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Design of Low cost Smart Health Suit for an application of Internet of Things Integration Platform on Modern Health Care System

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ABSTRACT

As the Information and Communications technologies are transforming our social interactions, our lifestyles and our workplaces. One of the most promising applications of information technology is healthcare and wellness management. Healthcare is moving from reactive responses to acute conditions to a proactive approach characterized by early detection, prevention and long-term healthcare management by observing Electrocardiogram (ECG) &Photoplethysmogram (PPG) gives realistic view of patients' heart condition. Which can track high blood pressure, anxiety, stress, depression and diabetes etc in normal daily routines of patients' life.In our research workwe are developing architecture of Smart Suit based on smart devices and sensor networks to monitor health of patients in various scenarios using Internet of Things (IOT) Integration Platform. The patients are monitored using a portable and mobile device which accumulates and processes data from an array of wearable sensors. The accuracy of the data received and responsiveness to an impending emergency increases with the use of higher quantity of sensors or with sensors possessing stronger sensing and processing capabilities.

Key word:Communication Technology, health Care, ECG, PPG, IOT, Mobile Devices.

I. INTRODUCTION

The health condition monitoring is particularly important in chronic conditions that are in treatment of cardiovascular diseases. Continuous monitoring & recording of biomedical signals such as Electrocardiogram (ECG) &Photoplethysmogram (PPG) gives realistic view of patients' heart condition. Which can track high blood pressure, anxiety, stress, depression and diabetes and other clinical factor in normal daily routines of patients' life.The total number of parameters to be monitored has to be designed keeping mind the balance with cost, complexity and the reliability of the system. The proposed e-health monitoring is highly suitable for the following four scenarios. Firstly patients with unstable physiologic regulatory systems for e.g. a patient suffering from respiratory congestion as a result of drug overdose or anaesthesia. The second situation for patients is those with a suspected life threatening situation, e.g. diagnosis predicting possibility of a cardiac arrest. Third one is identification of patients with a high risk of developing a life threatening condition. The fourth type of patients requiring monitoring is those with a critical physiological state, for e.g. patients with a

major trauma or recovering post-accident. Our system is also designed for the elderly people who require regular monitoring for multiple instances of the above mentioned cases. This system is aimed at facilitating accelerated diagnosis of diseases and also increased efficiency and accuracy in the process. It is also designed to instil a sense of security in the patient at all times by providing instantaneous attention for emergencies. In our architecture for the system, the smart device plays a major role in processing as well as relaying of data acting as a gateway hence reducing costs in the process. We have developed this architecture keeping in mind the prospect of this being used in rural parts of India, where health care units and hospitals are not as well equipped as their urban counterparts. In these regions, this system with mobile sensors and smart devices can be implemented for prognosis of patients. The IOT [1] Smart Health Monitor is depicted in Fig: 1.

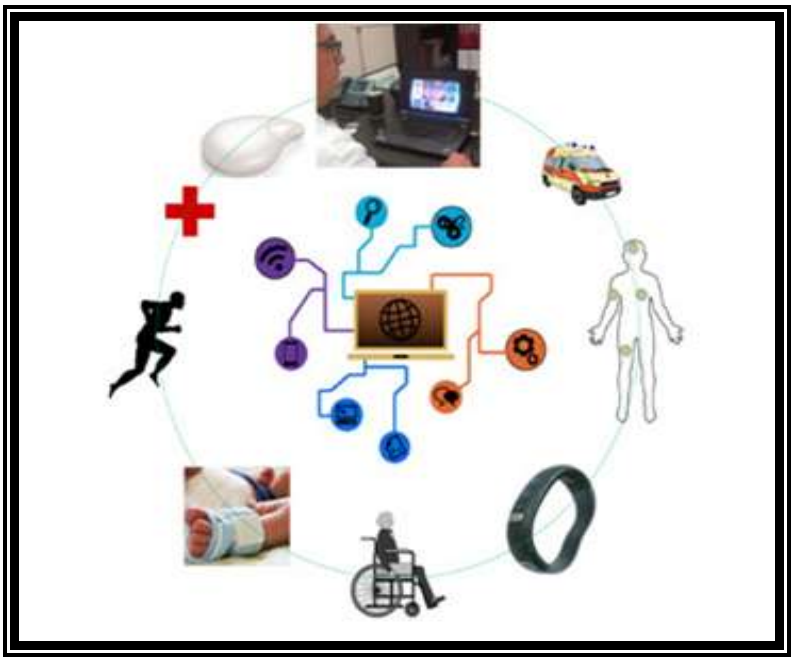


Fig: 1. IOT Smart Health Monitor

II METHODOLOGY

The architecture consists of three major layers which act as the backbone for our system. We have broadly categorized the architecture of our system into three layers based on the functionality of the components being used. Fig. 1 illustrates the three layers used in our architecture. The architecture is given in Fig: 2.

Different part of the our proposed architecture are mainly consist of three layer-

2.1 PERCEPTION LAYER:

The first layer at the bottom of the hierarchy consists of various types of sensors which collect real time data. These wearable sensors are embedded in the smart Wear .The medical sensors monitor vital parameters of the patient including body temperature, heart rate and Pulse. The data accumulated by the sensors are relayed to a processing device which attaches several data like unit, timestamp etc. and thereby creating metadata. With that, one unique id

is attached to each unit data in order to distinguish which report is for which patient. The data is sent to the next layer in the hierarchy through Gateway 1. The communication between the sensors and the gateway are conducted through short range communication systems.

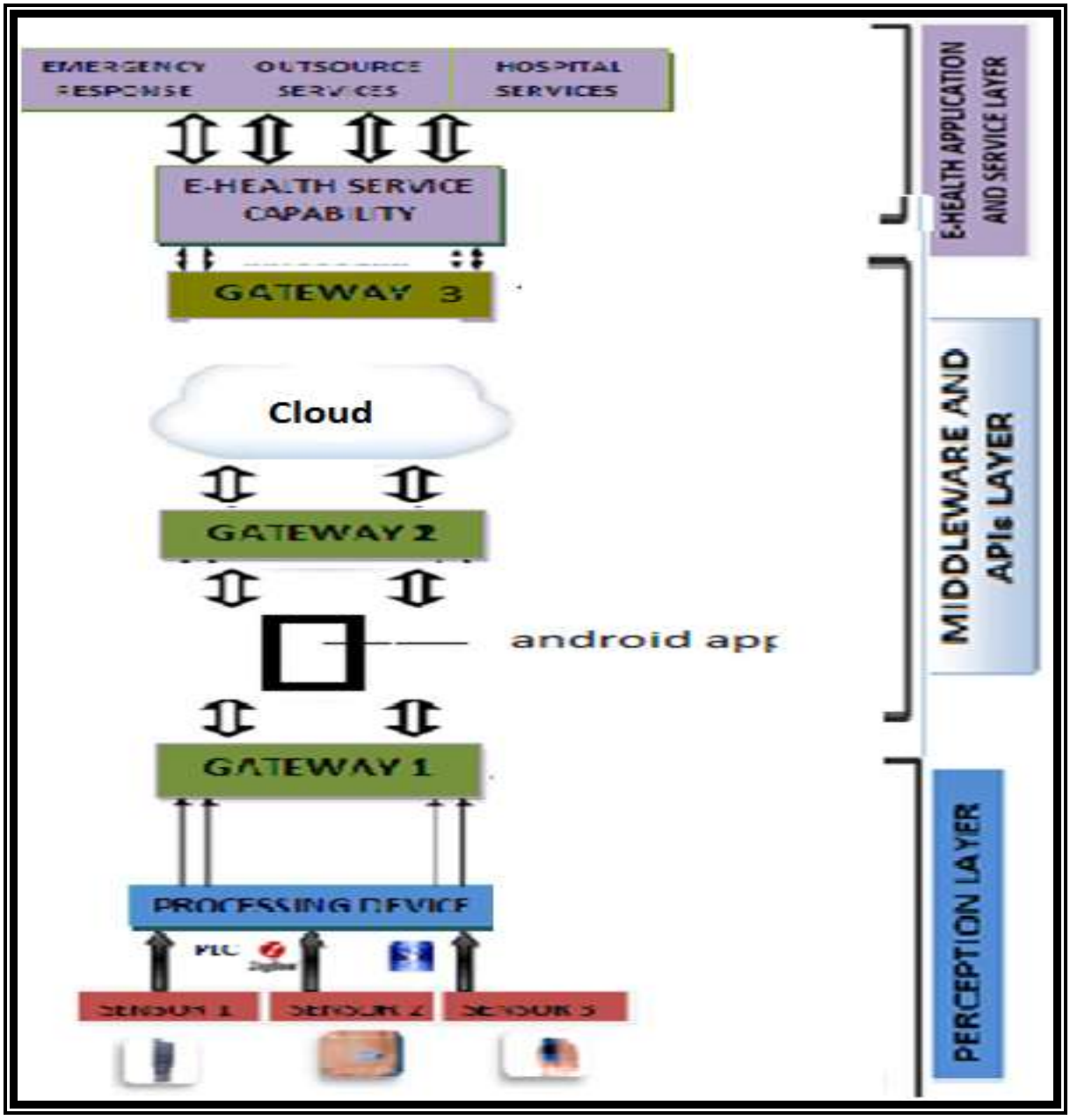


Fig: 2. Architecture of our proposed work

2.2 MIDDLEWARE AND APIS LAYER:

This layer is the pivotal layer of the system consisting of various APIs (Application Programming Interfaces)[2]. The android app in mobile stores the medical history of the patient as well as current records of the monitored parameters through gateway 1.From the app, the data is stored in the cloud through gateway 2. This storage

plays a central role in the emergency response and hospital monitoring system to correlate the data collected from the sensors to the stored thresholds for the parametric values. Whenever a patient is registered in the system one API creates the profile for that patient. These APIs support the profile creation, storage, queries regarding patient history and other reports synchronizing with the whole system. The data, gathered from the mobile app and stored in the cloud, is then relayed for outsourcing applications and services from the Gateway 3 or E-Health Service Capability module. Cloud is used for storage and processing and the result is forwarded to the mobile application.

2.3E-HEALTH APPLICATION AND SERVICE LAYER:

The third layer of the system is a terminal layer offering outsourcing services for the monitored data. This layer offers E-health Advice services to the patient. This process involves providing notification to the patient correlating to the values of parameters that are being received from the sensors which can be self-customized. Based on the pattern of data from the previous medical records of the patient, the e-health services offer advice comparing the previous trends with the current trend of sensor data. The emergency response system plays the role of informing the doctors and the caregivers in accordance with the level of emergency. Depending on the level of emergency the response team takes required action. The hospital module monitors the patient remotely from the location of the patient, if the monitored patient is at home or a remote location. This module also allows analysis of all patients under monitoring centrally in the hospital or health care centre.

III DIFFERENT SERVICES FOR THE MONITORING SYSTEM

The data acquired from the sensors are stored in a central database on the cloud. This data is processed in two ways, viz. on-board processing and on device processing. .

• On-board processing can be carried out on the central base station preferably a smart device. This allows immediate detection anomalies and care could be taken before the patient reaches healthcare institutes.

• On-server processing uses the real time metadata received from the sensors to process them with respect to data stored in the cloud itself. This type of processing requires better resources in the form of memory, throughput and processing time and hence is more suitable for on server processing than On-device processing. Based on the processing and storage of data our system offers a set of services as follows.

3.1 HOSPITAL SERVICES

Each patient is monitored using the vital parameters from the sensors embedded on the patient as well as in the surroundings. The values are further monitored by attendees present in the health care centre premises. For any anomalies in the values both visual alarm and audible alarm are deployed. The caregivers monitor these alarms for each of the patients and attend the patient with required medication to address the situation. These services are also available to patients opting for private monitoring at their residences. In this case, a caregiver is present on the premises however the monitoring is done remotely at a hospital. If an alarm is triggered it alerts both the staff present in the hospital and the caregiver on premises as well.

3.2 STORAGE SERVICES

In this set of services we offer a unique set of services in the form of local server storage. The local server storage is used to store medical histories of the patients with a particular database pertaining to each patient. These records can be used to correlate the current data received from the sensors for diagnosis. This pattern recognition process plays a pivotal role in the services mentioned subsequently. Cloud Storage can be used to securely store (i) medical reports, (ii) medical prescriptions along with particular medicines for which the patient has showed best recovery patterns and (iii) medicines to which the patient is allergic.

3.3 EMERGENCY RESPONSE SERVICES

Unlike the response from caregivers mentioned in the Hospitality Services, there are cases in which immediate attention is required from the caregivers for situations which may prove to be life threatening. There may be cases in which the threat may be beyond the scope of the caregivers and require intervention from the doctors. Fig.:3 illustrate the block diagram for the emergency response module.

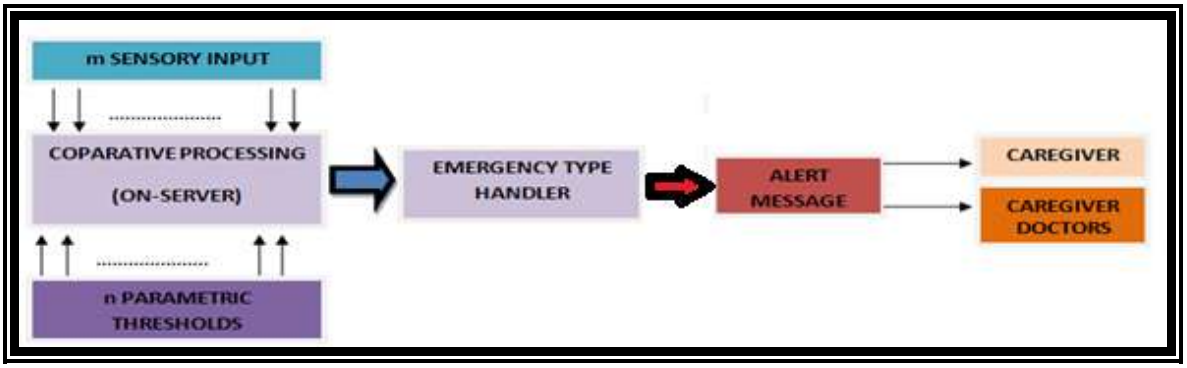


Fig: 3. Block Diagram for Emergency Response Service

The values received in real time from the sensors are sent to the mobile apps, where the data is processed and finally the processed data is stored in the local server. The database for each patient stores abnormal values for each parameter considered. Mobile app processing is used to compare all these values to the thresholds in real time. The breaches in threshold values acquired from the initial stage of processing are then sent to the Emergency Type Handler. The Emergency Type Handler then applies predefined logic to determine whether the breaches are inter-related and pose a greater threat combined. Based on the kind of threat the Emergency Type Handler assigns the threat to one of three levels.

• For Level I emergency, a message/alarm is sent with vital parameters and threshold breaches only to the caregivers.

• For a Level II emergency, a message/alarm is sent in a similar manner but to both the patient's doctors and caregivers.

3.4 PARENT MONITORING SERVICES:

With the ageing population worldwide and opportunities to work abroad, it is a common situation in which the parents stay away from their working off-springs. In cases of sudden health disorders and medical emergencies

the off-springs are often deprived of the information regarding the emergency due to a delay in communication. To bridge this gap between working professionals and their parents we have designed this service.

This is designed as a value-added service in which the offspring's receive continuous updates of the vital parameters of their parents and are updated on the emergencies through alerts similar to that of a caregiver. To implement this service we can send these updates through a smart phone application.

IV. CIRCUIT DIAGRAM AND COMPONENTS

The circuit comprises of one aurdino UNO development board, one Bluetooth module(HC 05),one pulse sensor and Temperature sensor(DHT11) interconnected by single strand wires in a fashion shown in figure below. Pulse sensor is connected with pin 7 of Aurdino UNO and other pins to VCC and ground respectively. The pulse sensor are receiving the denoting the pulse which are received on Aurdino.DHT11 which is a temperature and humidity sensor is used as temperature detector ,LM 35 could have been used as temperature sensor but DHT11 being more versatile and precise is choosen.DHT11 is connected to pin 8 of Aurdino UNO. The data are sending to the Android device by the use of Bluetooth module (HC-05) connected to the TX RX pin of the AurdinoUNO.The our developed circuit in brade board is depicted in Fig: 4.

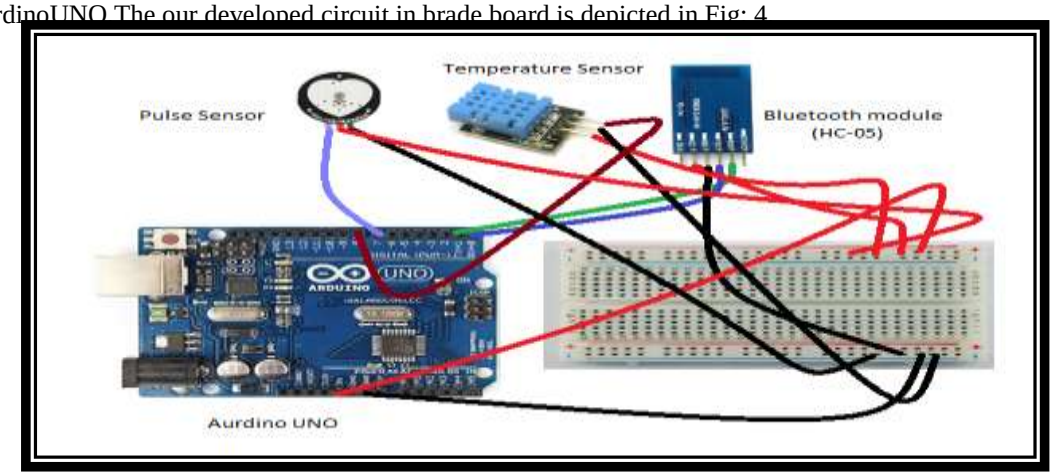


Fig: 4. Circuit Diagram of the System

4.1 END TO END CONNECTION METHODOLOGY

In this project we have designed a secure, Bandwidth efficient, powerful yet energy efficient connectivity technology which is relatively new in its approach and application. The process is depicted in Fig: 5.

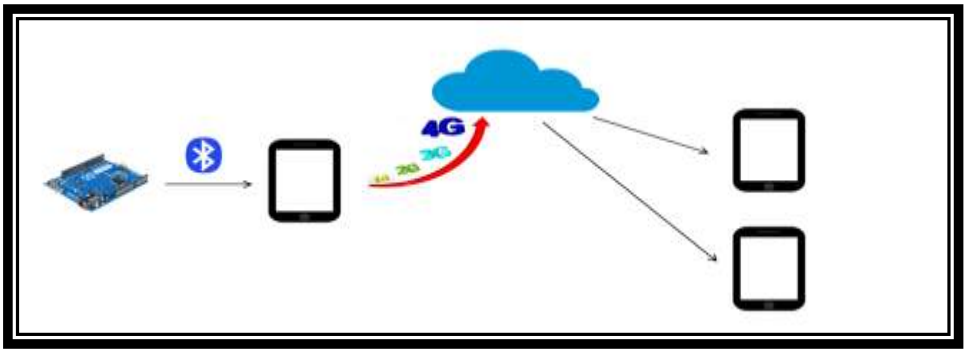


Fig: 5. End to End connection methodology

Based on Fig: 4. we can notice that we are transferring the processed sensor value to the Android powered mobile device via Bluetooth (Which is energy efficient as well as secure).Then the third party Application installed in the mobile is uploading the data to the cloud. Thus user can choose between
Multiple internet connectivity technology like 1G, 2G, 3G, 4G, WLAN etc.(Our System is working equally well in all this mentioned technology and Thus, bandwidth efficient).Then the users can interact with the data stored in cloud with its internet connectivity technology.

V .HARDWARE AND SOFTWARE PART OF THE SYSTEM

5.1 HARDWARE OF THE SYSTEM

The different parts we have used to develop this system are i)Aurdino Uno ii) Pulse sensor iii) Temperature Sensor (DHT-11) andiv) Bluetooth SPP (HC-05). The main part of the system is Aurdino Uno which is acting as central processing unit for this system [4].

The basic structure of Aurdino Uno is given in Fig: 6 and its standard specification given in Fig: 7 and specification of other part collected from internet and used over here is given in Fig; 8.

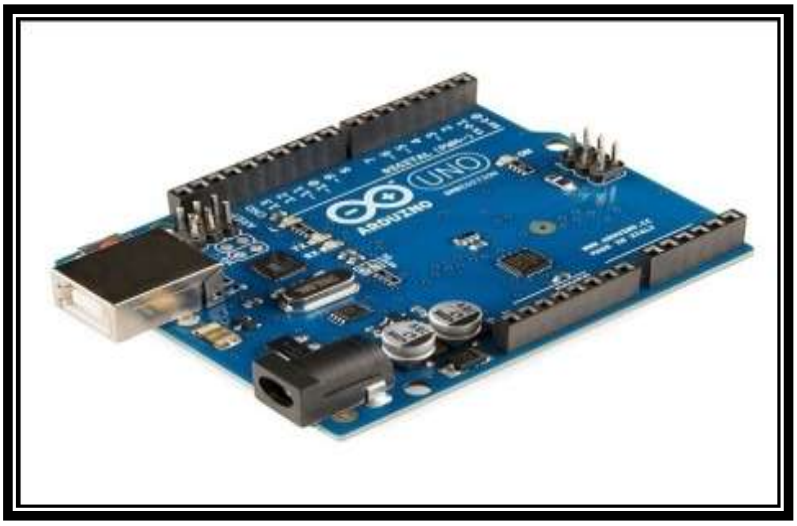


Fig: 6. Structure of Aurdino Uno

Technical specs

Microcontroller	ATmega328P
Operating Voltage	5V
Input Voltage (recommended)	7-12V
Input Voltage (limit)	6-20V
Digital I/O Pins	14 (of which 6 provide PWM output)
PWM Digital I/O Pins	6
Analog Input Pins	6
DC Current per I/O Pin	20 mA
DC Current for 3.3V Pin	50 mA
Flash Memory	32 KB (ATmega328P) of which 0.5 KB used by bootloader
SRAM	2 KB (ATmega328P)
EEPROM	1 KB (ATmega328P)
Clock Speed	16 MHz

Fig: 7. Technical Specification of Aurdino Uno.

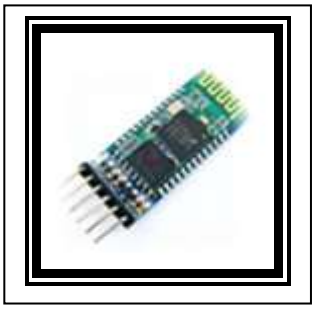
Pulse Sensor- Pulse Sensor is a well-designed plug-and-play heart-rate sensor for Arduino.It can be used by students, artists, athletes, makers, and game & mobile developers who want to easily incorporate live heart-rate data into their projects. It is a 24-inch Color-Coded Cable, with(male) header connectors.

Temperature Sensor (DHT-11) - The DHT-11 is a basic, ultra Low-cost digital temperature and humidity sensor. It uses a capacitive humidity sensor and a thermostat to measure the Surrounding air, and spits out a digital signal on the data pin.

HC_05 – This is a Bluetooth SPP module used for transparent Wireless serial connection. It supports Bluetooth 2.0 along with EDR(Enhanced Data Rate) 3.0 Mbps modulation with 2.4 GHz radio transceiver and baseband, using CSR Blue core with Adaptive Frequency Hopping feature.

Pulse Sensor

Temperature Sensor



Bluetooth SPP

Fig: 8. Specification of component used in the system

5.2 SOFTWARE INVOLVED IN THE SYSTEM

5.2.1 AURDINO IDE

This part of the software contains a text editor for writing code, a message area, a text console, a toolbar with buttons for common functions and a series of menus. It connects to the Arduino and Genuine hardware to upload programs and communicate with them. The screen shot of used software is given in Fig: 9.

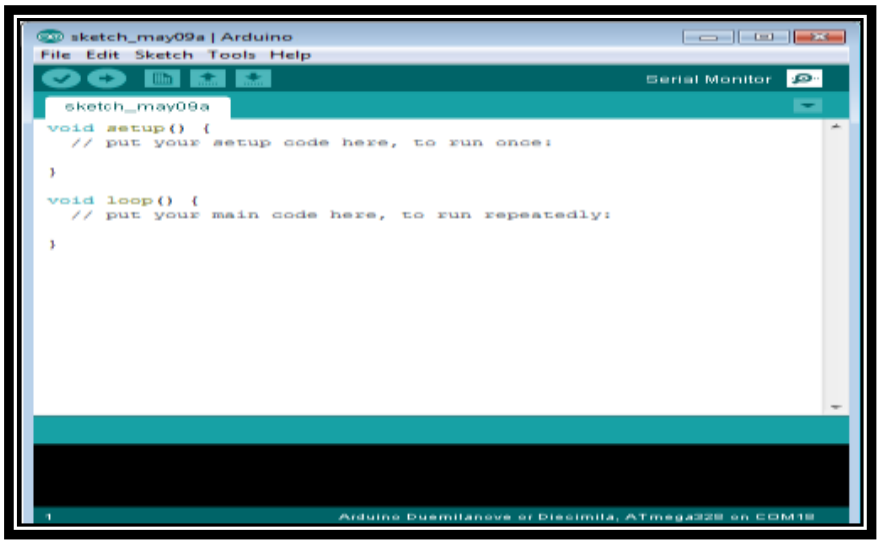


Fig: 9. Screen shot of used Aurdino IDE Sofware

5.2.2 ANDROID STUDIO 2.2

Android Studio 2.2 is based on JetBrains' IntelliJ IDEA software [5], Android Studio is designed specifically for Android development. It is available for download on Windows, macOS and Linux, and replaced Eclipse Android Development Tools (ADT) as Google's primary IDE for native Android application development. The developed APK, supports from Android 4 to Android 7 platforms. The screen shot of the software given in Fig: 10.

Fig: 10. Aurdino IDE 2.2

VI. CLOUD PLATFORM

ThingSpeak is an open source Internet of Things (IOT) application and API to store and retrieve data from things using the HTTP protocol over the Internet or via a Local Area Network. ThingSpeak enables the creation of sensor logging applications, location tracking applications, and a social network of things with status updates .We have used Things Tweet, MATLAB analysis features of ThingSpeak for cloud [3] computing and analysis.The home screen of ThingSpeak is depicted in Fig; 11.

Fig: 11. Thingspeak Home screen

The analysis and mechanisms of system is given in Fig: 12.

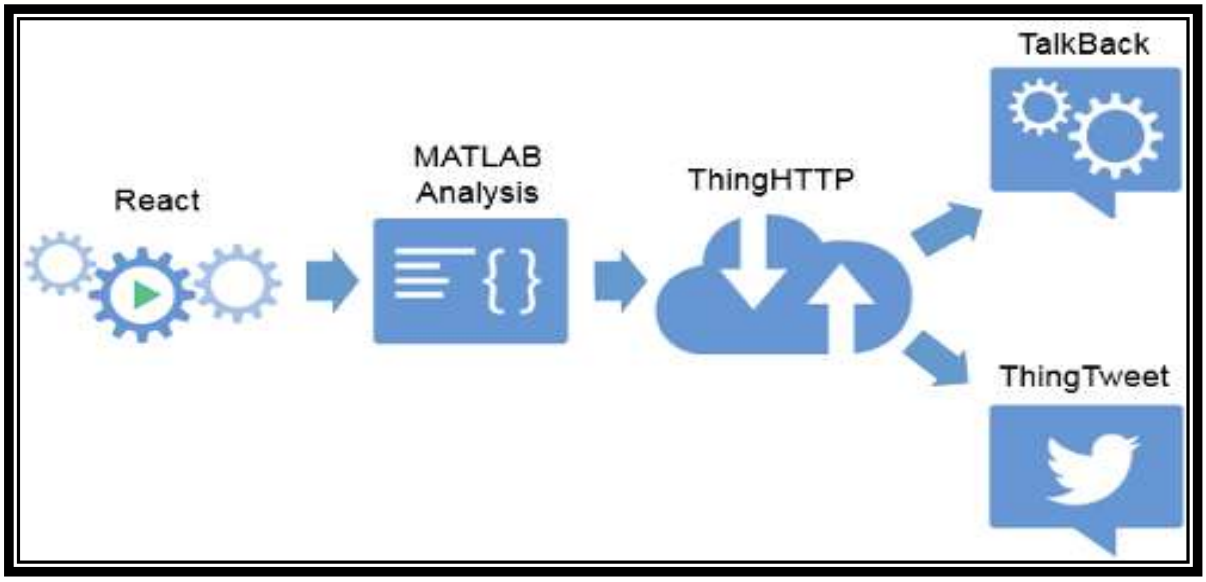


Fig: 12. Response and Analysis Mechanism

The final proposed model of our system is depicted in Fig: 13.

Fig: 13. Final Proposed Model

VII. FUTURE SCOPE

The Current System Can be further improved and upgraded by incorporating additional features like-

i) Incorporation more Sensors like ECG sensors, EMG sensors ,Airflow Sensors, Blood Pressure Sensors etc to investigate further important parameters of Human Body.

ii) GPS tracking and monitoring of the Health Suit so as to locate the user in Global Sphere.

iii) Development of more user-friendly and fluidic UI for better user experience.

iv) Development of efficient algorithms such that data received from sensors can be converted to more human understandable parameters.

v) Incorporation AI with cloud analysis such that pre warning notification can be generated from the received data of the sensors and take smart decisions.

VIII CONCLUSION

Even though a lot of research has been conducted on e-health monitoring systems, we have proposed a set of novel services based on the monitoring system. For final system development the research work is still going on. It will require immense research and testing before implementation, however it paves a new path for remote health monitoring systems. In our system ensures organized transmission of sensor data to monitoring. The medical data and history acquired for the patients are personal in nature. Hence our system ensures security of the highest order for the medical data on cloud storage. With further research in this aspect, our system can change the way we currently look at remote health monitoring services. We hope within a few couple of moth a fruitful system can be developed for improvement of our high-tech healthcare system.

REFERENCES

[1] M. Rajdhev, D. Stalin David, "*Internet of Things for Health Care", International Journal of Scientific Research in Computer Science, Engineering and Information Technology © 2017 IJSRCSEIT | Volume 2 | Issue 2 | ISSN : 2456-3307*

[2]Syed Muhammad Waqas Shah, Maruf Pasha, *"IoT-Based Smart Health Unit", Journal of Software, Volume 12, Number 1, January 2017, pp45-52*

[3] S. Sivakumar, V. Anuratha, S. Gunasekaran ,*" Survey on Integration of Cloud Computing and Internet of Things Using Application Perspective", International Journal of Emerging Research in Management &Technology – ISSN: 2278-9359 (Volume-6, Issue-4)- April 2017*

[4] Durga Amarnath M. Budida , Dr. R. S. Mangrulkar, *"A Review Paper on Design and Implementation of Smart*

Health Care System using IoT", International Conference On Emanations in Modern Engineering Science and Management (ICEMESM-2017) ISSN: 2321-8169 Volume: 5 Issue: 3,pp: 05 - 09

[5] Ketaki N. Bhoyar , Shivganga V. Gavhane, *"A SECURED MOBILE HEALTH CARE SYSTEM USING WIRELESS BODY SENSOR NETWORK",TORI, ISSN(PRINT): 2454-406X,(ONLINE): 2454-4078,VOLUME-2,ISSUE-4,2016*