E-ISSN 2581 – 7957
P-ISSN 2277 – 3916
CVR Journal of Science and Technology, Volume 24, June 2023
DOI: 10.32377/cvrjst2405

Family Health Monitoring System using Python for Biomedical Applications

Anjali Chindham[1], Sabavath Virisha[2], Rakesh Donthagani[3], Racha Ganesh[4] and K. Lal Kishore[5]
[1] UG Student, CVR College of Engineering/ECE Department, Hyderabad, India.
Email: anjalichindam153@gmail.com[1]
[2] UG Student, CVR College of Engineering/ECE Department, Hyderabad, India.
Email: sabavathvirisha@gmail.com[2]
[3] UG Student, CVR College of Engineering/ECE Department, Hyderabad, India.
Email: rakesh45roshan@gmail.com[3]
[4]Assoc. Professor, CVR College of Engineering/ECE Department, Hyderabad, India.
Email: rachaganesh@gmail.com[4]
[5]Professor, CVR College of Engineering/ECE Department, Hyderabad, India.
Email: lalkishore@cvr.ac.in[5]

Abstract: **In the present world nothing is more important than one's health. Good health is necessary for human satisfaction and well-being, and it contributes significantly to prosperity, wealth, and even economic growth. Hence, there is a huge necessity for healthy populations in the present real-time world for a better society and a longer human life cycle. Now a days people are becoming vulnerable due to climate changes, industrialization, and lack of physical activities. Everyone needs to monitor their health conditions regularly and take precautionary measures before it is too late. This precautionary measurement results in lower morbidity and longer life span of human beings. There are four basic and important parameters for every individual, that are checked to evaluate certain aspects of human health i.e., Body temperature, Pulse rate, Respiratory Rate, and Blood Pressure. All these human health parameters are collected from the various sensors and these sensors' information is given to a health monitoring system that is designed using Python. These health parameters are analyzed for different age groups of human beings for their health monitoring conditions for a better life. The age groups are considered as infant, adolescent. Middle age, and old age based on the age group. This designed system also gives the health condition parameters range and health status in terms of abnormality. Using these output values, proper suggestions, precautions, physical activities, and medications will be suggested in the form of health reports. With all these output parameters the health conditions of present human beings will be properly monitored for better survival.**

Index Terms: **Health System, Body Temperature, Blood Pressure Pulse Rate, Respiratory Rate, Python.**

I. INTRODUCTION

The current state of the healthcare system is disintegrated due to poor patient-doctor communication. Therefore, information technology using software languages becomes necessary to solve this issue. IoT-enabled medical equipment can significantly improve healthcare services. There is a big possibility of saving lives by implementing IoT concepts in healthcare [1]. In this study, a customized sensor is utilized to track the patient's breathing rate, bodily movement, body temperature, and heart rate. The Raspberry Pi is one of the most important IoT learning platforms. Due to its ability to provide a full Linux server on a tiny platform for a very low price, the Raspberry Pi is a popular platform. The general purpose I/O pins on the Raspberry Pi can be used to connect to services and actuators as well.

The integration of Raspberry Pi with IoT creates a cutting-edge medical solution [2,3]. Multi parameter displays, which can track and display different parameters simultaneously, are becoming more and more popular these days. Pulse oximetry, ECG, blood pressure, and temperature are among the parameters that are measured with a thermoelectric transducer [4]. The Internet of Things (IoT) is a network of actual physical things that use embedded technology to communicate, detect, or respond to internal conditions or environmental changes. "Things on the Internet of Things" refers to any form of object, whether it is a smart gadget with higher artificial intelligence that can communicate with other objects very effectively or a dumb object without any communication skills [5]. Previously, it was difficult for a doctor to keep a check on a patient in a remote location during an emergency. To allow the doctor to continuously access the data and to alert the career when the patient is in a severe condition, a system is developed which can continuously monitor the patient's status and automatically sends the data to a server [6]. In the past, only various devices for various metrics could be used to monitor the patient. Therefore, it is recommended to combine various equipment into a single module to monitor the patient's necessary circumstances [7]. Each sensor's data was recorded and uploaded to the server. The data was retrieved from numerous devices connected to the internet using secure login information [8]. It is a significant problem for the providers to effectively handle the massive amounts of information and data produced by these interconnected IoT devices [9]. Internet of Things Analytics (IoT) is a technology used to address this issue of storing and analyzing enormous amounts of data [10, 11].

The healthcare sector has experienced considerable expansion in recent years and has significantly increased both employment and revenue [12]. A few years ago, a physical examination in the hospital was required to diagnose diseases and other abnormalities in the human body [13, 14]. Most of the patients had to remain in the hospital for the duration of their therapy. This has increased healthcare costs and put pressure on healthcare facilities in rural and isolated areas [15].

Received on 31-03-2023, Revised on 09-05-2023, Accepted on 14-05-2023.

CVR Journal of Science and Technology, Volume 24, June 2023
DOI: 10.32377/cvrjst2405

For a long time, traditional checkups in a specialist medical facility were the norm for determining blood sugar, blood pressure, and heart rate [16]. Today's patients may take their vital signs every day because of the wide range of sensors that are available to read vital signs, including blood pressure cuffs, glucose meters, heart rate monitors, and electrocardiograms [17,18].

In present world, the health related issues are the major reason for increasing human death rate. Due to the statistics of different surveys, every day around 1,51,600 people are losing their lives because of these health issues. Modernization and precaution measurements of health care system can reduce this people's death rate per day. In the Conventional health care systems, the health care professions play a primary role for health monitoring of human beings. [19]. But, nowadays, there are a lot of old people who are living alone at home, and they may not have access to the hospitals for regular medical care. Hence, there is a requirement of health monitoring system which will help every human being in examining all health parameters. The FPGA is used to create this monitoring system, which will examine heart rate, temperature and processes the data at high speed [20].

The health monitoring system can be designed by adding different sensors to a human being to monitor different health parameters. These sensors data outputs are processed by using data aggregator, communication link and processing unit. A specialized gadget and/or personal computer may serve as the data aggregator and processing unit. [21].

The physiological parameters of human beings need to be monitored by the healthcare monitoring system are different for different age groups. For instance, the criteria for constant monitoring system of the pregnant woman consists of monitoring the status of Blood Pressure (BP), heart rate, and movements of the developing foetus etc. Similarly, it is a challenging task to monitor a patient's health if they have a chronic illness or physiological issue. The challenge is that the doctor must frequently visit the patient and evaluate their condition by examining the recorded physiological measures, such as body temperature and blood pressure etc. [22] Most of the health monitoring systems uses microcontrollers for their implementation, but in this design, FPGA is used because of the advantages in terms of reconfigurability, flexible functionality and adoption for advanced technologies. This FPGA based design is also used for better power efficiency, small operations at precise timings, real-time and improved performance applications. [23].

Health related issues are the major problem for human society in the entire world. Hence, there is a requirement of design in the technique and a system which allows a person to remotely measure the vital indicators at any time. This type of system will help the people who are constantly busy in their routine life and busy schedule. Due to this busy daily schedule of activities people are becoming physically and mentally susceptible. This results in time constraints for their families and to maintain the level of fitness needed for healthy survival. The fundamental tenet of healthcare is "appropriate care for the right person at the right time," which results in more acceptable outcomes, improvements in terms of healthcare dependency and cost-effective solutions.

The intense demand on urban healthcare administration has spurred technological development to produce the right solutions to the problems that are emerging. The challenge is that a patient must regularly visit the doctor to monitor their health status using the observed data, such as Body temperature, Pulse rate, Respiration rate and Blood pressure. Hence, the proposed health monitoring system is suggested by combining monitoring of different health parameters into a single module. The design of the proposed system is accomplished with the aid of Python-based real-time monitoring system for Bio-medical applications.

In this paper, section 2 covers the information and design methodology about the design of existing and proposed Health Monitoring systems. Section 3 covers the information about hardware and software components by using the flow chart and algorithms of Health Monitoring system. Section 4 covers the Result analysis. Section 5 shows the Conclusion followed by References.

II. DESIGN METHODOLOGY

There are different health monitoring systems to support Body Temperature, Pulse Rate, Respiratory Rate and Blood Pressure are available with certain advantages and limitations as discussed below.

The Body Temperature Monitoring System [24] essentially measures and senses body temperature. This generates a sound alarm system when a patient's temperature changes quickly and turns on an LED when a patient's temperature is expected to worsen soon. To measure the patient's actual body temperature, an LM35 temperature sensor must be inserted into the patient's body cavity. For further analysis, the data must be gathered and preserved. Any machine learning technique may forecast the temperature measurements for every half-hour or hour using this data. It is possible to establish upper and lower threshold limitations. As a result, two tasks will be completed simultaneously. This continuous monitoring will be helpful in analyzing the predicted and actual values with the threshold ranges. A positive signal will be given to alarms if there is any discrepancy.

The Heart Rate Monitoring system using IoT [25] project is made up of several parts, including LCD display, Wi-Fi module, receiver module, heartbeat sensor, and 5V Regulated Power Supply. The microcontroller serves as the project's central processing unit and keeps track of the patient's heart and pulse rates. The patient's temperature is calculated by a temperature sensor, and the patient's heart rate is monitored by a heart rate sensor. One can measure the heart rate with the help of the lights on the heart rate sensor module. The amount of blood in the capillaries is represented by the reflected light when the finger is placed on the pulse sensor.

The Respiratory Monitoring System for Asthma Patients based on IoT [26] uses Ethernet shield to display the respiration rate number in a web browser, clinicians can easily access the patient's information from anywhere in the hospital. The patient's health status can then be determined without the aid of medical personnel by applying data mining techniques. Early disease identification is made feasible by this system. Future data retrieval processes will take

CVR Journal of Science and Technology, Volume 24, June 2023
DOI: 10.32377/cvrjst2405

advantage of wireless technologies, cloud storage, and big data analytics.

The IoT blood pressure monitoring system [27], which is implemented by using both software and hardware. The system's block diagram represents and shows that Raspberry Pi can recognize data from the blood pressure device and send it over the internet. Because of this the users may view the monitoring results using Telegram and mail applications. These results are accessible for anyone who has the authority to access the data and information.

To overcome all the limitations of these existing systems, a new health monitoring system is designed with all the four health conditioning parameters and their age groups to support the entire family health care monitoring. This system also provides proper medication as a suggestion if abnormal cases exist. The suggested data is stored in the form of reports, so that people can be aware of their health status and can be in regular contact with their physical body for a proper healthy lifecycle. This system will monitor the health of various family members by taking four important measurements: body temperature, pulse rate, respiratory rate, and blood pressure. This approach evaluates each of these four variables based on their age. While there are some existing devices to monitor each of these four factors separately up to this point, this proposed method is using different standard values for different age groups. These values are taken from different sensors, and they are given as inputs to the health monitoring system. These inputs will be analyzed for the human body's typical ranges for each of their age groups using Python. Finally, a report with the measured values and the human body's standard values will be produced.

The block diagram of proposed health monitoring system is shown in Figure 1. The different health parameters like body temperature, pulse rate, respiratory rate and blood pressure of a human are collected from different sensors. Their values are given to the Python based Health monitoring system.

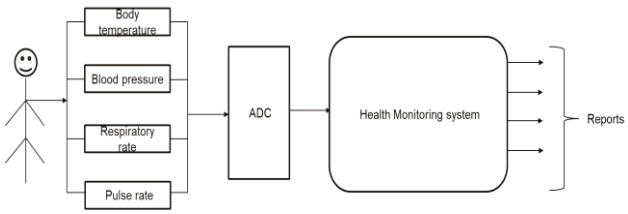

Figure 1. Block diagram of Health Monitoring System

The values of different age groups and corresponding health parameter values ranges are shown in Table 1.

The age of human being will be taken as first input, then based on this age value, there are four sub age groups. They are classified as child age (3-16), young age (17-25), middle age (26-45) and old age (>45) groups. Each age group has the corresponding standard for health parameters in terms of Body temperature, Pulse rate, Respiratory rate, and Blood pressure. The health conditioning and report generating will be done as per the selected age group based on flow chart and design algorithms.

TABLE I.
PARAMETER RANGES

Health parameters	Child Age (3 - 15 years)		Young Age (16 - 25 years)		Middle Age (25 - 45 years)		Old Age (> 45 years)	
Body Temperature	96.6 F - 98 F		95.3 F – 98.4 F		95.5 F – 98.2 F		96 F – 97.4 F	
Pulse Rate	75 – 120		60 – 100		90 – 140		75 – 136	
Respiratory Rate	20 – 30		16 – 25		12 – 20		16 - 25	
Blood Pressure	Systolic	Diastolic	Systolic	Diastolic	Systolic	Diastolic	Systolic	Diastolic
	97-112	56-76	112-128	66-80	122-124	74-77	95-145	70-90

Flow Chart and Algorithms of Health Monitoring System

The flow chart of the Family health monitoring system is shown in Figure 2.

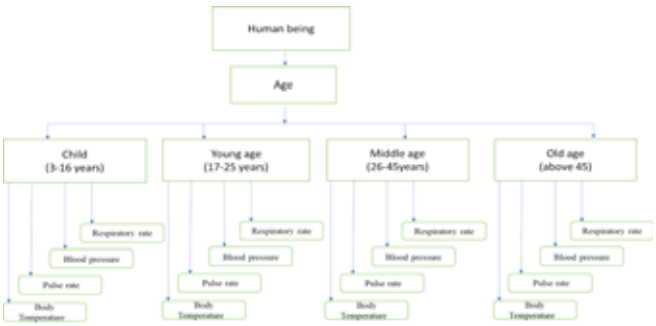

Figure 2. Flow chart of Family Health Monitoring System

This flowchart considers the human being age with the allotted age groups for child age (3-16), young age (17-25), middle age (26-45) and old age. All these age groups are deeply analyzed with health monitoring parameters for proper health condition status and report generation using their design algorithms.

III. DESIGN ALGORITHMS

The design algorithms for the proposed health monitoring system are specified for different age groups like Child age, young age, middle age, and old age groups are discussed below.

Algorithm for Child Age Group

Figure 3 describes the algorithm for the child age group. The four health parameters that are given as input will be analyzed with the moderate values of those respective health parameters as shown in table1. If the input parament values are in the range of the moderate health parameters, the system displays normal. If the parameter value is higher than the moderate range the system displays that respective parameter value of the human being is high and if the parameter value is lower than the moderate range the system displays that respective parameter value of the human being is low.

E-ISSN 2581 – 7957
P-ISSN 2277 – 3916

CVR Journal of Science and Technology, Volume 24, June 2023
DOI: 10.32377/cvrjst2405

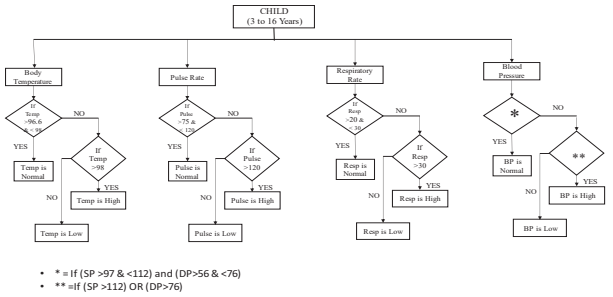

Figure 3. Algorithm for Child Age Group

Algorithm for Young Age Group

Figure 4 describes the algorithm for the young age group. The four health parameters that are given as input will be analyzed with the moderate values of those respective health parameters as shown in Table 1. If the input parament values are in the range of the moderate health parameters, the system displays normal. If the parameter value is higher than the moderate range the system displays that respective parameter value of the human being is high and if the parameter value is lower than the moderate range, then the system displays that respective parameter value of the human being is low.

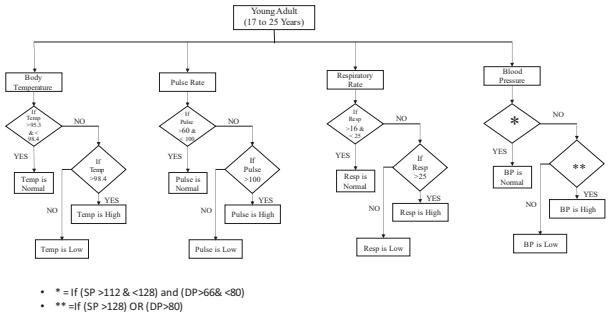

Figure 4. Algorithm for Young Age Group

Algorithm for Middle Age Group

Figure 5 describes the algorithm for the middle age group. The four health parameters that are given as input will be analyzed with the moderate values of those respective health parameters as shown in Table 1. If the input parament values are in the range of the moderate health parameters, the system displays normal. If the parameter value is higher than the moderate range the system displays that respective parameter value of the human being is high and if the parameter value is lower than the moderate range the system displays that respective parameter value of the human being is low.

Algorithm for Old Age Group

Figure 6 describes the algorithm for the old age group. The four health parameters that are given as input will be analyzed with the moderate values of those respective health parameters as shown in Table 1. If the input parament values are in the range of the moderate health parameters, the system displays normal. If the parameter value is higher than the moderate range the system displays that respective parameter value of the human being is high and if the parameter value is lower than the moderate range the system displays that respective parameter value of the human being is low.

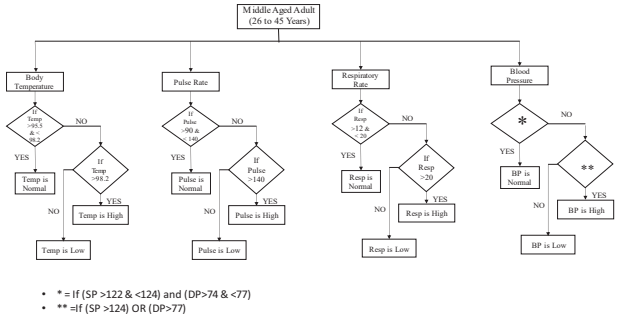

Figure 5. Algorithm for Middle Age Group

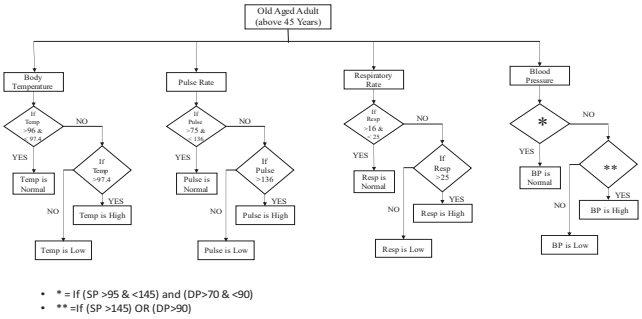

Figure 6. Algorithm for Old Age Group

IV. Result Analysis

This section gives information about the results of the family health monitoring system. This system is designed by using Python with different age groups and different health monitoring parameters. This system is deeply analyzed by using their design algorithms and verified for proper health condition status.

Here is an example of a family containing four family members i.e., Ganesh, Rakesh, Virisha and Anjali. In the proposed system first, the system will ask for number of family members in a particular family, as in this case there were four family members, the system will take four as input. The different test cases and reports for four family members using the proposed health monitoring system are shown as different cases like case1, case2, case3 and case4 for child age, young age, middle age and old age are shown below.

Test Case 1: Health Monitoring of Child Age Group

Now the system asks for their name, age, temperature, bp systolic, bp diastolic, pulse rate and respiratory of the fourth family member i.e., Anjali. After that it analyses the given data based on the age of Anjali (15). As her body temperature is 96 which is less than moderate range for her age, the output is generated as "body temperature is low". As her pulse rate is 85 which is in moderate range for her age, the output is generated as "pulse rate is normal". As her respiratory rate is 33 which is more than moderate range for her age, the output is generated as "respiratory rate is high". As bp systolic and diastolic is 115 and 77 respectively which is greater moderate range for her age, the output is generated as "bp is high". and attached report 1 for her health status.

The generated report for child age group and health parameters of Anjali is shown in Figure 7.

```
Enter name: Anjali
Enter age: 15
Enter Body temperature: 96
Enter Pulse rate: 85
Enter Respiratory rate: 33
Enter BP systolic: 115
Enter BP diastolic: 77
your body temperature is low, please refer report1
your pulse rate is normal
your respiratory rate is high, please refer report1
your blood pressure is high, please refer report1
```

Figure 7. Report of Family Health Monitoring System for child age group

Test Case 2: Health Monitoring of Young Age Group

Now the system asks for their name, age, temperature, bp systolic, bp diastolic, pulse rate and respiratory of the third family member i.e., Virisha. After that it analyses the given data based on the age of Virisha (21). As her body temperature is 98 which is in moderate range for her age, the output is generated as "body temperature is normal". As her pulse rate is 69 which is in moderate range for her age, the output is generated as "pulse rate is normal". As her respiratory rate is 20 which is in moderate range for her age, the output is generated as "respiratory rate is normal". As bp systolic and diastolic is 97 and 65 respectively which is less than moderate range for her age, the output is generated as "bp is low" and attached report 2 for her health status.

The generated report for young age group and health parameters of Virisha is shown in Figure 8.

```
Enter name: Virisha
Enter age: 21
Enter Body temperature: 98
Enter Pulse rate: 69
Enter Respiratory rate: 20
Enter BP systolic: 97
Enter BP diastolic: 65
your temperature is normal
your pulse rate is normal
your respiratory rate is normal
your blood pressure is low, please refer report2
```

Figure 8. Report of Family Health Monitoring System for young age group

Test Case 3: Health Monitoring of Middle Age Group

Now the system asks for their name, age, temperature, bp systolic, bp diastolic, pulse rate and respiratory of the second family member i.e., Rakesh. After that it analyses the given data based on the age of Rakesh(30). As his body temperature is 98.1 which is in moderate range for his age, the output is generated as "body temperature is normal". As his pulse rate is 89 which is not in moderate range for his age, the output is generated as "pulse rate is low". As his respiratory rate is 18 which is in moderate range for his age, the output is generated as "respiratory rate is normal". As bp systolic and diastolic is 100 and 78 respectively which is not in moderate range for his age, the output is generated as "bp is low" and attached report 3 for his health status.

The generated report for middle age group and health parameters of Rakesh is shown in Figure 9.

```
Enter name: Rakesh
Enter age: 30
Enter Body temperature: 98.1
Enter Pulse rate: 89
Enter Respiratory rate: 18
Enter BP systolic: 100
Enter BP diastolic: 78
your temperature is normal
your pulse rate is low, please refer report3
your respiratory rate is normal
your blood pressure is low, please refer report3
```

Figure 9. Report of Family Health Monitoring System for middle age group

Test Case 4: Health Monitoring of Old Age Group

The system asks for their name, age, temperature, bp systolic, bp diastolic, pulse rate and respiratory of the first family member i.e., Ganesh. After that it analyses the given data based on the age of Ganesh (49). As his body temperature is 99 which is not in moderate range for his age, the output is generated as "body temperature is high". As his pulse rate is 100 which is in moderate range for his age, the output is generated as "pulse rate is normal". As his respiratory rate is 29 which is less than moderate range for his age, the output is generated as "respiratory rate is low". As bp systolic and diastolic is 100 and 80 respectively which is in moderate range for his age, the output is generated as "bp is normal" and attached report 4 for his health status. The generated report for old age group and health parameters of Ganesh is shown in Figure 10.

```
Enter number of family members: 4
Enter name: Ganesh
Enter age: 49
Enter Body temperature: 99
Enter Pulse rate: 100
Enter Respiratory rate: 29
Enter BP systolic: 100
Enter BP diastolic: 80
your body temperature is high, please refer report4
your pulse rate is normal
your respiratory rate is high, please refer report4
your Blood pressure is normal
```

Figure 10. Report of Family Health Monitoring System for old age group

V. CONCLUSIONS

The main idea of this device is to provide better and efficient health services to the human beings. Now a days health marketing is becoming the major aspect, in which there is a huge growth of population. So, everyone can afford a health monitoring device which keeps us in regular update with our body. The health care market is one of the majors in which there is a huge growth, the future of health care will be more reliable on this device and also it is very helpful for our upcoming generations. This device takes less than a minute to compute the result of body such as Blood Pressure, heart rate, body temperature, and respiratory rate and also its help's the patients to easily carry this device with them wherever they go and it is also useful for project developers of biomedical device systems.

The above parameters data is stored inside the cloud, so that the experts and doctors could make use of this data and provide a fast and an efficient solution. It allows the objects to be sensed and controlled remotely and it provides the information through smart objects. This device will give a health report of a person which tells us about the person's health condition. Finally, it displays the health status of a human being whether the person is normal or abnormal. Based on this health report a doctor can examine his patient from anywhere and anytime. Continuous monitoring of health and cost-effective disease management is the only way to ensure economic viability of the healthcare system.

REFERENCES

[1]. Nor Shahanim Mohamad Hadis , Muhammad Nazri Amirnazarullah, Muhammad Mahdi Jafri, Samihah Abdullah, "IoT Based Patient Monitoring System using Sensors to Detect, Analyse and Monitor Two Primary Vital Signs" , Journal of Physics: Conference Series, DOI: 10.1088/1742-6596/1535/1/012004.

[2]. K. Arshak, E. Jafer and C. S. Ibala, "FPGA Based System design suitable for Wireless Health Monitoring Employing Intelligent RF module," SENSORS, 2007 IEEE, Atlanta, GA, USA, 2007, pp. 276-279, doi: 10.1109/ICSENS.2007.4388390.

[3]. Narasimha Rao Jasti Madhu, "IoT based Remote Patient Health Monitoring System". B.E., DR AIT, India, 2010

[4]. Thirumalasetty Sivakanth and S. Kolangiammal, "Design of Iot Based Smart Health Monitoring and Alert System," I J C T A, 9(15), 2016, pp. 7655-7661

[5]. Jorge Gómez , Byron Oviedo , Emilio Zhuma., "Patient Monitoring System Based on Internet of Things" Procedia Computer Science 83 (2016) 90 – 97

[6]. Punit Gupta, Deepika Agrawal, Jasmeet Chhabra, Pulkit Kumar Dhir, "IoT based Smart HealthCare Kit", 2016 International Conference on Computational Techniques in Information and Communication Technologies (ICCTICT).

[7]. Archit Sharma, Ruqaiya Khanam, Akriti Kumari, Subham Singh, "A Smart Patient Health Monitoring System Using Raspberry Pi 3", JETIR (ISSN-2349-5162), October 2017, Volume 4, Issue 1

[8]. Mohammad Salah Uddin, Jannat Binta Alam, and Suraiya Banu, "Real Time Patient Monitoring System based on Internet of Things", Proceedings of the 2017 4th International Conference on Advances in Electrical Engineering (ICAEE),Page No-516-521.

[9]. Amandeep Kaur, Ashish Jasuja , "Health Monitoring Based on IoT using RASPBERRY PI", International Conference on Computing, Communication and Automation (ICCCA2017), ISBN:978-1-5090-6471-7/17, Page No-1335-1340.

[10]. K. Mohanraj, N. Balaji, R. Chithrakkannan "IoT Based Patient Monitoring System Using Raspberry Pi 3 and LabVIEW", Pak. J. Biotechnol. Vol. 14 (3) 337-343 (2017).

[11]. Shafaque Nasruddin Soparkar, Dr. Lochan Jolly, "Improved Medical Healthcare System Based On IoT," Vol. 6, Issue 8, August 2017

[12]. Sangle Sagar D, Deshpande Niranjan R, Vadane Pandurang M,Dighe M. S, "IoT Based Health-Care System Using Raspberry Pi," International Research Journal of Engineering and Technology (IRJET), Volume: 04 Issue: 04 | Apr -2017,e-ISSN: 2395 -0056.

[13]. "An FPGA Implementation of Health Monitoring System using IoT" A. Jhansi Naga Sai Surekha,D. Archana,N. Hannah Priyanka, S. Munavvar Hussain in International Journal of Creative Research Thoughts Volume-6, Issue-2, April-2018

[14]. D.Shiva Rama Krishnan, Subhash Chand Gupta, Tanupriya Choudhury, "An IoT based Patient Health Monitoring System", 2018 International Conference on Advances in Computing and Communication Engineering (ICACCE-2018), Paris, France 22-23 June 2018.

[15]. Sunilkumar Laxmanbhai Rohit and Bharat V. Tank, "IOT Based Health Monitoring System Using Raspberry Pi-Review", Proceedings of the 2nd International Conference on Inventive Communication and Computational Technologies (ICICCT 2018), IEEE Xplore Compliant - Part Number: CFP18BAC-ART; ISBN:978-1-5386-1974-2, Page No-997-1002.

[16]. Gutte, A., & Vadali, R. (2018). IoT Based Health Monitoring System Using Raspberry Pi. 2018 Fourth International Conference on Computing Communication Control and Automation (ICCUBEA), 1-5.

[17]. Yedukondalu Udara, Srinivasarao Udara, Harish H M, Hadimani H C " Health Monitoring System Using IoT," International Journal of Engineering and Manufacturing Science, ISSN 2249-3115 Volume 8, Number 1 (2018) pp. 177-182

[18]. Thirumalasetty Sivakanth and S. Kolangiammal, "Design of Iot Based Smart Health Monitoring and Alert System," I J C T A, 9(15), 2016, pp. 7655-7661

[19]. Perumalla Srinivasa Rao, Kamatham Yedukondalu & Racha Ganesh (2021) FPGA implementation of digital 3-D image skeletonization algorithm for shape matching applications, International Journal of Electronics, 108:8, 1326-1339, DOI: 10.1080/00207217.2020.1859143

[20]. Tamilselvi, V., Sribalaji, S., Vigneshwaran, P., Vinu, P., & Geetharamani, J. (2020). IoT Based Health Monitoring System. 2020 6th International Conference on Advanced Computing and Communication Systems (ICACCS), 386-389.

[21]. Bikash Pradhan ,Saugat Bhattacharyya ,and Kunal Pal "IoT-Based Applications in Healthcare Devices" Hindawi Journal of Healthcare Engineering Volume 2021, Article ID 6632599, 18 pages https://doi.org/10.1155/2021/6632599

[22]. Badiganti, P. K.; Peddirsi, S.; Rupesh, A. T. J.; Tripathi, S. L.., "Design and Implementation of Smart Healthcare Monitoring System Using FPGA", first International Conference on Computational Electronics for Wireless Communications, ICCWC 2021 ; 329:205-213, 2022

[23]. Mohammad Monirujjaman Khan, Turki M. Alanazi, Amani Abdulrahman Albraikan and Faris A. Almalki, "IoT-Based Health Monitoring System Development and Analysis" Volume 2022, Article ID 9639195, 11 pages

[24]. Gourab Banerjee, " Body Temperature Monitoring System"

[25]. Harshavardan K, Aravind S, Maanashaswaruban M," Heart Rate Monitoring System Using IoT", International Research Journal of Engineering and Technology (IRJET)

[26]. A.Raji, P.Golda Jeyaseeli, "Respiratory Monitoring System for Asthma Patients based on IoT"

[27]. Norlezah Hashim, Nurbahirah Norddin, Fakrulradzi Idris, Siti Nur Ilmani Mohd Yusoff, Madiha Zahari, "IoT Based Blood Pressure Monitoring System", Indonesian Journal of Electrical Engineering and Computer Science, Vol.19, No.3, ISSN2502-4752http://doi.org/10.11591/ijeecs.v19.i3.pp1384-1390.