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Smart Mirror Design using Raspberry Pi

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Abstract: **Information is needed to integrate smart mirror technology and into one's daily schedule. As the mirror is in place, the user will get interaction and information during their routines like weather data, day highlights, daily schedule, motivational quotes. Data can be viewed in the mirror during routines, which saves the user time. This paper provides a working prototype, i.e. design and development of a smart mirror using Raspberry Pi 3 for the home environment and for commercial use in various industries. Since the microcontroller unit is 'ON' all day, it heats up, which is fixed using a cooling fan. To display information in the mirror, the setup is provided with a network connection, which displays the latest information. Look at the acrylic sheet through the mirror for the entire setup display is placed on the back. If the mirror is useful for this purpose, imagine that it would be very useful. The device looks like a normal mirror but with a screen inside. It collects real-world machine data such as location-based latest news and headlines, weather reports and local time display. Smart mirror makes life easier by saving time.**

Index Terms: **Raspberry Pi 3, Acrylic sheet, Smart mirror.**

I. Introduction

Over the past few years, technology has become an important and indispensable part of our daily routine. As technology is rapidly evolving, people expect to become more productive and e-centric in their daily activities. The use of smart phones, tablets, laptops and other similar devices has provided tools that help people stay productive and most importantly time efficient.[1] The design is to introduce a multipurpose mirror that is intended to fill in as both enrichment and data source. With a single glance at the mirror, there will be basic information on what to wear based on the weather forecast for the day or how much time they have left if they want to arrive on time for their intended destination.

Interactive computing, with embedded devices connected to wireless, is used in a variety of everyday activities, changing and improving living standards. Based on these interactive computing and communication technologies, now many devices have emerged. Multimedia intelligence can provide convenient, secure and personal services everywhere. This makes convenient for many users whether for domestic or for industries. It is used as Design and development of interactive multimedia futuristic smart mirror with artificial intelligence for ambient home environment, as well as commercial uses in various industries.

Smart mirror provides an effortless experience that allows the user to walk and is usually greeted with information that they need another device. The use of smart mirror is to increase their productivity by saving user time.

II. Literature Survey

There are significantly more products than actual products. Some may blame it on the fact that the smart home is still a growing market and is limited by manufacturing costs without making products available from everyday consumers. The fact that there are more products shows interest in developing a more affordable and functional smart mirror.[2] however, even if the actual products developed by a company are distributed on features, they are still in the development stage or are already considered a viable competitor at a much higher price. Few of them are—

i) Interactive Mirror

Touch the built-in touchscreen mirror to keep the user interactive.[3] Unlike our smart mirror, only one point of touch is detected because it mimics a mouse.

ii) Magic Mirror

Magic mirror utilizes TV with mirror. By using Microsoft Kinect, it can track movement of the person who interact, and voice is also recognized.[4]

iii) The Android-powered Mirror

In this, the LCD screen secured with hazy intelligent glass is utilized to make the mirror. The mirror contains applications, for examples, climate, news, weight, temperature and water stream [5]. Water stream is an intriguing expansion and is brilliant at helping water preservation.

iv) Memomi

Memory mirror is abbreviated as Memomi. It is another innovative mirror on the rundown. At present accessible is magic mirror, otherwise it is called as Memomi [6]. It is being utilized as a substitution for changing areas in shops that sell garments. Clients can collaborate with the mirror through the versatile application.

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TABLE I.
SUMMARY OF EXISTING METHODS

S.No.	Author's Name	Year of publication	Title of the paper	Limitations
1	Tataina Lashina	2004	Intelligent bathroom. In European Symposium on Ambient Intelligence (EUSAI'04), Eindhoven, Netherlands,	Accepts limited amount of data. Neither camera nor the other sensors suggest the features of a smart object.
2	L.Ceccaroni and X. Verdaguer	2004	Magical mirror: multimedia, interactive services in home automation	Web services are not used and lack of human interaction.
3	Seraku	2012	Seraku's smart wash Basin	Cost is more because additional sensors are required to track the hands position and motion.
4	Franco Chiarugi	2016	Wize Mirror - a smart, multisensory cardio-metabolic risk monitoring system	This mirror doesn't use any client acknowledgment; however the interface can be redone through a PDA application that is likewise used to control some other home components.

The summary of existing methods is shown in above table I. In contrast with the works depicted over, proposed work is diverse in that we intend to build up a working framework for offering types of assistance in the home climate dependent on web server principles and off-the-rack innovation, where the savvy reflect is the interface to get to or control different information takes care of, different data administrations.

TABLE II.
COMPARISON OF PROPOSED MIRROR WITH EXISTING MIRRORS

Feature	Interactive mirror	Magic mirror	Android-powered mirror	Memomi	Proposed mirror
OS	Windows 10	Linux OS	Android	Customized	Raspbian OS
App Requirement	No	No	No	Yes	Yes
Touchscreen	No	No	Yes	Yes	No
Weather update	Yes	No	Yes	Yes	Yes
Automatic sleep	No	Yes	No	No	Yes
Social networking	Yes	No	Yes	Yes	Yes

III. PROPOSED METHOD

The proposed technique means to give users an intuitive interface for streamlined and customized services in the solace of the home of the user. It is smart and easy to use arrangement as a mirror that likewise goes about as a gateway to intelligent services. For example, multimedia and news sources are among others.

PC Specifications:

A computer is used in smart mirror, which takes the input data from the various peripherals. It is made up of a mini ITX Intel motherboard. This motherboard has the features like- USB ports, HDMI port and audio ports, etc. Intel i3 processor with graphics card included. The following table II gives the hardware specifications for this computer.

The motherboard with 4GB of DDR3 RAM as well as 64GB strong state drive. Finally, a 380-watt power supply used the PC. A scale down iTX PC case housed all the parts referenced and gave fitting air cooling to the hardware. Each of these parts contains the planned temperature guideline framework to give the greatest security against temperature and stickiness harm to the hardware.

TABLE III.
SPECIFICATIONS OF A PC

Motherboard	mini ITX Intel
RAM	4GB
CPU	Intel i3
Solid State Drive	64GB
Power Supply	380 watts

System Requirements:

To control the mirror, the microcontroller is used, and the segments utilized should be powered by a 5V power gracefully.

The framework utilized in the mirror

- Should have the option to interface with a Wi-Fi interface just as a PC show.
- Should have the option to take user contribution to program the user's location and switch what information is being shown on the auxiliary screen [7].
- Hardware components should fit inside the mirror size [8].

The total system will likewise be mounted on a wall, so there should be an edge assembled that can uphold this weight. Also, the system utilized in the mirror should have the option to interface with a Wi-Fi interface just as numerous LCD shows. The Wi-Fi should have the option to work inside a home, so it should be sufficiently touchy to get the signal from a home Wi-Fi switch. [9]

A. Design

Hardware part mainly consists of:

- Raspberry Pi
- Power Supply
- Monitor
- Wi-Fi
- Cooling Fan

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Raspberry Pi is also known as, RPi. It is a progression of little single-board PCs created in the UK by the Raspberry foundation to advance educating of essential software engineering in schools and in some nations.

Raspberry Pi3 board uses +5V USB power supply. The general purpose I/O(GPIO) pins of RPi board can just securely draw 16mA. The HDMI port uses 50mA, the camera module requires 250mA. The keyboard's and mouse's current range is 100mA to 1000mA.

The monitor is used to display the data, which is connected to Raspberry Pi board. Wi-Fi is commonly a locally situated switch. It fetches up to date information such as weather forecasting, news, etc.

Cooling Fans are utilized to draw cold air from an external perspective, remove warm air from within, and move air through heat sink to cool the element. These fans normally come in standard sizes and available in 3-pin and 4-pin connectors. These are used to cool in PCs and the microcontroller., which runs continuously.

The CPU of Raspberry Pi is indicated to run between 40° C to 85°C. if that CPU temperature surpasses 82°C, at that point the CPU's clock speed will be eased back until the temperature dips under 82°C.

The Block diagram for designing hardware is as shown in the figure1.

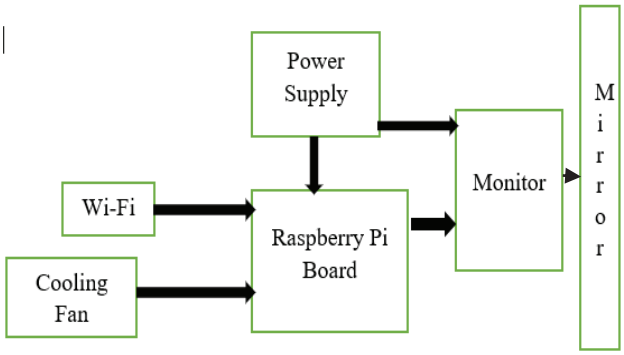

Figure 1. Hardware setup for Smart Mirror

Figure 2 shows the prototype of smart mirror. Setting up LCD and connecting it to the Raspberry pi 3. Connecting Installation of Frame around LCD and placing Acrylic Sheet in front of LCD. [10]

Next step in the design of smart mirror is software setup. It includes Booting up the Raspberry pi-3 and Configuring the modules for all features. E.g.: Calendar, Weather, NEWS etc. [11] Booting is a start-up sequence that starts the operating system of a computer when it is turned on. A boot sequence is the initial set of operations that the computer performs when it is switched on. Every computer has a boot sequence.

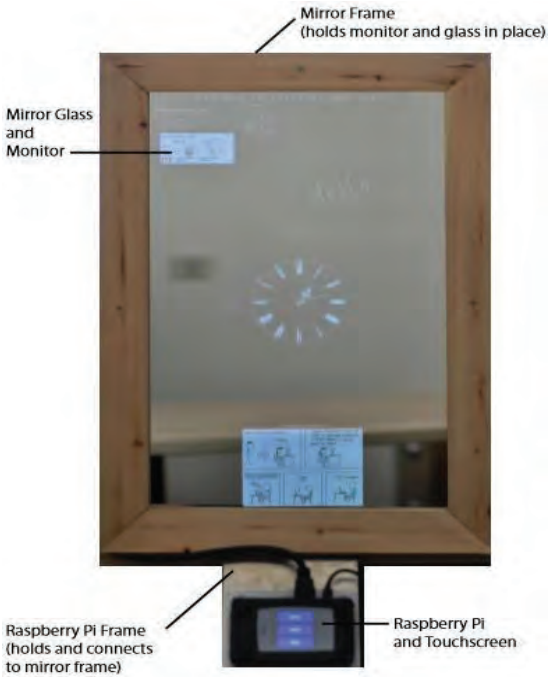

Figure 2. Smart Mirror prototype

The properties that can be configured are:

TABLE IV.
CONFIGURATION PROPERTIES

Choice	Definition
Port	The smart mirror server running port and its default value is 8000.
Address	Interface IP address that accepts connections. The default address is local host, which prevents the built-in webserver from being exposed to machines on the local network. To expose to other machines, use 0.0.0.0.
IPWhiteLis t	It gives the list of IPs that allowed to access the proposed smart mirror. The default address is "127.0.0.1, "::ffff:127.0.0.1", "::1", which is only from the local host. Also configure IP ranges with subnet masks "127.0.0.1", "127.0.0.1/24" (or) "127.0.0.1","192.168.2.1", "127.0.0.1/24", "192.168.0.100".
Zoom	It allows the user to scale mirror contents with a given zoom factor. The default value is 1.
Language	It gives the language of interface.
TimeZone	A form of time notation is used. The possible values are 12 hours or 24 hours format. Default value is 24 hours.
unit	Unit used in default weather modules. The possible values are imperial or metric. Default is metric.
module	It gives the array of active modules. These modules must have objects in range.
customCSS	It gives the path. The default is css/custom.css
elctronOpti ons	This function is used to configure the browser screen size and position i.e. fullscreen, width, height, etc.

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The following modules are open source modules. They installed by default.

- Clock
- Calendar
- Present Weather
- Weather Forecast
- Email
- News Feed
- Compliments

Clock:

It is open source module. It gives information about current date and time. The information will be updated real time.

There are some properties to be configured like time Format, display Seconds, clock Bold, show Period, show Date, show Week, date Format, display Type, time zone, seconds Color, etc.

Calendar:

The "calendar" module displays events from a public and is also open source. It is also capable of combine multiple calendars.

The properties configured are:
Calendars, date Format, date End Format, show End, time Format, full Day Event Date Format, urgency, etc.

Present Weather:

This module shows the current climate, including the windspeed, the dusk or dawn time, the temperature and a symbol to show the current conditions**.** This one is also an open source.

The configuration options are- url, symbol, color, repeating Count Title, maximum Entries, maximum Number of Days Auth, symbol Class, title Class, time class, etc.

Weather Forecast:

This weather module shows the climate forecast for coming week, including a symbol to show the current conditions, the base temperature and the greatest temperature.

The configuration options are-location, locationID, units, roundTemp, degreeLabel updateInterval,animationSpeed, timeFormat, showPeriod, showPeriodUpper, showWindDirection, showWindDirectionAsArrow, showHumidity, showIndoorTemperature, onlyTemp, lang, etc. Figure 3 shows the weather forecast of last 5 days.

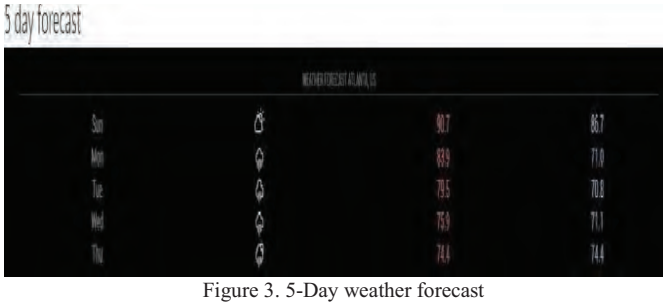

Figure 3. 5-Day weather forecast

EMAIL:

This module displays emails on smart mirror and listens for new incoming emails. When a new email is received, the mirror is updated to display it.

The configuration options are user, password, host, post, tls, authTimeout, numberOfEmails, maxCharacters, fade, etc.

Newsfeed:

This is one of the open source modules and it shows news features dependent on the RSS channel. Looking through news features happens time sensitive however can likewise be constrained by sending news source explicit warnings to the modules. Collaborating with the module, warning systems permits to send notices to the newsfeed module.

The configuration options are- showSourceTitle, showPublishDate, showDescription, wrapTitle, maxNewsItem, startTags, endTags, scrollLength, logFeedWarnings, etc.

Compliments:

This module shows a random compliment on the mirror. The configuration options are- up date Interval, fade Speed, compliments, remote File, classes, morning Start Time, morning End Time, afternoon Start Time, afternoon End Time, etc.

B. Performance measures

By using following functions, the performance of proposed smart mirror is computed.

- **ShowToast (msg, dur)-** gives a message on the bottom part of the screen during the indicated duration.
- **ShowAlert (title, msg,IDalert)-** gives the alert message that the user can select using gesture input with alert ID.
- **SetTitle (title)-** sets the status bar message.

An API was used which is made by Google, has 50 query a day limit but it is the best one available. To use the API the user, need to make an HTTP POST request with 20000-bit rate.

C. Results

This section provides the results of smart mirror. Figure 4 shows current date, current weather status information, and all calendar events. Figure 5 is smart mirror output which gives clock, calendar, email notifications, weather forecasting, compliments, etc.

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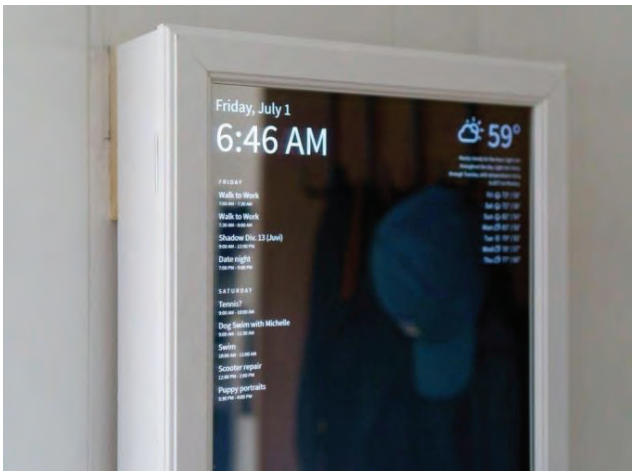

Figure 4. Calendar events

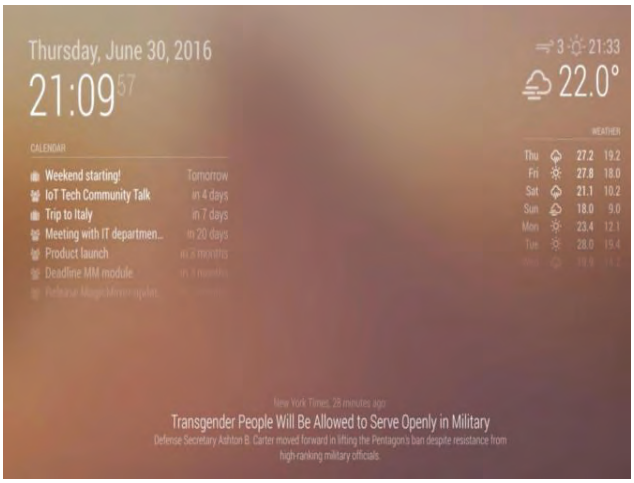

Figure 5. Smart Mirror output shows Time, Date, Weather, Notifications etc.

IV. Conclusions

A smart mirror is planned which gives normal communication among clients and the surrounding home administrations. The mirror display is given by an LED monitor which shows all the essential data which are helpful for the client. This mirror also gives a picture-in-picture sub-display to encourage the presentation of services, for example, maps, recordings through youtube. By and large, the model gives an effectively extendable structure that can be used to give significantly greater usefulness to the user. This work will be extended in future (by examining how the surrounding context of the user) and so as to offer ideal assistance encounters in the home climate.

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