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Smart Health Care Monitoring System based on Internet of Things (IOT)

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Abstract— In the everyday occupied work, monitoring the home patient and overseeing their state of health ceaselessly is an exceptionally troublesome task. Especially agedness person's ought to be occasionally monitored and to be educated to the doctor about their health status now and again to spare their life in critical situation. Health monitoring is the serious problem in today's world. Because of absence of appropriate health monitoring, quiet experience the ill effects of genuine medical problems. To take care of this issue, there are lot of IOT devices are there to monitor the health of patient automatically now days. A smart health monitoring system is put into practice which utilizes heart beat and blood pressure sensors associated with ARDUINO UNO board to keep track the health of a patient. In the event, if a system notices any unforeseen changes in patient heartbeat and blood pressure, then it will spontaneously caution the doctor with a Short Message Service (SMS) about the patient's status with the assistance of global system for mobile communication (GSM) module and furthermore shows subtleties of heartbeat and blood pressure of patient live. On the off chance that the patient can't arrive at the clinic implies, Global Positioning System (GPS) module will assist the doctor with identifying the patient's area. In this manner, IOT based patient health tracking system effectually monitors the health status of patient and save their survives on schedule.

Keywords— Health Monitoring, IOT Devices, Heart Beat Sensor, Blood Pressure Sensor, Short Message Service, Global System for Mobile Communication, Global Positioning System

I. INTRODUCTION

Health monitoring is one of the serious issues in this day and age. Health specialists are taking unique consideration and watch out their patients [1]. The urban communities obliging more populace actually confronting bewildering weight of metropolitan living. Despite the fact that the clinical assets and offices in urban communities are extended very day, still the adequate level is not achieved. The IOT platform offers a promising innovation to accomplish the aforementioned healthcare services and can additionally improve the medical service systems [2,3]. IOT is the aggregate collection of devices, apps, sensors and network and these are interlinked with each other to gather and interchange data.

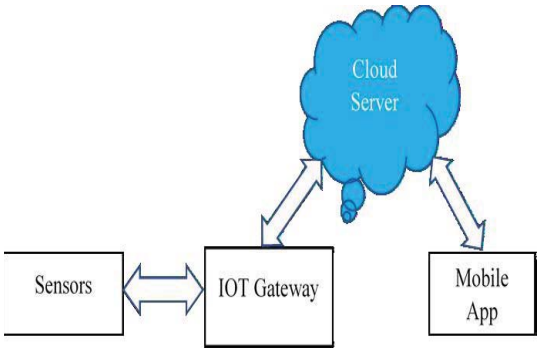

Fig.1. IOT Architecture

IOT is another insurgency of the web that is quickly building up speed driven by the progressions in sensor organizations, cell phones, remote interchanges, systems administration and cloud advances. Variety of IOT devices are now days obtainable to oversee the healthiness of patient over web. Lately, the expanded interest in wearable sensors is additionally accessible in market for less expensive rate for personal healthcare as well as activity awareness. Wearable IOT devices like belts and wrist bands allow non-invasive and incessant examining of physiological parameters can assist in continuous health and fitness monitoring. The wearable devices form a type of wireless sensor networks in which measurements from a number of wearable devices are continuously sent to a master node (such as smart phone) which then sends the data to a server or cloud based back end for analysis and archiving. Health care providers can scrutinize the perceived health care information to assess any health anomalies. Commonly used body sensors include body temperature, heart rate, pulse oximeter oxygen saturation (SPo2), blood pressure, electrocardiogram (ECG), movement (with accelerometers) and electroencephalogram (EEG).

In proposed system, heart beat and blood pressure sensors are used for monitoring the patient health. In general, the most imperative predictors of health is heart rate which is how many times our heart beats in 1 minute, normally it varies from one person to other. It's lower when human is in rest and higher when you exercise.

Anomalous pulse rate is a rate at which heart pulsating excessively quick (above 100 bpm) or slow (below 60 bpm), i.e a fluttering sensation around the chest area. At the point when electrical impulses of heart become excessively quick or lethargic or erratic, then heart beats unevenly and may cause poor blood circulation in the body. As a result, remaining body parts acquire only minimum oxygen which in turn some organs will get injure. Sometimes, anomalous heart rhythms are innocuous, however, some cases may cause uncomfortable symptoms and can cause unexpected cardiac demise if not treated. The sensor used to sense the blood pressure of our body is called blood pressure sensor. It is very essential to measure blood pressure at regular intervals as excessive blood stress results into serious diseases such as heart attack, kidney sickness etc.

To acquire the vital data of the user, IOT wearable platforms can be utilized and then the recognized data is communicated remotely for tracking the historical backdrop of the patient. Such an availability with outer gadgets and administrations will take into account taking preventive measure (e.g., after anticipating a forthcoming heart stroke) or giving prompt consideration (e.g., when a user tumbles down and needs assistance). The distinctive attribute of IOT in healthcare applications is the consistent observation of a patient through examining numerous parameters and furthermore gathers a virtuous outcome from the historical backdrop of continual monitoring [4]. To facilitate communication between patients, medical devices and doctors, IOT offers reliable hand-held devices to be entrenched with the patients [5]. The sensors will perceive the signals in incessant way and transport it wirelessly for further investigation [6]. At the same time, physician utilize this data and do early treatment to a patient. In addition to this, data can be conferred to the family doctors and family members. The development that improves these features is now accessible yet isn't available and moderate by a massive part of the public in non-modern countries for, instance, India. This work shows a system constrained by ARDUINO to persistently observe the vivacious parameters, for instance, heart rate and blood pressure of a specific individual. Cloud Server Database is utilized for stowage of perceived data and authorized person only interpret the data through mobile application.

The rest of this exploration work is sorted out as follows: after the current framework is summed up in Section 2, the proposed model is presented intricately in Section 3.

The rest of this research work is figured out by means of the following: existing system is summarized in Section 2, after that the developed model is introduced elaborately in Section 3. In Section 4, the efficiency of our developed prototype is evaluated. Lastly, we close this paper in Section 5.

II. EXISTING SYSTEM

As of late, several IOT systems have been developed for IOT healthcare applications. Some of them are as per the following.

Himadri et al.[7] developed a health observation system which traces the patient's healthiness like pulse and pressure rate, temperature with the succor of sensor's and internet to reveal their beloved ones if there is a drag. On the off chance that a system recognizes any sudden changes in patient health, at that point the system alarms the doctor concerning the patient's status over IOT.

Shubham et al. [8] elucidated about proposed scheme in which distinctive medical devices, for instance, sensor's and web or mobile based applications are utilized in order to make world class medical aid to the patients even if they were in the far off region i.e with no emergency clinics. RASPBERRY PI is utilized inorder to record the patient's heart rate and blood pressure and communique this information to their family members as well as to their doctor up to date and full medical information on the off chance any medical emergency emerges. The perceived data is then scrutinized and then chronic disorders or other diseases, for example, respiratory failures in primary stage itself is recognized with data mining practices for better decision making.

Shiva et al. [9] interpreted about patient health monitoring system that utilizes sensor technology and internet to convey the health of a patient to the friends and family if there ought to emerge an event of emergency. This systemuses temperature as well as heartbeat sensor interfaced with ARDUINO UNO for tracking patient's health status. To track the patient status, micro controller is linked with LCD display and WI FI to deliver the data to the web server. In the event that there ought to emerge an event of any fluctuations in patient pulse or body temperature, at that point alert signal is directed about the patient using IOT. This system additionally displays patient's information live with timestamps over the internetwork.

Akkas et al. [10] elucidated that in order to keep track of patients' vital signs, the primary fragment of IOT based system is Wireless Body Area Networks (WBAN) which incorporate miniature smart devices set in or on the patient's body can pass on the perceived data like pulse rate and relative oxygen wirelessly to the central database by means of IOT innovation.

Milon et al. [11] clarified about IOT based smart healthcare system which oversee a patient's healthiness and environment of the patients. The error proportion of this scheme is within a certain limit.

Acharya et al. [12] developed a healthcare monitoring framework in IoT milieu which mainly keep track on some vital signs of human health like heartbeat, ECG, body temperature and respiration through pulse, ECG, blood pressure and temperature sensor's. Raspberry Pi accumulates the perceived data from every sensors for processing which in turn communique it to IOT network. The major downside is interfaces for data visualization are not developed.

Gregoski et al. [13] introduced a smartphone-based heart rate monitoring scheme in which a mobile phone and camera are utilized to track flow of blood in person finger and afterward cardiac output is resolved and conveyed wirelessly to PC, empowering people to assay their heart rate by simply looking at their cell phones as opposed to utilizing hands each time. This framework isn't feasible if person need to check ceaseless heart rate.

Pioggia [14] explicated about IOT systems in which information about the person's health could be communicated with doctors who are in emergency, so that the doctor's will provide solution in critical circumstances.

Tamilselvi et al. [15] built up a health monitoring framework for checking elementary indications of a patient like heart rate, percentage of oxygen saturation, body temperature and eye movement using heartbeat, SpO2, temperature and eye blink sensors and to process the sensed data, ARDUINO UNO was utilized, but here no precise performance metrics are designated for a patient.

Trivedi et al. [16] introduced health parameter surveillance framework in which sensors will accumulate the data of a patient which is analog in nature and forwarded into ARDUINO UNO which in turn converted into digital values by analog to digital (ADC) converter. Bluetooth difuse the physical qualities to the health monitoring system. But the main downside of this system is

wide area is not covered by bluetooth.

III. PROPOSED SYSTEM

Fig.2. shows the segments utilized while building up the IOT based Health Monitoring System.

1) Heart Beat and Blood Pressure Sensor
2) ARDUINO UNO
3) GSM and GPS Module
4) ThingSpeak

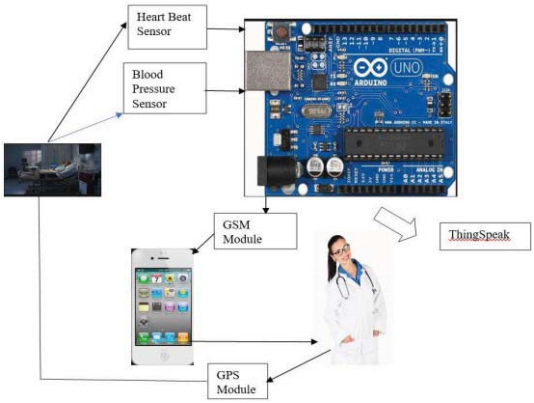

Fig.2.Smart Health Monitoring System

A. Heart Beat Sensor

There are two ways to measure a heartbeat of a person.

1) It can be manually checked by scrutiny pulse at person's body locations:1) Wrist 2) Neck
2) Using a sensor

Heartbeat Sensor is utilized to estimate the speed of a person's heartbeat in beat per minutes and working principle is based on Photoplethysmograph in which vagaries in volume of blood in an organ is appraised by how much amount of light is flowing through an organ. Infra Red Light Emitting Diode (IR LED) and the detector are the light sources of this sensor and can be organized in dual ways: i) Transmissive Sensor ii) Reflective Sensor. In former case, both light sources are placed opposingly and same way person's finger must amid between transmitter and receiver. In later case, both light sources are proximate and in front of the sensor, person's finger must be positioned.

Fig.3. reveals the interconnection between ARDUINO UNO and heartbeat sensor.

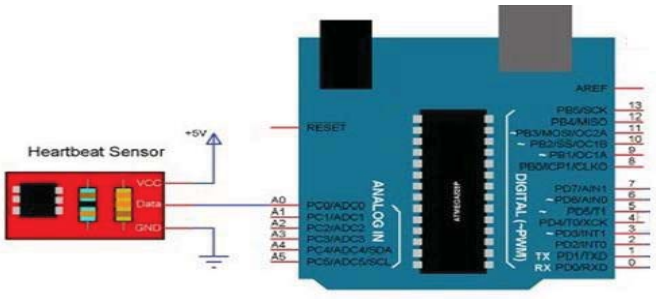

Fig.3. Connection between Heart Beat Sensor and ARDUINO

Here the output of the sensor module is linked with the analog input pin (Pin 0) of ARDUINO UNO.

B. Blood Pressure (BP) Sensor

BP is how much pressure is required for disseminating blood against the walls of blood vessels and is expressed as the percentage of the systolic and diastolic pressure. BP sensor is a device used to measure the blood pressure of human body.

Fig.4. shows the association between Blood Pressure Sensor and ARDUINO. Start by connecting VIN pin to the 5V output on the ARDUINO and interface GND of Blood Pressure Sensor to ground of ARDUINO. On the ARDUINO boards, the SDA (data line) and SCL (clock line) known as A4 and A5 is connected with SDA and SCL of blood pressure sensor.

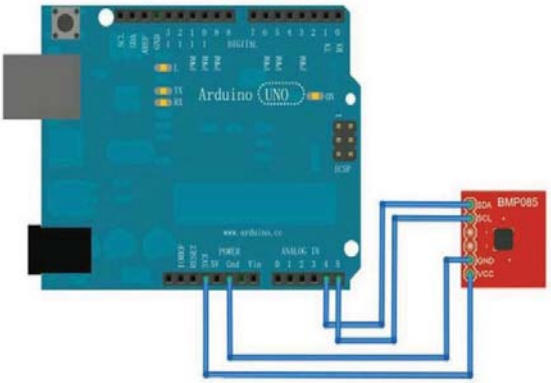

Fig.4. Connection between Blood Pressure Sensor and ARDUINO

C. ARDUINO UNO

ARDUINO shown in Fig.5. is a prototype platform which comprise of both hardware and software called ARDUINO IDE (Integrated Development Environment) employed to develop the computer code and upload it to physical board and circuit board, which can be programmed named as microcontroller. The significant highlights of the board is to constantly peruse the analog or digital input signals from heart beat as well as blood pressure sensors and forward it to the family members as well as doctor.

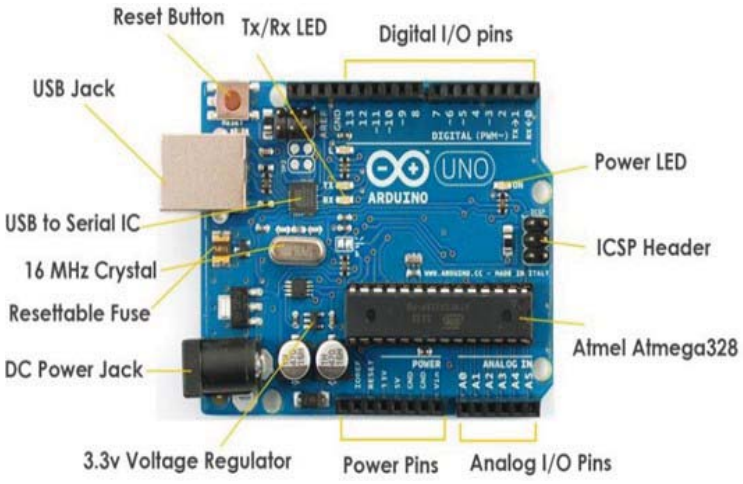

Fig.5. ARDUINO UNO

TABLE 1.1 ARDUINO SPECIFICATIONS

MCU	ATmega328P
Architecture	AVR
Operating and Input Voltage	5V and 6V-20V(limit)
Clock Speed	16 MHz
Flash Memory	32 KB
Static Random Access Memory	2 KB
Electrically Erasable Programmable Read Only Memory	1 KB
Digital I/O Pins	24
Analog Input Pins	6

D. GSM Module

SIM900A shown in Fig .6. is a dual band GSM/GPRS solution in a SMT module for enabling the communique between microprocessor and GSM network.

Fig.6. GSM Module

Fig. 7. shows the connection between GSM Module and ARDUINO UNO. TX and RX pin of GSM is linked with RX and TX pin of ARDUINO.

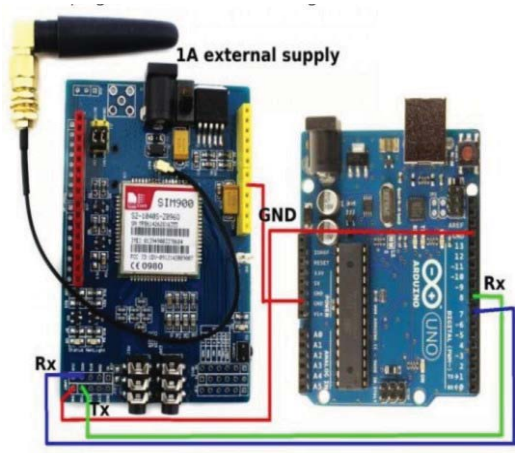

Fig.7. Connection between GSM Module and ARDUINO

E. GPS Module

A GPS receiver module is a device that obtains data from GPS satellites and also collects the geographical situation of the patient.

TABLE 1.2 GPS SPECIFICATIONS

Modulation	Gaussian Minimum Shift Keying
Access Methods	TDMA/FDMA
Bit Rate	270 kbps
Frequency Band	Uplink Frequency Range :933 - 960 MHz Downlink Frequency Band: 890 - 915 MHz
Channel Spacing	200kHz
Speech Coding	Linear Predictive Coding
Duplex Distance	80 MHz

Fig.8. shows the connection between ARDUINO UNO and GPS Module in which GND and VCC of ARDUINO UNO is linked with GND and 5V of GPS module. TXD and RXD used for serial communication is linked with digital pins 4 and 3 of ARDUINO UNO.

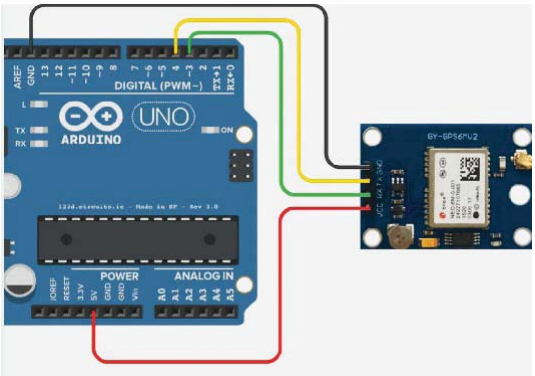

Fig. 8. Connection between ARDUINO and GPS Module

This framework is valuable since the specialist can keep an eye on patient wellbeing parameters just by getting an alarm message through SMS.

F. ThingSpeak

Is an IOT analytics platform that lets us to agglomerate, visualize and scrutinize live data in cloud. We can send up to 8 data simultaneously to the ThingSpeak and the data uploaded will be converted to graphical representation automatically. To send sensed data to ThingSpeak, Application Programming Interface keys are needed. There are two API keys generated, one is called read API key and another is called write API key.

V. RESULTS AND DISCUSSION

This section explicates the experimental outcomes of the developed system which collects data from sensors like heart beat sensor and blood pressure sensor.

Fig.9. shows the consequences of the heart beat sensor. A typical heart rate for adults goes from 60 to 100 bpm. For the most part, a lower pulse very still infers more effective heart work and better cardiovascular fitness. In the event that an individual's pulse is reliably over 100bpm, the individual is considered to have a high pulse, which is otherwise called tachycardia. On the off chance that an individual pulse exists somewhere in the range of 60 and 100 bpm, at that point the heartbeat of an individual is in ordinary state.

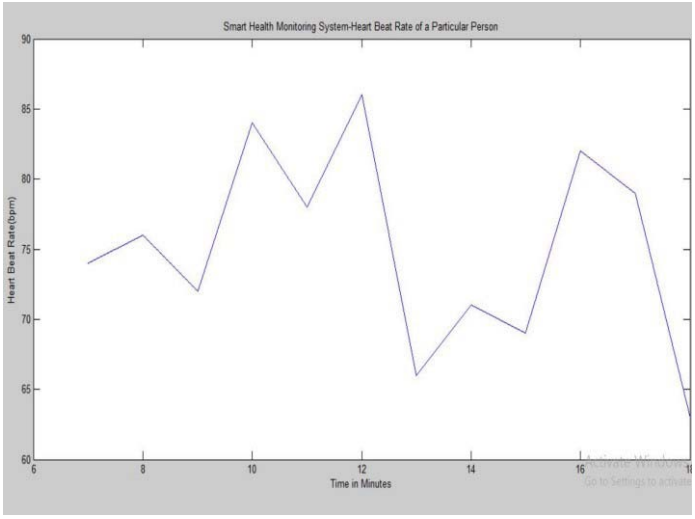

Fig.9. Heart Beat Rate of a specific person during an hour

Fig.10. shows the Pressure rate of a specific person vs time. The average blood pressure for adult is 120/80 mmHg. Pressure Rate of a particular person is measured between an hour.

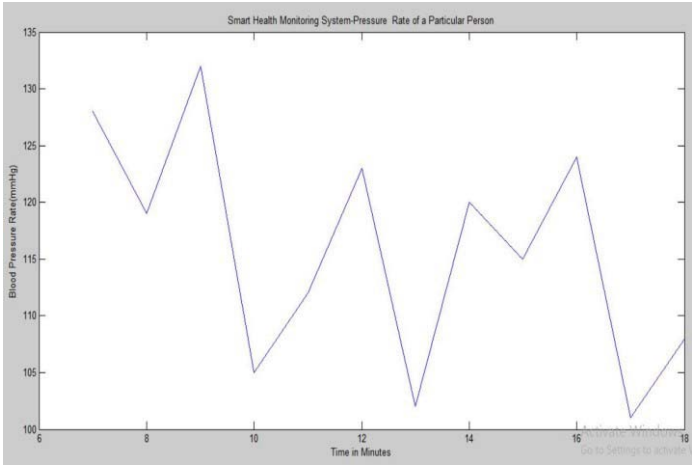

Fig.10. Pressure Rate of a specific person during an hour

V. CONCLUSION

IOT is the practical resolutions for any faroff data tracking specifically in healthiness nursing arena. In this work, an IOT based health monitoring system was developed and checks the blood pressure and pulse rate of a specific person, which are likewise shown on LCD. Then the readings of sensor's are directed to a medical server wirelessly and received by authorized personals. With the values received, the doctor diagnoses the sickness and the condition of wellbeing of the patient and afterward recommend legitimate medication.

REFERENCES

[1] Gulraiz J. Joyia, Rao M. Li Saqat, Aftab Farooq and Saad Rehman, "Internet of Medical Things (IOMT): Applications, Benefits and Future Challenges in Healthcare Domain", Journal of Communications, Vol. 12, No. 4, 2017.

[2] K. Perumal and M. Manohar, "A Survey on Internet of Things: Case Studies, Applications, and Future Directions, In Internet of Things: Novel Advances and Envisioned Applications", Springer International Publishing, pp 281-297,2017.

[3] S.M. Riazul Islam, Daehan Kwak, MD. Humaun Kabir, Mahmud Hossain and Kyung Sup Kwak, " The Internet of Things for Health Care: A Comprehensive Survey", IEEE ,pp 678-708,2015.

[4] Ruhani Ab. Rahman, NurShima Abdul Aziz, MurizahKassim and Mat IkramYusof, "IOT Based Personal Health Care Monitoring Device for Diabetic Patients", IEEE,2017.

[5] Yuehong YIN,Yan Zeng,Xing Chen and Yuanjie Fan," The Internet of Things in Healthcare: An Overview",Journal of Industrial Information Integration, Vol 1,pp 3–13, 2016.

[6] Ullah, Kaleem, Munam Ali Shah and Sijing Zhan, "Effective Ways to Use Internet of Things in the Field of Medical and Smart Health Care", International Conference on Intelligent Systems Engineering (ICISE),2016.

[7] Himadri Nath Saha, Supratim Auddy and Subrata Pal," Health Monitoring using Internet of Things (IOT), IEEE, pp.69–73, 2017.

[8] Shubham Banka, Isha Madan and S.S. Saranya," Smart Healthcare Monitoring using IOT", International Journal of Applied Engineering Research, Vol 13, No 15, pp. 11984-11989,2018.

[9] D. Shiva Rama Krishnan, Subhash Chand Gupta and Tanupriya Choudhury," An IOT Based Patient Health Monitoring System", IEEE,2018.

[10] M.A.Akkaş, R.Sokullu and H.Erturk Çetin,"Healthcare and Patient Monitoring using IOT", Internet of Things, Vol 11, 2020.

[11] Md. Milon Islam, Ashikur Rahaman and Md. Rashedul Islam," Development of Smart Healthcare Monitoring System in IOT Environment", SN Computer Science,2020.

[12] Acharya AD, Patil SN, "IOT based Health Care Monitoring", IEEE, pp. 363–8,2020.

[13] Gregoski MJ, Mueller M, Vertegel A, Shaporev A, Jackson BB, Frenzel RM, Sprehn SM and Treiber FA," Development and Validation of a Smartphone Heart Rate Acquisition Application for Health Promotion and Wellness Telehealth Applications", International Journal of Telemedicine and Applications, pp 1–7,2012.

[14] Pioggia, "Personal Health System Architecture for Stress Monitoring and Support to Clinical Decisions", Computer Communications, Vol.35, pp.1296-1305, 2017.

[15] Tamilselvi V, Sribalaji S, Vigneshwaran P, Vinu P and Geetha Ramani J, "IOT based Health Monitoring System", IEEE,2020.

[16] Trivedi S and Cheeran AN," Android based Health Parameter Monitoring", IEEE,2017.