations. There is very little likelihood of the form of business and its importance changing drastically. While no one can be sure of the future destiny of management education, the necessity and its importance and its growing popularity is one thing on which there is unanimity of views. And it is in this context that one is tempted to remark that, while it cannot be answered emphatically to the question quo vadis management education, what can be said approvingly is 'que sera sera' (whatever has to happen to management education is bound to happen). And for sure, it is for good.

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Marketing Mix and Retail Practices Aimed for Demographics of Customers of Selected Retail Stores

Dr.B. Archana
CVR College of Engineering, Department of Management Studies, Ibrahimpatan, R.R.District, A.P., India.
Email: archana_boda@yahoo.co.in

***Abstract*—India is a land of increasing retail opportunities. Retailing has bright prospects, propelled by the changes taking place among the demographics of customers. In this relevance, the retailers marketing strategy takes into consideration, factors like pricing, location, brands and retail practices. The present study attempts to identify the marketing mix and to score the retail practices of selected retail stores offered to the identified set of demographics of customers.**

***Index Terms*—Retail stores, Retail practices, Demographics, Marketing Mix.**

I. INTRODUCTION

Retailing is one of the largest industries in India and one of the biggest sources of employment in the country. Although the retailing industry has existed in our country for centuries, it is only in the recent past that it has witnessed such a tremendous growth. Retailing is derived from the French word 'retailier', which means, "to cut a piece off". Thus, retailing can be defined as a set of business activities that adds value to the products and services sold to the final consumers for their personal, family or household use.

The existence of the customer is integral to the existence of the retail store. The ability to understand customers is the key to developing a successful retail strategy. To be able to satisfy the customers, it is necessary to understand them in terms of their demographics, which include gender, age, race, socio-economic status and other statistics. As competition increases and the customer becomes more and more knowledgeable and demanding, the retailer needs this knowledge to stay ahead of his competitors and to build a competitive advantage. In this perspective, a retail store takes into consideration, factors like marketing mix which includes pricing, branding & location of stores and also the various retail practices that it offers to its demographics of the customers. In this backdrop, the present paper attempts to study the following objectives:

II. OBJECTIVES OF THE STUDY

1. To identify the demographics of the customers of selected retail stores.
2. To study the marketing mix offered to the identified demographics.
3. To score the retail stores for their retail practices offered to the identified demographics.

III. THE SOURCES OF DATA

For the purpose of the study a structured questionnaire was designed and the data was collected from Retailers of various selected retail stores located in the twin cities of Hyderabad and Secunderabad of Andhra Pradesh.

IV. DATA ANALYSIS

The 100 retailers selected as the sample for the purpose of the study were categorized into twelve store types for analysis as Department Stores, Hyper Markets, Footwear Outlets, Super Markets, Optical Showrooms, Electronic Stores, Food Retailers, Furniture Stores, Gifts and Novelties, Jewellery Stores, Garments Stores and Other Retail stores.

Objective 1: To identify the demographics of the customers of selected retail stores.

1.1. Gender

Table 1.1.in Appendix depicts that majority of the selected retail stores were retailing both for male and female customers.

1.2 Age

Table 1.2 in Appendix depicts that all the selected retailers considered for the study were retailing for all the age groups of customers.

1.3 Socio-Economic Status

Table 1.3 in Appendix depicts that the selected retailers for the purpose of the study had majority of the customers who belonged to the Middle class of Socio-Economic levels. The second majority of the customers belonged to Upper Middle class.

Objective 2: To study the marketing mix offered to the identified demographics

2.1 Brands Sold

As the Table 2.1 in Appendix depicts, the selected retailers of the study were on a majority selling national brands for their customers.

The article is based on the Ph. D Thesis of the author.

2.2 Pricing Strategies

The retailers of various selected store types had given their responses with regard to their Pricing Strategies, as shown in the Table 2.2 in Appendix. Majority of them followed MRP pricing strategy, whereas, Odd pricing strategy and EDLP pricing strategy were practiced only by 1 percent of them.

2.3. Location Criteria

The retailers of selected store types were asked to give preferences for considering the criteria for locating their retail stores. The Table 2.3 in Appendix it is clear that 100 percent of these retailers on the first basis opined in favor of criteria like Visitors group attraction, Security, Well connected transport, Planned Shopping area, Occupancy costs, Landlord control and Tax incentives. 50 percent of the retailers gave their next preference on location criteria for Competition factors. And the other criteria listed in the table were given the subsequent preferences, by the various retailers.

Objective 3: To score the retail stores for their retail practices offered to the identified demographics

3.1. Measuring Retail Practices (Weights)

The 100 retailers considered for the study were asked to state their retail practices, by ranking the various elements as: Usually, Sometimes and Rarely. These 100 retailers were grouped into twelve types based on their store type. Each of these selected store types were given scores for their customer practices followed, by assigning weights for their responses, as '5' for 'usually', '3' for 'sometimes' and '1' for 'rarely'. The same is shown Table 3.1 in Appendix.

3.2. Scoring the Retail Practices

From the above retail practices measured for the selected retail stores, the following are the scores assigned as shown in the Table 3.2 in Appendix. As the Mean value of the Department Stores is high among the 12 selected retail stores considered for the study, it could be concluded that the Department stores had ranked maximum score for their various retail practices offered to the customers belonging to the set of demographics.

CONCLUSIONS

Retailing is a dynamic industry which is constantly changing due to shifts in the needs of the customers and the growth of competitors. The expectations of the customers take the shape of the products, location, offerings and other elements that help the customer choose a retail store and decide on patronizing it. One of the biggest challenges for the retailers today, is to carefully plan clearly and to build a long-term relationship with the customers. Retailers also need to identify the demographics of the customers to target them and understand them. Thus, retailing is a blend of marketing mix and retail practices offered to benefit any set of demographic customers.

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APPENDIX:

Table 1.1: Gender

	Selected Retail Stores												
Gender	Department stores	Hyper Markets	Footwear stores	Supermarkets	Optical stores	Electronic Stores	Food retailers	Furniture stores	Gifts & Novelties	Jewellery stores	Garment stores	Other retail stores	Total Retail stores
Male	0	0	0	0	0	0	0	0	0	0	9	0	9
Female	0	0	0	0	0	0	0	0	0	0	5	2	7
Male & Female	2	6	4	9	2	4	14	4	5	7	13	14	84
Total Retail stores	2	6	4	9	2	4	14	4	5	7	27	16	100

Source: Questionnaire to the retailers

Table 1.2: Age

Age	Selected Retail Stores												
	Department stores	Hyper Markets	Footwear stores	Supermarkets	Optical stores	Electronic Stores	Food retailers	Furniture stores	Gifts & Novelties	Jewellery stores	Garment stores	Other retail stores	Total Retail stores
All age groups	2	6	4	9	2	4	14	4	5	7	27	16	100
Total Retail stores	2	6	4	9	2	4	14	4	5	7	27	16	100

Source: Questionnaire to the retailers

Table 1.3: Socio-Economic Status

Socio-Economic Levels	Selected Retail Stores												
	Department stores	Hyper Markets	Footwear stores	Supermarkets	Optical stores	Electronic Stores	Food retailers	Furniture stores	Gifts & Novelties	Jewellery stores	Garment stores	Other retail stores	Total Retail stores
Very rich	0	0	2	0	0	0	1	0	0	1	3	0	7
Rich	2	2	1	8	0	3	2	0	0	0	3	5	26
Upper Middle	0	3	0	0	0	1	5	2	2	1	10	6	30
Middle	0	1	1	1	2	0	6	2	3	5	11	5	37
Total Retail stores	2	6	4	9	2	4	14	4	5	7	27	16	100

Source: Questionnaire to the retailers

Table 2.1: Brands sold

Brands	Selected Retail Stores												
	Department stores	Hyper Markets	Footwear stores	Supermarkets	Optical stores	Electronic Stores	Food retailers	Furniture stores	Gifts & Novelties	Jewellery stores	Garment stores	Other retail stores	Total Retail stores
National	0	4	2	3	2	3	14	4	5	7	23	14	81
International	2	0	2	0	0	1	0	0	0	0	4	2	11
Store	0	2	0	6	0	0	0	0	0	0	0	0	8
Total Retail stores	2	6	4	9	2	4	14	4	5	7	27	16	100

Source: Questionnaire to the retailers

Table2.2: Pricing strategies

Pricing strategies	Selected Retail Stores												
	Department stores	Hyper Markets	Footwear stores	Supermarkets	Optical stores	Electronic Stores	Food retailers	Furniture stores	Gifts & Novelties	Jewellery stores	Garment stores	Other retail stores	Total Retail stores
High	2	3	0	1	0	0	0	0	0	0	2	2	10
Low	0	1	0	3	2	4	4	3	3	1	8	8	37
Odd	0	0	1	0	0	0	0	0	0	0	0	0	1
MRP	0	2	3	4	0	0	10	1	2	6	17	6	51
EDLP	0	0	0	1	0	0	0	0	0	0	0	0	1
Total Retail stores	2	6	4	9	2	4	14	4	5	7	27	16	100

Source: Questionnaire to the retailers

Table 2.3: Location criteria

Location criteria	Selected Retail Stores												
	Department stores	Hyper Markets	Footwear stores	Supermarkets	Optical stores	Electronic Stores	Food retailers	Furniture stores	Gifts & Novelties	Jewellery stores	Garment stores	Other retail stores	Total Retail stores
Visitor group attraction	2	6	4	9	2	4	14	4	5	7	27	16	
Large local customers	0	2	2	7	1	0	0	0	0	0	0	0	
Security	2	6	4	9	2	4	14	4	5	7	27	16	
Source of entertainment	2	2	1	1	0	1	5	0	0	2	5	4	
Well connected transport	2	6	4	9	2	4	14	4	5	7	27	16	
Planned shopping area	2	6	4	9	2	4	14	4	5	7	27	16	
Parking space	2	3	1	2	0	4	1	0	0	0	4	2	
Occupancy costs	2	6	4	9	2	4	14	4	5	7	27	16	
Landlord control	2	6	4	9	2	4	14	4	5	7	27	16	
Competition factors	2	6	3	8	1	2	2	2	1	5	10	8	
Tax incentives	2	6	4	9	2	4	14	4	5	7	27	16	
Protection from weather	0	0	0	2	0	0	1	0	0	0	0	0	
Total Retail stores	2	6	4	9	2	4	14	4	5	7	27	16	100

Source: Questionnaire to the retailers

Table 3.1: Retail Practices

Retail Practices		Selected Retail Stores												
		Department stores	Hyper Markets	Footwear	Supermarkets	Optical stores	Electronic Stores	Food retailers	Furniture stores	Gifts & Novelties	Jewellery stores	Garment stores	Other retail stores	Total Retail stores
Customer service	Usually	2	6	4	9	2	4	14	4	5	7	27	16	100
Customer incentives	Usually	0	0	0	7	1	0	2	0	0	0	2	0	12
	Sometimes	2	3	2	2	1	3	8	3	3	6	17	12	62
	Rarely	0	3	2	0	0	1	4	1	2	1	8	4	26
Information from customers	Usually	2	4	4	4	2	2	12	2	2	5	21	14	74
	Sometimes	0	2	0	5	0	2	2	2	3	2	6	2	26
Receive complaints	Usually	2	5	0	8	2	2	12	4	5	7	24	14	85
	Sometimes	0	1	3	1	0	2	2	1	0	0	3	2	15
Attending to customer complaints	Usually	2	6	4	9	2	3	12	4	5	7	27	14	95
	Sometimes	0	0	0	0	0	1	2	0	0	0	0	2	5
Interaction with customer	Usually	2	1	0	0	0	0	2	0	0	0	0	1	6
	Sometimes	0	5	4	8	1	4	11	4	5	7	26	15	90
	Rarely	0	0	0	1	1	0	1	0	0	0	1	0	4
Invite feed back on performanc e	Usually	2	1	1	0	0	0	1	0	0	0	0	0	5
	Sometimes	0	1	1	4	0	2	4	2	2	5	13	6	40
	Rarely	0	4	2	5	2	2	9	2	3	2	14	10	55
Understand customer needs	Usually	2	5	4	5	2	4	12	3	5	4	25	14	85
	Sometimes	0	1	0	3	0	0	2	1	0	3	2	1	13
	Rarely	0	0	0	1	0	0	0	0	0	0	0	1	2
Resolve customer complaints	Usually	2	6	4	8	2	3	14	0	5	7	25	16	92
	Sometimes	0	0	0	1	0	1	0	4	0	0	2	0	8
Customer contribute innovative ideas	Usually	2	1	1	0	0	0	1	0	4	0	2	1	12
	sometimes	0	4	3	9	2	4	11	0	1	6	24	15	79
	Rarely	0	1	0	0	0	0	2	4	0	1	1	0	9
Encourage customers to use help lines	Usually	2	1	2	5	2	1	4	0	0	0	6	4	27
	Sometimes	0	5	2	4	0	3	8	3	4	2	17	10	58
	Rarely	0	0	0	0	0	0	2	1	1	5	4	2	15
Points to customers	Usually	2	0	0	1	0	0	0	0	0	1	1	1	6
	Sometimes	0	1	0	4	0	0	1	0	0	1	3	1	11
	Rarely	0	5	4	4	2	4	13	4	5	5	23	14	83
Total Retail stores		2	6	4	9	2	4	14	4	5	7	27	16	100

Source: Questionnaire to the retailers

Table 3.2: Score for the retail practices

Selected Retail Stores	Mean	N	Std. Deviation	Std. Error of Mean	Median
Department stores	61.00	2	.000	.000	61.00
Hyper Markets	48.67	6	3.445	1.406	47.00
Footwear stores	51.00	4	3.651	1.826	51.00
Supermarkets	49.44	9	2.603	.868	51.00
Optical stores	49.00	2	2.828	2.000	49.00
Electronic Stores	47.00	4	2.828	1.414	46.00
Food retailers	48.86	14	3.880	1.037	49.00
Furniture stores	47.50	4	3.416	1.708	48.00
Gifts & Novelties	47.80	5	2.683	1.200	49.00
Jewellery stores	49.29	7	2.138	.808	49.00
Garment stores	49.00	27	3.843	.740	49.00
Other retail stores	49.00	16	3.795	.949	49.00
Total	49.14	100	3.774	.377	49.00

Source: Questionnaire to the retailers