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Remote Monitoring of Physiological Parameters Based on Wireless Embedded Internet

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Abstract : In current situation the most of the rural areas have not transformed in the medical assessment methods and local monitoring has been used to measure biological parameters.So multi-physiological parameter monitoring equipments are important, expensive, and not suitable for remote monitoring. So the proposed system integrates onboard and mobile communication machineries to develope a novel type of multi-biological parameter inspection system with distant data communication functionality. An embedded ARM-based computer system is formed first by assessing the underlying ideologies of the embedded system and Then, the human-computer contact interface, data procurement, and analytical segment are considered, Lastly, to communicate with the health center server by linking to the internet system we can access distant communication of local detection data and also alarm signals whenever met with the unsafe conditions are realized. The structure can gather and display numerous functional parameters such as pulse rate, blood pressure, oxygen capacity, and real-time body temperature. The results of the experiment shows that the monitoring function of the system and the distant data communication function comply with the project requirements and can quickly and precisely find unusual data and accomplish a remote alarm. The proposed system is having data transmission stability and high reliability and is also convenient for remote accessing so it's a supreme monitoring device for hospitals and public healthcare centers**.**

Keywords : ***Biological parameter, ARM Embedded system, Remote monitoring, Data transmission Function***

I. INTRODUCTION

In today's society, ageing of the population poses a serious social problem especially in case of elders health A good way to diagnose and treat cardiovascular disease is to prevent heart illness, high blood pressure, and other circulatory diseases that seriously impact elderly health, Mental health is determined by monitoring physiological parameters, so the actual monitoring, and study ofa user's most important biological parameters is extremely important when preventing, diagnosing, and treating chronic diseases. Since the 1970s, when the first single-purpose monitoring device was introduced, But, due to restrictions in its monitoring function, the equipment cannot meet the requirements of clinical monitoring applications. The development of sensors and electronics in the 1990s increased the number of monitoring parameters from single parameters to multiple parameters. Today Physiological parameter intensive care has developed alongside improvements in sensor technology, computer knowledge, and medical measurement. A few industrialized nations in Europe, such as the United States, Japan, and Germany, are leading research on functional parameter monitoring, but the majority of these studies use low-rating single-chip micros and have straightforward objectives. They are only able to collect and display ECG signals; they are unable to perform data analysis. The acquisition and processing of weak physical signals has improved more rapidly in developed countries than in domestic markets and monitors cannot be maintained in real-time. Due to the rapid growth of domestic technology, some excellent screen brands were developed in China as well, namely Shenzhen Mindray, Guangdong, Shenzhen, etc.

Embedded systems have developed rapidly with the expansion of microelectronic technology. The embedded computer can utilize its potent network connectivity and real-time monitoring capabilities in a remote monitoring system. When advanced data processing is not necessary, they can take the role of bulky, expensive industrial control systems The embedded computer system's strong processor and network connection capabilities make it simple to connect to the internet. The use of embedded computer systems in the remote medical monitoring system is significant from a practical standpoint. The computer-based monitoring system for several parameters is not only lightweight, small, and portable but also economical.

This paper defines the advancement that has evolved in medical field like multi-physiological parameter monitoring system using the ARM embedded platform. A linking to the internet web allows the system to interconnect with health center server via distant communication of local detection data and the sending off alarm indications when risky conditions are detected. Moreover, it can assemble and show multiple biological limitations such as heart rate, blood pressure,blood oxygen capacity, and body temperature in real-time. The monitoring function and remote data communication function of the system meet the design specifications, according to the test findings, It can detect the required data quickly and accurately and also can send an alarm signal remotely. Hence this paper proposes a new kind of multi- biological parameter monitoring arrangement that can transmit data remotely. It is compact, easy-to-expand, robust, reliable, portable, flexible, and ideal for hospitals and public medical centers.

1.1 Overview of Embedded System.

An embedded structure is a microcontroller or microprocessor based scheme which is intended toachieve a definite task, it has some applications in some specialized fields like home appliances, automation, telecommunication , instrumentation, aerospace so on. Figure 1 illustrates the three basic components of an embedded system: the hardware platform, the functional system, and the application software. The hardware component includes components like input/output interfaces, microprocessors, and application software that can control the things that need to be controlled. Thus, the processor is the central component of an embedded system that generates output after processing data**.** A simple human- machine interface enables the user to interact with the object and the interface is easy to operate. The operation of embedded systems requires continuous innovation and connecting new methods, which is particularly important in distributed environments.

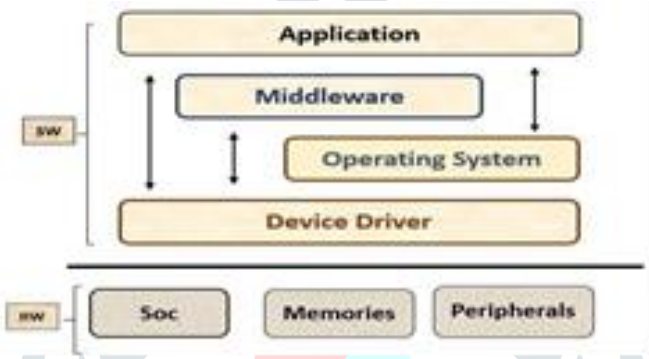


Figure 1; Embedded system architecture

Embedded systems are widely employed in a variety of industrial, instrumentation, and automotive settings. So. by connectingto the internet, embedded devices can actually achieve wireless remote data transfer and control. A web server and an embedded TCP/IP protocol stack make up the majority of the embedded internet.

1.2 Application of MATLAB

MATLAB is a mathematical computing environment developed by MathWorks that can be used to program in multiple paradigms. So in the proposed system MATLAB will be used forprogramming the raspberry pi which is an arm based embedded system to acquire the sensors datafrom raspberry pi and also processing the sensors values on the raspberry pi and analyzing the dataand sharing the information to the users/doctors/nurses over internet network.so by making use ofthis tool we can also create a human computer interface for viewing and analysing the data.

II OBJECTIVE

The main objective of our project is that it is giving remote access to the Doctors or Nurses or any users with sensor modules, matlab software and remote data transmission function to analyze and judge the patients physiological information in time and also transmitting this physiological information/data to the monitoring center through internet/wifi with the help of iot cloud server so that doctors or nurses can monitor the patients health status in a timely manner there by providing protection for patients life safety from remote location.

III DESIGN OF PROPOSED SYSTEM.

The medical monitoring system tracks a number of biological parameters of the human body using an embedded computer system.So its an ARM based monitoring system which typically contains multi-parameter sensor circuits and ADC module which is responsible for analog-digital conversions which are basically used to collect the physiological data such as blood pressure, body temperature, blood oxygen ,heart rate,pulse rate respectively.in theproposed system we have used an arm processor so as to receive the collected data correspondingly that sends the respective to the user interface created by Matlab which displaysand stores the collected data. From the UI interface the required data will be send to the Gmail,data base as well as to the iot cloud server that enabling on-site monitoring. By communicatingthese composed data over the Internet or web server, distant multi-parameter intensive care can be realized.

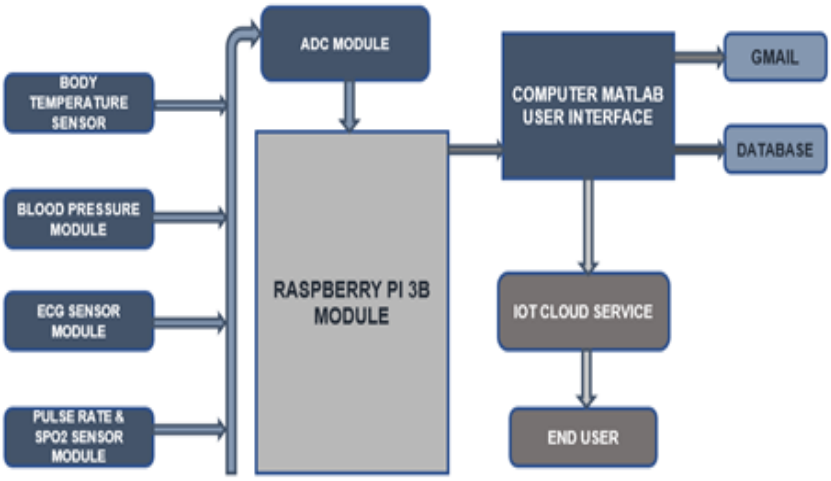


Figure 2. Block diagram of the system

3.1 Application of Embedded Internet Technology

A method for combining embedded systems and the internet to build a system network. The two elements of embedded internet systems are data transfer between fieldbus strategies and gateways,internet protocol adaptation like Wi-Fi, Zigbee, Bluetooth and data analysis. Thanks to technology like embedded systems andthe Internet, sharing resources, connecting, and managing remote devices are now easier.

3.2 Human Communication Interface Module.

Human-computer communication interface allows user and computer to interact with each other. A total of five interfaces are available in the system, including the core interface, the structure interface, the PCA interface, and the ECG interface. Here both system and PCA-settinginterfaces are transferred from the core interface, both the patient data setting interface and the ECG setting interface are part of the system setting interface.In this system, an interface can be divided into four parts: a dimension area, a parameter setting and demonstration area, awaveform exhibition area, and a result demonstration part.In general, the parameter set and display area consists primarily of the system set button, the PCA set button, etc.

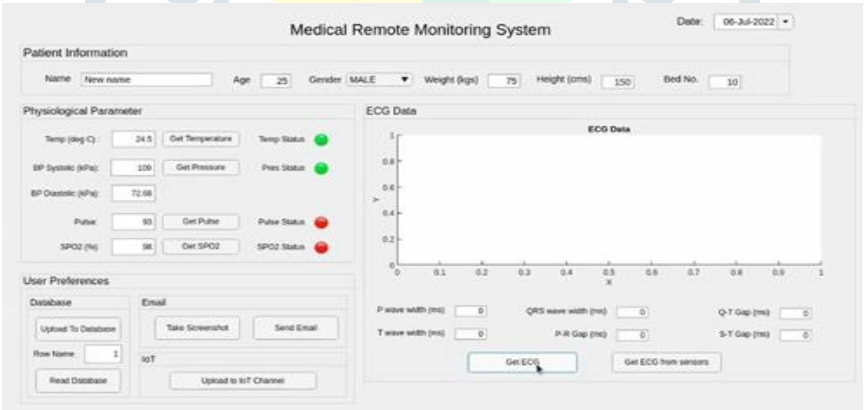


Figure 4. Human UI interface

In user interface functional measurement area consists of two functions to measure blood pressure andtemperature, the display area for test results includes parameters such as heart rate, blood oxygenlevel, pulse rate, blood pressure, normal and anomalous information. waveform demonstration area largely includes ECG signals and pulsation waveforms. The key interface features mainly blood pressure, measurement functions, waveforms, measurement results, and alarm data. By clicking the get push control in the main interface, the UI thread will begin gathering the relevant data and send instructions for data assembly to the hardware over the serial connection.The hardware will then begin gathering data after it has received the acquisition command. Following that, data will be transmitted via I2C serial bus to the data analysis thread, and finally, a data will be updated on the UI interface. Here, the interface module has a database area for storing data as well as a user communication preference channel like email or an IoT cloud server that allows end users to access the same information from a distance location.

IV DATA AQUISITON FROM SENSOR MODULE'S.

The data aquisition module generally collects ECG data, blood oxygen information, bloodpressure data, and body temperature data. There are three threads in this module: one for acquiring ECG data, one for acquiring blood oxygen data, and one for acquiring blood pressure data During the collection of ECG and blood oxygen data, real-time data is acquired, while during the collection of blood pressure data, data is acquired for each measured blood pressure.

1.Ecg Data Collection:

The ECG waveforms can be collected via many leads and vary from person to person, but they can be broken down into certain common parts like P, Q, R, S, T, and U waves, as well as P-R intervals, S-T segments, and Q-T intervals, among others. There are numerous methods for detecting ECGs.

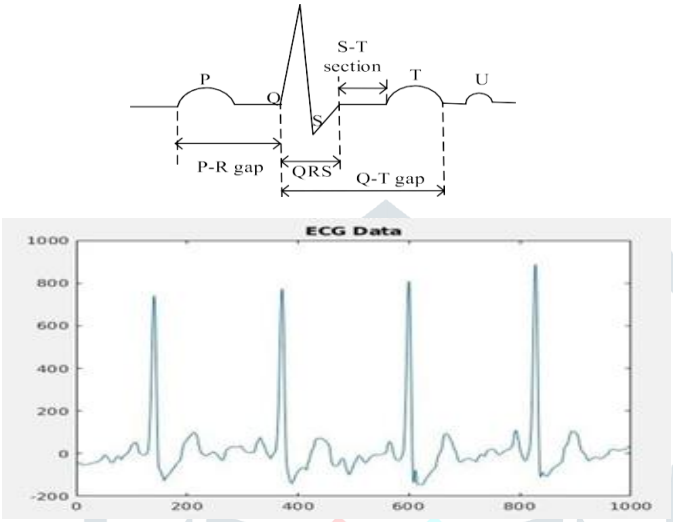


Figure 5.Getting ECG data from sensor in matlab

The P wave in the given ECG waveform signifies the possible variation that occurs during the atrial muscle's depolarization and is known as the atrial stimulation wave. Its width and amplitude are both less than 0.11 seconds. The remaining three waves Q, R, and S are collectively referred to as QRS complexes, because they represent all of the ventricular muscles'potential fluctuations during depolarization. The P-R interval of a healthy adult ranges from 0.1 to 0.20 seconds, and the S-T part, which stands for weak electrode variation created throughout the process of repolarization after ventricular depolarization, refers to the period from the end ofthe QRS complex to the start of the T wave. When the heart rate is less than 60 or greater than 100,then alarm signal is transmitted to the abnormal alarm thread. The ECG data analysis thread, in the meantime, manages the alert signaland also shows the aberrant heart rate on the user interface. The ECG data is then transmitted across the network to a distant server for processing via the network communication thread. Theinformation is directed to the main interface for demonstration if the heart rate is within the typical range, which is between 60 and 100.

2. Body Temperature Data Collection:

The body's temperature is an indicator of how efficiently it can generate and expel heat. The bodymaintains its temperature within a safe range even when the environment around it changes substantially in temperature. The normal temperature range for humans matches their body temperature. The average range for human body temperatures is 36.5 to 37°C. Individuals have varying body temperatures. In the proposed system we have used BMP180 sensor which is also atemperature sensor to measure and collect the body temperature data

3. Blood Pressure Data Collection.:

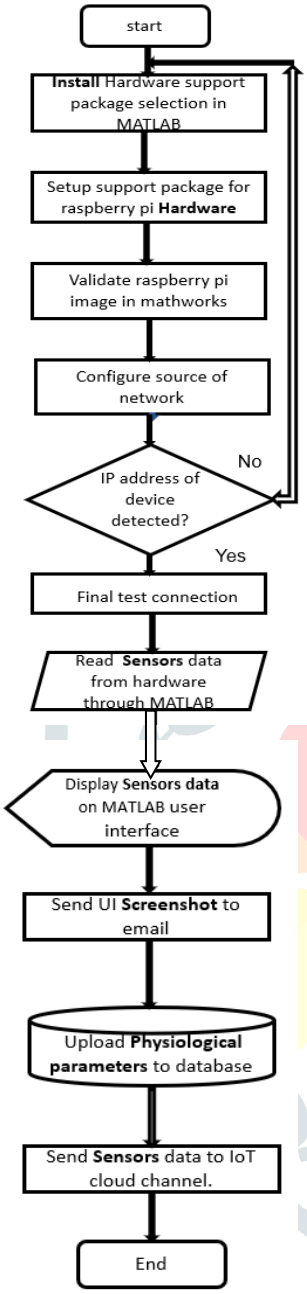
A blood pressure measurement can be done invasively as well as non-invasively. The Blood Pressure Sensor, a non-invasive gadget, measures human blood pressure, a crucial indicator. Pressure sensors are used in this gadget to monitor the systolic, diastolic, and mean arterial pressure. Circulating blood puts pressure on a blood vessel's walls. By dividing the systolic pressure by the diastolic pressure, a blood pressure reading is obtained.So with the help of barometric pressure sensor BMP180, we have collected the relevant data using anarm embedded raspberry pi 3b+, analysed the data using matlab software, and showed it on the UI interface.

4. Blood oxygen and spo2 Data Collection:

Blood oxygen capacity and pulsation rate, which are crucial physiological parameters for patient monitoring, In the analysis of blood oxygen information, a high saturation indicates that the body's metabolism is too high and its metabolic rate is too high when the saturation is at or over 100%. If the blood oxygen saturation is less than 90%, the oxygen delivery to the human blood is insufficient and it is too low. In order to collect the heart rate and blood oxygen saturation for the proposed system, we have

employed the MAX30100, a combined pulse oximetry and heart rate monitor sensor.Along with these sensors, we have employed ADC Module ADS1115, a 16-bit analog- to-digital converter that can measure a wide range of signals with high precision. It is also a fantastic choice for usage in the system because it is ultra-compact, low power, and has an internal reference voltage

Algorithm Flowchart of Working Principle.



V. EXPERIMENTAL SETUP AND RESULTS.

The experimental setup for the system is shown below i.e. the work is finished that consists of hardware setup and computer system and both connected with the help of internet /Wi-Fi protocol as shown below . According to test results, the client can use its own local browser to access the patient's medical records or check on the patient's health status from any location. In medical field this system actsas data acquisition, control system and also as web server, so the system is compacted with less complexity. So here we got the results from the data collected or taken from the particular sensorcircuits as shown in below figures respectively.

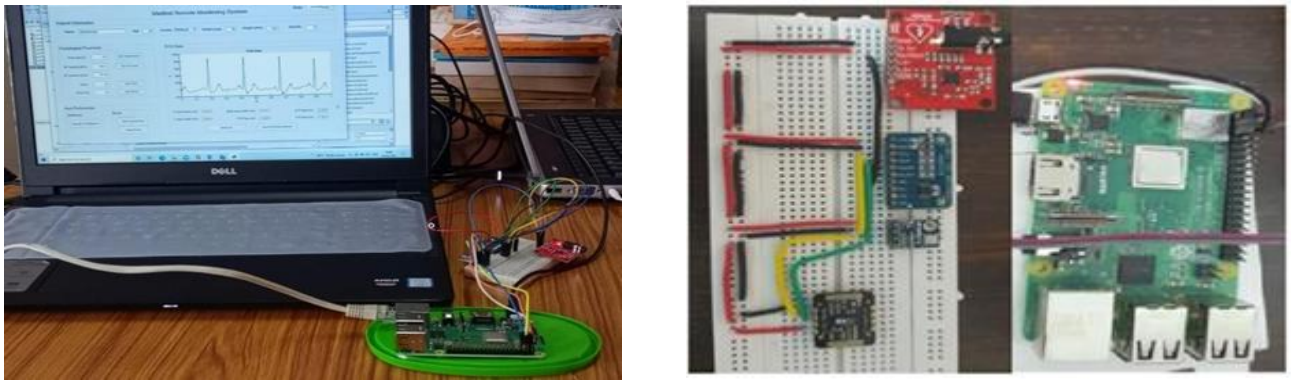


Figure 6 Experimental setup

Figure 7 Created user interface in Matlab

Figure 8 Getting all patients data from sensors through UI interface

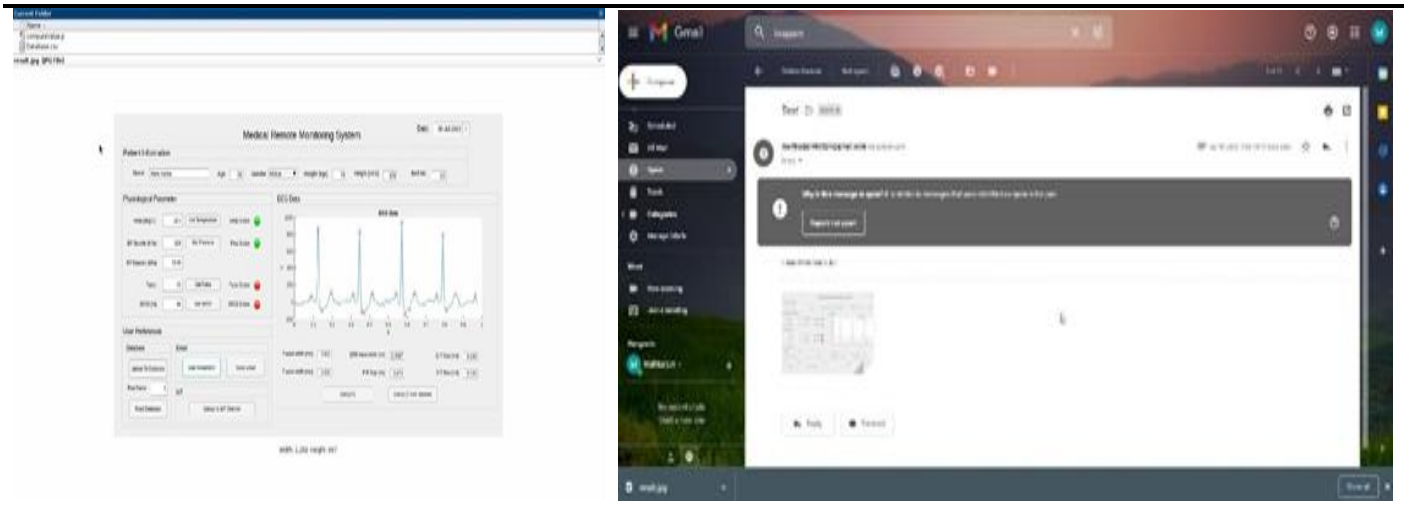


Figure 9 Screenshot image of above UI information/Data is received through mail

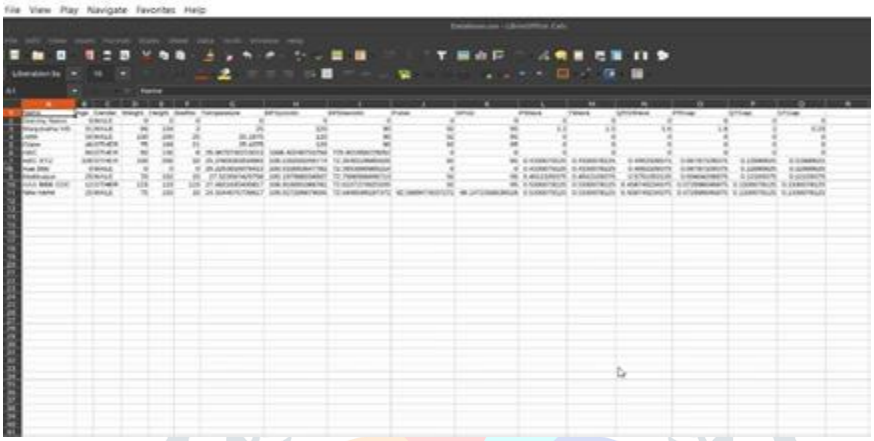


Figure 10 Data stored in database

5.1 IOT with Adafruit.io cloud service.

In the present situation there are many solutions in the cloud like Azure, AWS and google which have a great and complex iot platform out there but adafruit is one of the solution which is a verygood iot platform. In the proposed system we are sending all the patients health information to the cloud service called Adafuit io in which we have created the feeds for navigation and also with the help of source of internet anyone can easily access the same information from remote location.Here we have used python script that is used to connect our system to web services and makes possible to visualize our data in real time.

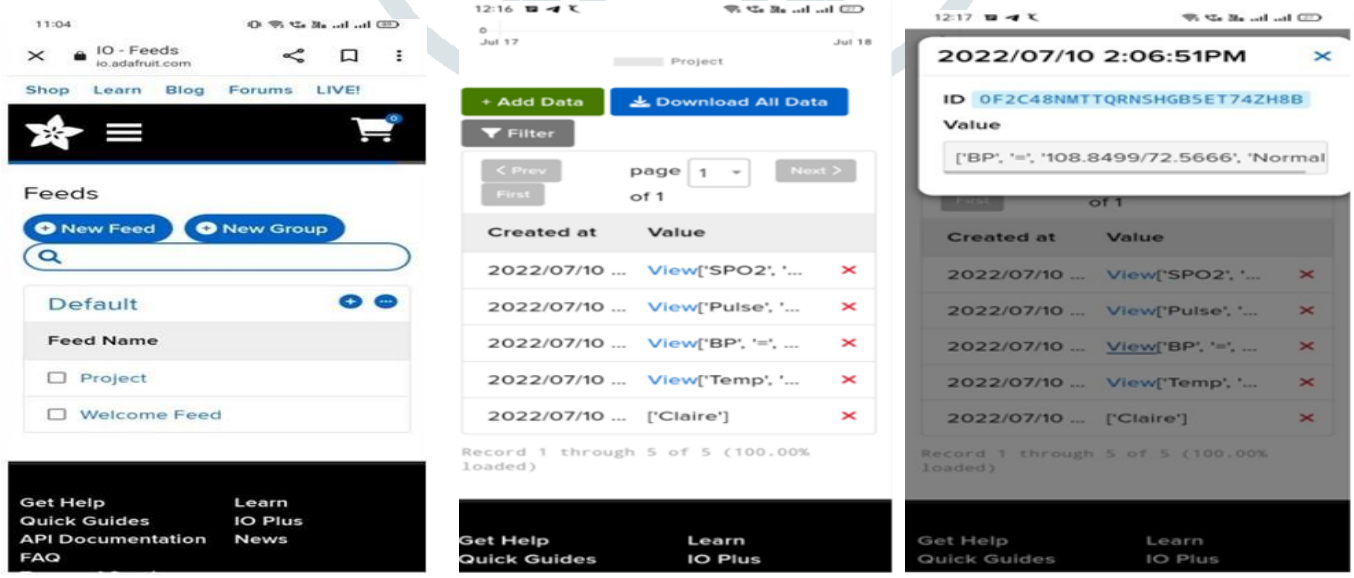


Figure 11 Data received through iot cloud service.

VI. CONCLUSION

Medical surveillance systems have become more and more important as new medical technologyhave evolved and as the world's population has grown. Therefore, in telemedicine, an embedded computer system may evaluate the patient's functional data in real time and transmit it to the monitoring centre over an internet web system. In such a case, doctors are able to immediately determine a patient's health status, saving their lives. This addresses the population's urgent need for remote, real-time health indicator monitoring and protection. To track and identify numerous physiological characteristics in healthy people and to diagnose and treat illnesses earlier, multi- parameter monitors should be employed. Consequently, this device can monitor the patient at any time and be quick and user-friendly.

VII.ACKNOWLEDGEMENT

Peer discussions and contributions On the aforementioned topics, researchers value their colleagues' great conversations and contributions.

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