VISVESVARAYA TECHNOLOGICAL UNIVERSITY

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A Project Report on

"Real-time and secured wireless health monitoring system"

Submitted in partial fulfillment of the requirements for the award of the degree of

Bachelor of Engineering

in

Electronics and Communication Engineering

by

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July 2022

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CERTIFICATE

This is to certify that the project work entitled **"Real-time and secured wireless health monitoring system"** is carried out by **Amith N (4JN18EC009), Arjun Kamath (4JN18EC014), Chethan R(4JN18EC021), Chinmay G P(4JN18EC023)** , the bonafide students of JNN College of Engineering, Shimoga in partial fulfillment for the award of "Bachelor of Engineering" in department of "Electronics and Communication Engineering" of the Visvesvaraya Technological University, Belagavi, during the year 2021-2022. It is certified that all the corrections/suggestions indicated for internal assessment have been incorporated in the report deposited in the departmental library. The project report has been approved as it satisfies the academic requirements in respect of project work prescribed for the said degree.

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ABSTRACT

Health is very important for human life, especially of old age people. In this modern generation occurrence of diseases became more compared to earlier so it became necessary to take care of health. In these days heart attack cases are increasing and also other diseases, so as to prevent these, real time health monitoring is needed. In current health care-system the patient needs frequent visit to hospital to know their health condition, which is not an easy task to do for patient. Our project will provide a health model which help to monitor patient by 24*7 which avoids the need to visit hospital frequently. This helps to know the health condition of patient using wearable sensors and internet of things technology. In our project, few parameters has been chosen Electrocardiogram (ECG), Pulse rate, Temperature and Position detection by using wearable sensors. These sensors are connected to Raspberry pi. Once the node MCU is connected to internet, it acts as a server and sends data on a specific URL. The parameters can be monitored on any mobile device including laptops or smart phones which are connected under same network.

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Chapter 1

Preamble

1.1 Introduction

Health is one of the global challenges for humanity. In the last decade the healthcare has drawn considerable amount of attention. The prime goal was to develop a reliable patient monitoring system so that the healthcare professionals can monitor the patients, who are either hospitalized or executing their normal daily life activities. Recently, the patient monitoring systems is one of the major advancements because of its improved technology[1]. Currently, there is need for a modernized approach. In the traditional approach the healthcare professionals play the major role. They need to visit the patients ward for necessary diagnosis and advising. There are two basic problems associated with this approach[2]. Firstly, the healthcare professionals must be present on site of the patient all the time and secondly, the patient remains admitted in a hospital, bedside biomedical instruments, for a period of time[3]. In order to solve these two problems, the patients are given knowledge and information about disease diagnosis and prevention. Secondly, a reliable and readily available patient monitoring system (PMS) is required[4]. In order to improve the above condition, we can make use of technology in a smarter way. In recent years, health care sensors along with raspberry pi play a vital role. Wearable sensors are in contact with the human body and monitor his or her physiological parameters. In our system we are measuring patients parameters (ECG, temperature, heart rate, pulse, etc) with different available sensors[5]. These sensors collected data i.e. biometric information is given to raspberry pi and then it is transferred to server. In this modern generation occurrence of diseases became more compared to earlier so it became necessary to take care of health[6]. Now a days heart attack cases are increasing also other diseases[7].so, as to get the emergency disfunctions from a hospitalized patient body, real time health monitoring is needed. Continuous monitoring of critical patients and their biological parameters are transmitted to doctors console, and doctors domain address in person using Internet of Things technology (IoT). This project helps to know the health condition of patient using wearable sensors. In this project, few important parameters has been chosen Electrocardiogram (ECG), Pulse rate, Temperature and Body Position detection by using wearable sensors.

1.2 Literature Survey

1.Wearable Monitoring devices by Teng XF et.al.,2017(IEEE Rev Biomed Eng)Journal of biomedical and health informatics VOL.21, NO.5, Nov 2018

Technology plays the major role in healthcare not only for sensory devices but also in announcement, recording and display device. Internet of things serves as a compound for the healthcare and plays prominent role in wide range of healthcare applications. In this project the PIC18F46K22 micro-controller is used as a gateway to communicate to the various sensors such as ECG sensor and pulse oximeter sensor.

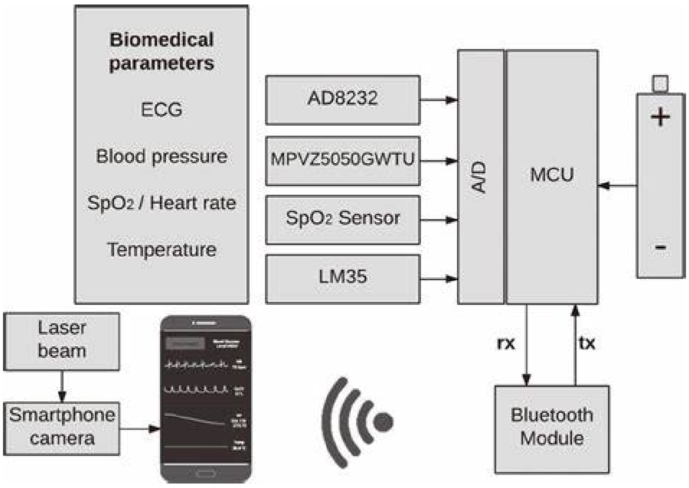


Figure 1.1: Frame work of health monitoring system

Advantages

- Portable and user-friendly.

Disadvantages

- Inaccurate of data due to wrong positioning of devices.

2.Smart-phone Based Health Monitoring System by Md. Milon Islam and Md. Rashedul Islam in 2019.VOL.NO.2, ISSUE 12

The authors proposed an effective approach, Smart phones are one of the most useful devices in the world. A smart phone usually contains many types of sensors and many sensors to be added in the future. Other sensors included in the smart-phone are wireless sensors, Bluetooth module, Accelerometer, Fingerprint sensor, Gyroscope, Magnetometer, Barometer, Proximity, GPS tracker, Camera, NFC - next to the field sensor most commonly used for health programs monitoring. Advantages: Wifi-fingerprints are used to find the locations of patients in indoor environment during emergency situations.

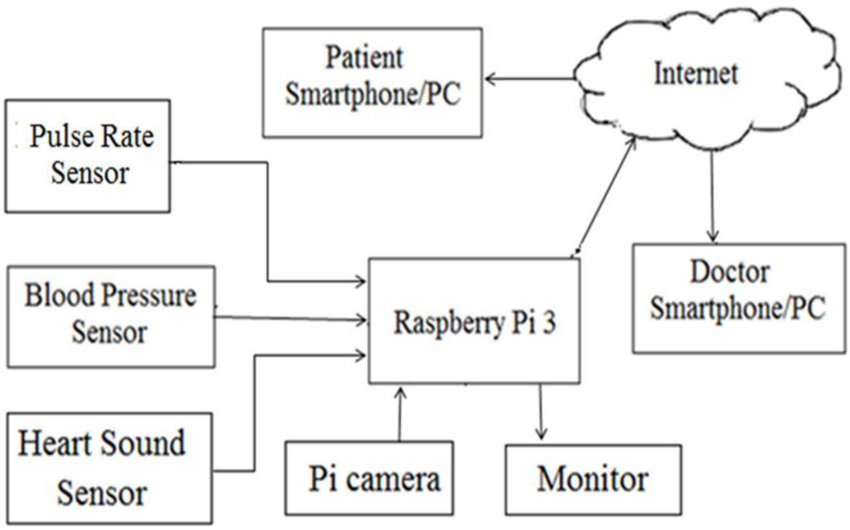


Figure 1.2: Block diagram of proposed system algorithm

Disadvantages

- Data may not be accurate always due to environment interface by wifi-signals.

3.Continuous Heart rate Monitoring System using IoT by Johan Bhurny et.al.,2018. IEEE instrumentation and measurement society

The authors proposed an practical research to create a less expensive PPG sensor and this is achieved by using a combination of LED-photodiode to emit light and receive reflected light. It penetrates into the tissues deep enough to detect a variety of blood volume. A light-based sensor can be used to detect this variety of heartbeats, this is done using a non-invasive Photoplethysmography (PPG) sensor.

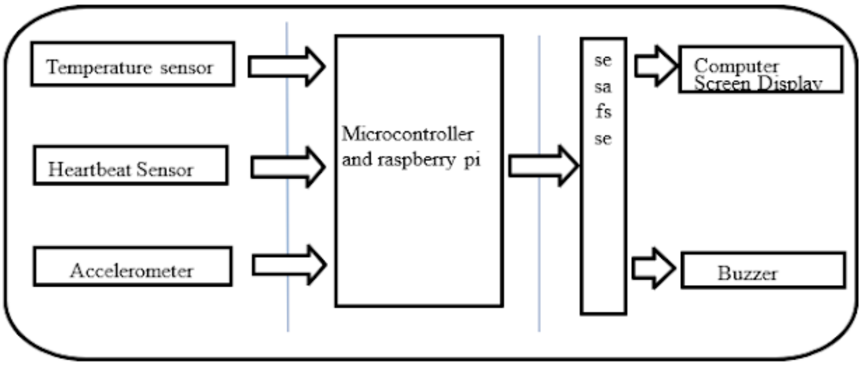


Figure 1.3: proposed system

Advantages:

- Monitoring through single platform of hardware and software.

Disadvantages:

- Multiple applications lead to complexity.

4.Secured Smart Healthcare Monitoring System Based on IoT by Mara Viqueira Villarejo and Begoa. Volume 63, Issue 6

Serves as a compound for the healthcare and plays prominent role in wide range of healthcare applications. In this project the PIC18F46K22 microcontroller is used as a gateway to communicate to the various sensors such as ECG sensor and pulse oximeter sensor. The data can be accessed anytime by the doctorGarca Zapirainetal in 2016,Alterations and Stress Using an ECG and a SCR 3 Technology plays the major role in healthcare not only for sensory devices but also in announcement, recording and display device. It is very important to monitor a number of medical parameters and post operational days. Hence the latest trend in Healthcare communication method using IOT is adapted Internet of things.

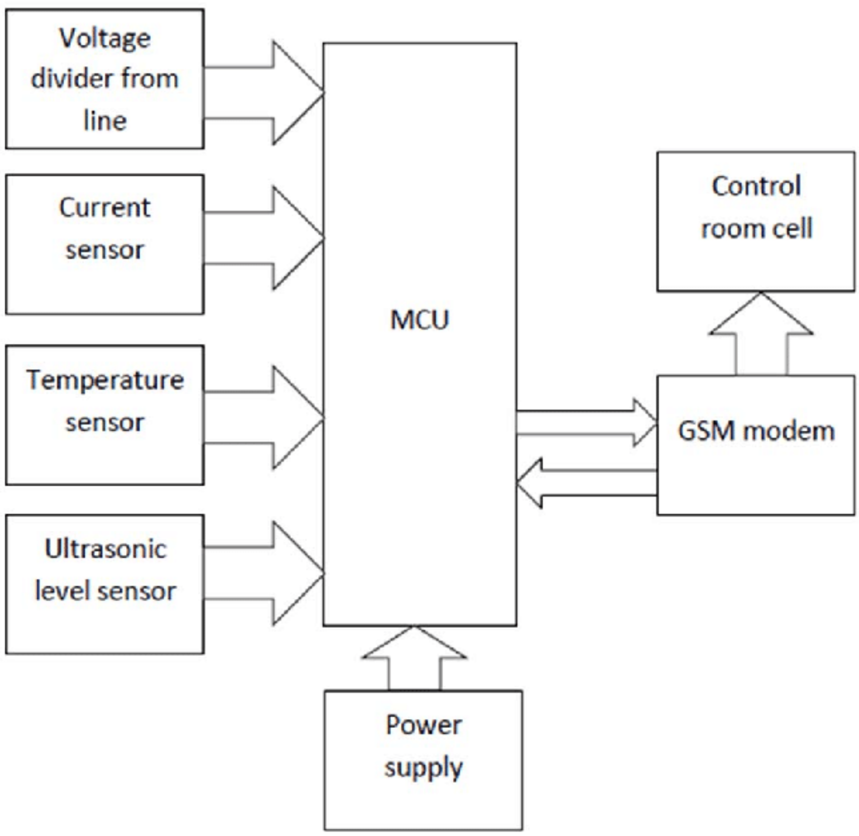


Figure 1.4: Preprocessing steps implementation

5.Well-being monitoring through wireless sensor network and cloud computing using IoT by Sunil L. Rahane et.al ,7 July 2017, International Journal of Advanced Research in Electrical, Electronics and Instrumentation.VOL.4,Issue 2

In most of the hospitals health professionals use heart rate monitoring systems using manual methods to measure ECG by connecting lids to the chest of patient. The graph of ECG is monitored on the bedside monitor or special monitoring devices. These devices are wired and bulky and do not support long distance communication. The systems have many disadvantages like requirement of costly hospital stays which is not affordable for longer periods, needs expert monitoring and high cost maintenance. Current advances lead to automation of heart rate and ECG measurement using different methods.

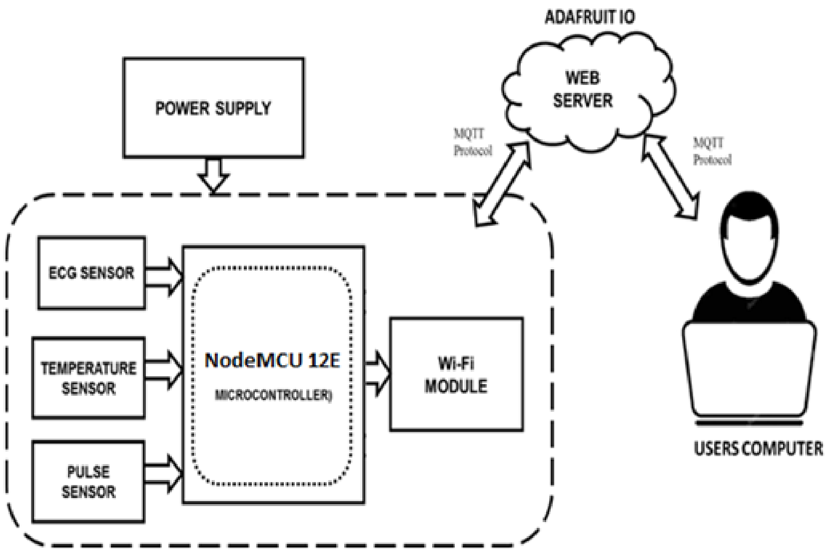


Figure 1.5: block diagram of health system

1.3 Aim of the project

To design and develop IoT based Real-time and secured wireless patient health monitoring system using server to store the patients health data and alert the doctors in case of emergency.

1.4 Objectives

- To understand the health condition of the patient by downloading all the data from the website.
- To analyze the ECG, pulse rate, temperature and body movement using python code and obtain the real-time signals from patient body.
- To transmit the obtained signals to the base station.
- Received signals are analyzed at the server.

1.5 Methodology

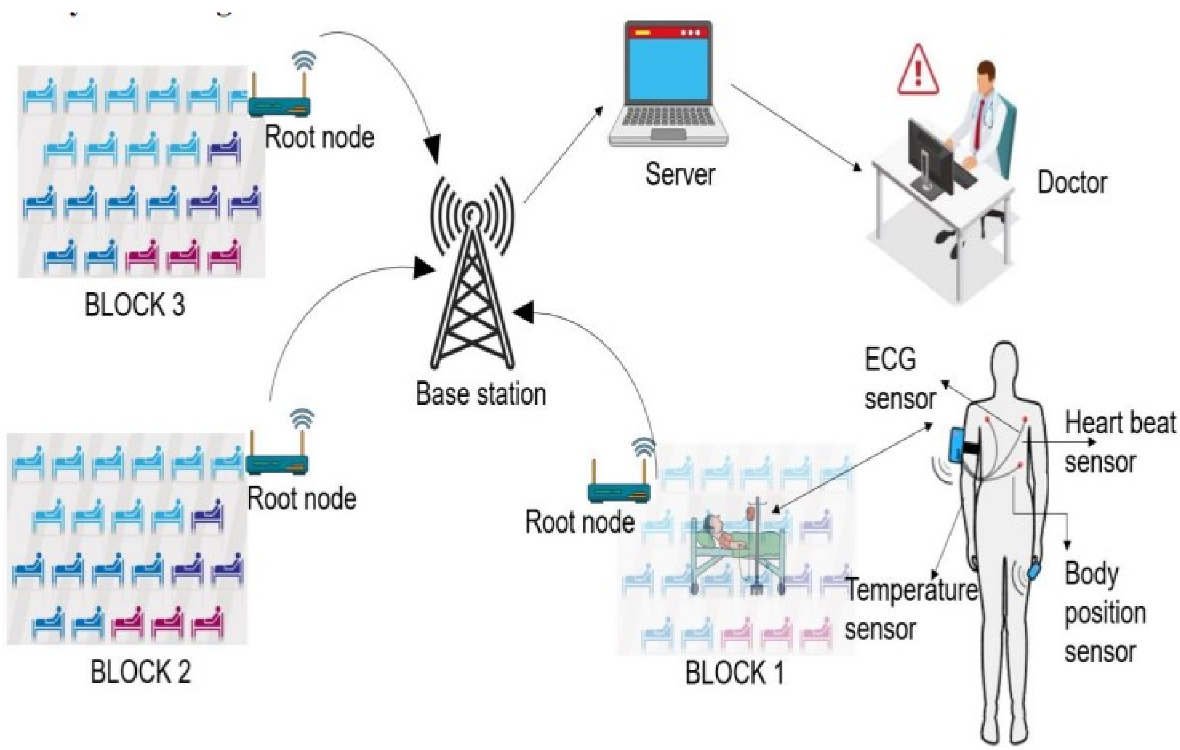


Figure 1.6: Conceptual architecture of Real-time health monitoring system

STEP 1:

The Pulse Rate sensor is fixed to the patients finger. This contains an IR sensor in it. Every pumping we get pulse from that sensor. This sensor output is given to the ESP8266 Node MCU via Signal conditioning unit for amplification.

Figure 1.7: Pulse rate sensor

STEP 2:

NTC type thermistor is used as a temperature sensor. This temperature sensor output varies based on the temperature, this output is also given to NodeMCU.

Figure 1.8: Temperature sensor

STEP 3:

ECG sensor is a cost-effective board used to measure the electrical activity of the heart. This electrical activity can be charted as an ECG or Electrocardiogram output as an analog reading. ECGs can be extremely noisy, the AD8232 Single Lead Heart Rate Monitor acts as an op-amp to help obtain a clear signal from the PR and QT Intervals easily and connected to Node MCU.

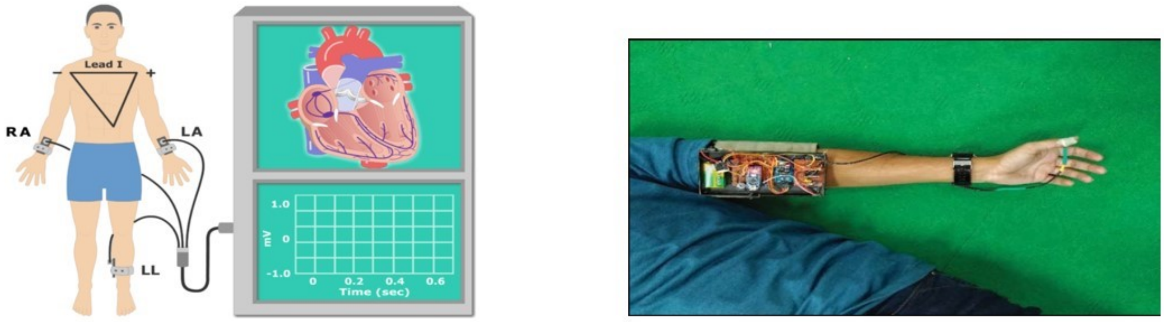


Figure 1.9: ECG setup for a patient

STEP4:

The accelerometer sensor ADXL335 used here is a full -3-axis accelerometer with small, thin, low power, signal outputs. This measures the full range of acceleration. This sensor is able to find the gravitational fixed acceleration in various applications. The user sensor uses the X, Y and Z capacitors.

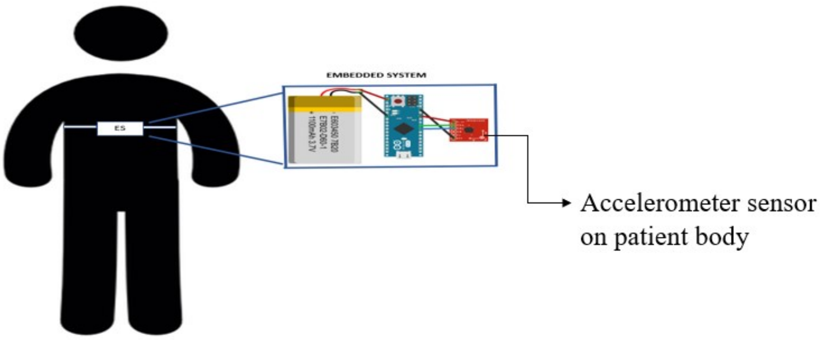
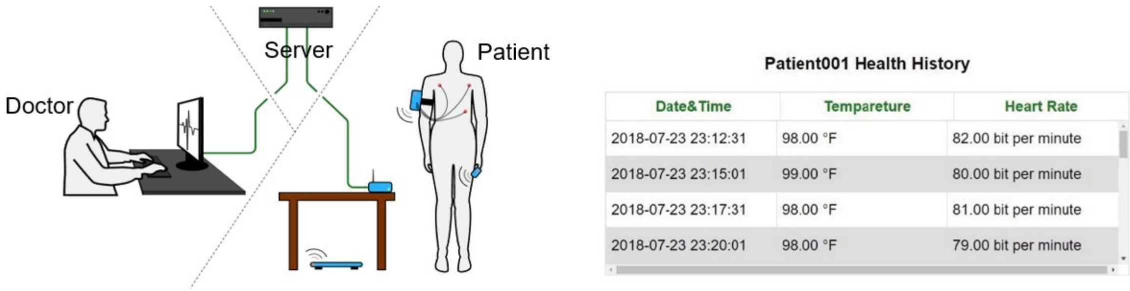


Figure 1.10: Accelerometer sensor setup on patient body

STEP 5:

All signals are collected in Node MCU and transferred to the server where all data are stored. If the condition of the Patient is critical, it will alert the doctors through message alert these sensors are connected Node MCU it acts as a client and sends data on a specific server. Here the base station gets all the signals from various sensors from more than one patient in a hospital blocks. The parameters are continuously monitored by the doctor or a medical examiner.



Date&Time	Tempareture	Heart Rate
2018-07-23 23:12:31	98.00 °F	82.00 bit per minute
2018-07-23 23:15:01	99.00 °F	80.00 bit per minute
2018-07-23 23:17:31	98.00 °F	81.00 bit per minute
2018-07-23 23:20:01	98.00 °F	79.00 bit per minute

Figure 1.11: overall scenario of smart health monitoring system

1.6 Scope of the project

The system can be further improved further by adding artificial intelligence system components to facilitate the doctors and the patients. The data, consisting medical history of many patients parameters and corresponding results, can be explored using data mining, in search of consistent patterns and systematic relationships in the disease. For instance, if a patients health parameters are changing in the same pattern as those of a previous patient in the database, the consequences can also be estimated. If the similar patterns are found repeatedly, it would be easier for the doctors and medical researchers to find a remedy for the problem.

1.7 Limitations

Limited Accessibility:

Reliable broadband connectivity is a must when implementing RPM, which makes doing so difficult for smaller healthcare facilities and those in rural or underserved areas. Economic considerations are often an issue in some of these facilities and even in urban areas that are otherwise well-served but may be operating under financial duress.

Lack of Patient and Provider:

RPM is one of the least effective patient engagement initiatives. Researchers have explained that the relatively low enthusiasm for RPM is due to the fact that wearables arent yet accessible for all patients, and that reliance even in part on patients to monitor and maintain equipment on their end makes many clinicians skittish. Some physicians have expressed concerns over the integrity (or accuracy) of retrieved data, and some patients have balked over security issues, i.e., the potential for their private health data to be intercepted by third parties and used for nefarious purposes.

Lack of Provider Engagement:

In addition to provider skepticism and resistance to the unfamiliar, some clinicians also cite doubts that RPM technology will help increase patient accountability and prompt higher-risk patients to moderate high-risk behavior. Some physicians and clinics have also balked at the initial expenditure for implementing RPM, increased software requirements, and compatibility issues with electronic medical record systems.

Error Rates of Existing RPM Utilities:

The reliability and accuracy of some wearable devices have also come into question among physicians, who have cited the fact that manufacturers provide little or no documentation to support said reliability and accuracy regarding their products. Many of these are reluctant to stake their reputations and patient health on devices for which error rates are unknown. A recent review in JAMA Dermatology showed that smartphone apps for melanoma detection have a 30between various wearables showed large variations in accuracy between different devices, with error margins of up to 25 percentage.

1.8 Organization of the report

This report is organized into four chapters.

The Chapter 1 includes the introduction about the project, i.e aim and objectives, methodology and literature survey.

The Chapter 2 includes the theoritical background.

The Chapter 3 contains design and implementation of our project like block diagram and software details.

The Chapter 4 includes the results that we have obtained.

The Chapter 5 includes the conclusion and expected results.

Chapter 2

Theoritical Background

2.1 Raspberry Pi 3

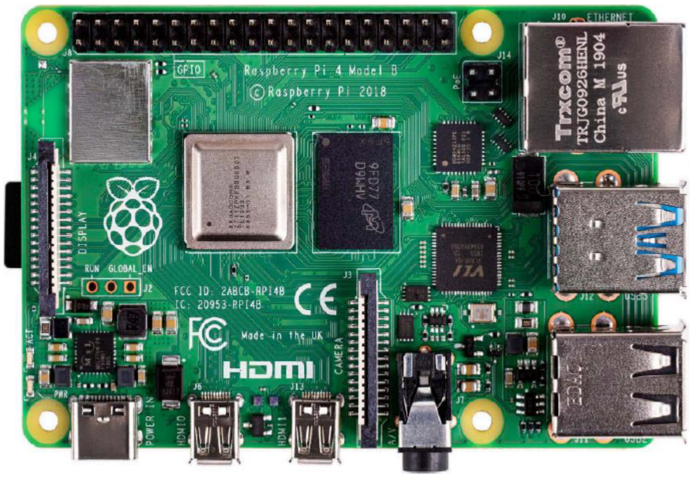


Figure 2.1: Raspberry PI Module

The Raspberry Pi 3 Model B is the latest version of the low-cost Raspberry Pi computer. The Pi is not like your typical device; in its cheapest form it does not have a case, and is simply a credit-card sized electronic board of the type you might find inside a PC or laptop, but much smaller. we are using with version 8GB of RAM for its better all-round performance. The Raspberry Pi is a credit card-sized computer with an ARM processor that can run Linux. This item is the Raspberry Pi Model B+, which has 512 MB of RAM, an Ethernet port, HDMI output, audio output, RCA composite video output, four USB ports, and 0.1 spaced pins that provide access to general purpose inputs and outputs (GPIO). The Raspberry Pi requires a microSD card with an operating system on it. The Raspberry Pi is very popular, with lots of example projects and information available online. The Raspberry Pi is a credit card-sized computer based on the BCM2835 system on chip, which includes an ARM11 processor and a powerful GPU. The Raspberry Pi supports various distributions of Linux including Debian, Fedora, and Arch Linux.

The Raspberry Pi was designed by the Raspberry Pi Foundation in order to provide an affordable platform for experimentation and education in computer programming. The Raspberry Pi can be used for many of the things that a normal desktop PC does, including word-processing, spreadsheets, high-definition video, games, and programming. USB devices such as keyboards and mice can be connected via the boards four USB ports. With its 0.1-spaced GPIO header and small size, the Raspberry Pi also works as a programmable controller in a wide variety of robotics and electronics applications. Over two million Raspberry Pi have been sold, and lots of resources for the Raspberry Pi are available online.With its 0.1 spaced GPIO header and small size, the Raspberry Pi also works as a programmable controller in a wide variety of robotics and electronics applications. It can also be combined with our A Star 32U4 Robot Controller LV with Raspberry Pi Bridge to make a great controller for a small robot. We also carry a selection of Raspberry Pi expansion boards.

To use the Raspberry Pi, you will need a few additional things that are not included: A 5 V power source with a micro USB connector. We recommend this 5 VDC 1 A wall power adapter and a USB A to MicroB cable. A microSD card with an operating system on it, which also serves as the main storage for the device. Input and output devices, such as a keyboard and monitor. You might also consider getting a case to house and protect your Raspberry Pi, such as the Translucent Enclosure for Raspberry Pi Model B+.While the Raspberry Pi is powered from a 5 V supply, it operates at a 3.3 V logic level and its pins are not 5V-tolerant. Connecting higher voltages, like 5 V, directly to an I/O pin could damage the board. We recommend you use something like our bidirectional logic level shifter to interface this board with 5V systems.

One feature included with the Raspberry Pi 3 Model B+ is a wireless dual-band LAN that comes with modular compliance certification. For those who are unaware, electronic products cannot be constructed and then released to the market without having some tests done to them, and many of these tests look for interference. Testing for interference can be incredibly costly and difficult to isolate, but, thanks to the WLANs modular compliance certification, you can expect significantly lower EMC issues when integrating the Pi into a product.

2.2 Node MCU

Figure 2.2: Node MCU

The NodeMCU (Node MicroController Unit) is an open source software and hardware development environment that is built around a very inexpensive System-on-a-Chip (SoC) called the ESP8266. The ESP8266, designed and manufactured by Espress if Systems, contains all crucial elements of the modern computer: CPU, RAM, networking (wifi), and even a modern operating system and SDK. When purchased at bulk, the ESP8266 chip costs only 2 USD a piece. That makes it an excellent choice for IoT projects of all kinds. Through its pins we can read inputs - light on a sensor, a finger on a button, or a Twitter message -and turn them into an output - activating a motor, turning on an LED, publishing something online. It has also WiFi capabilities, so we can control it wirelessly and make it work on a remote installation easily! We can tell our board what to do by sending a set of instructions to the microcontroller on the board. To do so we can use the the Arduino Software (IDE).

2.3 Temperature sensor

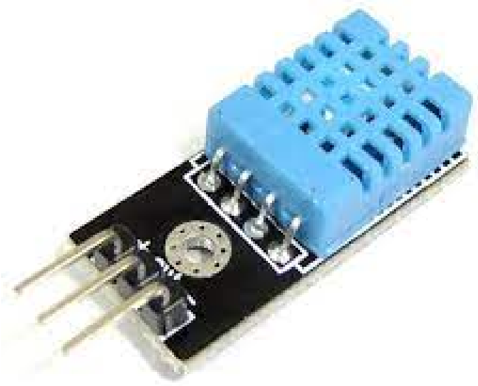


Figure 2.3: DHT11 Temperature sensor

DHT11 sensor consists of a capacitive humidity sensing element and a thermistor for sensing temperature. The humidity sensing capacitor has two electrodes with a moisture holding substrate as a dielectric between them. Change in the capacitance value occurs with the change in humidity levels. The IC measure, process this changed resistance values and change them into digital form.

For measuring temperature this sensor uses a Negative Temperature coefficient thermistor, which causes a decrease in its resistance value with increase in temperature. To get larger resistance value even for the smallest change in temperature, this sensor is usually made up of semiconductor ceramics or polymers.

The temperature range of DHT11 is from 0 to 50 degree Celsius with a 2-degree accuracy. Humidity range of this sensor is from 20 to 80 percent with 5 percent accuracy. The sampling rate of this sensor is 1Hz .i.e. it gives one reading for every second. DHT11 is small in size with operating voltage from 3 to 5 volts. The maximum current used while measuring is 2.5mA

2.4 ECG sensor

The AD8232 sensor is used for signal conditioning in ECG as well as other measurement applications of biopotential. The main purpose of this chip is to amplify, extract as well as filter biopotential signals which are small in the noisy conditions like those formed through the replacement of remote electrode as well as motion.The heart rate monitoring sensor like AD8232 includes the pins like SDN pin, LO pin, LO pin, OUTPUT pin, 3.3V pin, and GND pin. So that

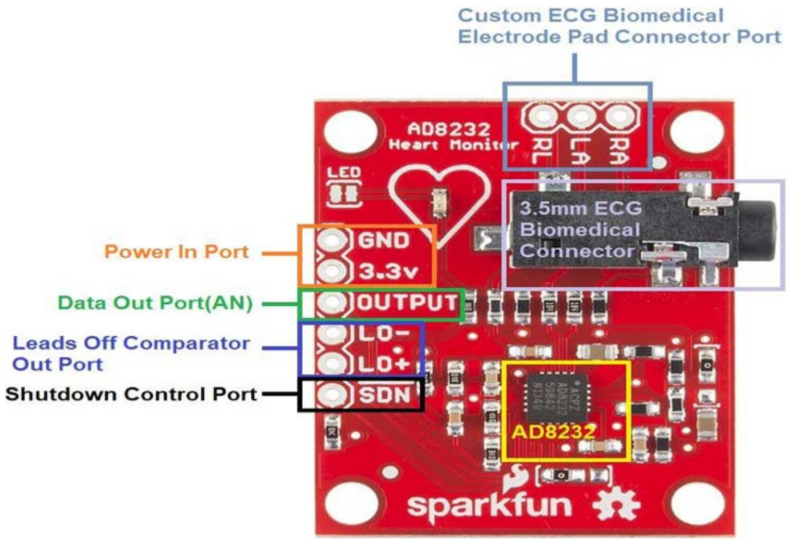


Figure 2.4: AD8232 ECG sensor

we can connect this IC to development boards like Arduino by soldering pins.Additionally, this board includes pins like the right arm , left arm and right leg pins to connect custom sensors. An LED indicator in this board is used to indicate the heartbeat rhythm of humans.

The AD8232 sensor comprises a function like quick restore, used to decrease the length of long resolving tails of the HPFs.

2.5 Accelerometer Sensor

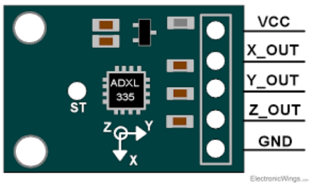


Figure 2.5: ADXL335 Accelerometer Sensor

Currently different types of accelerometers are available in market which are used for different purposes. Some works on the principle of MEMS(micro electro mechanical sensor) working. Which consists of a small mass which is etched into silicon surface and then integrated into a small circuit. When force is applied on this mass then it covers some displacement, so acceleration is produced in this mass according to newton second law of motion F equals to ma which is sensed by its sensor. Similarly, if we talk about analog accelerometers then they work on two principles such as capacitive sensing and piezo electric sensing. Both have different advantages and disadvantages. Similary,ADXL335 accelerometer is an analog accelerometer therefore it works on the principle of capacitive sensing. In capacitive sensing accelerometer, when it is moved in any direction then its capacitance is changed. When this capacitance is changed then its analog voltages are changed which is sensed by its interfacing controller.

2.6 Pulse rate sensor

Figure 2.6: Pulse rate sensor

The pulse sensor working principle is very simple. This sensor has two surfaces, on the first surface, the light-emitting diode and ambient light sensor is connected. Similarly, on the second surface, the circuit is connected which is accountable for the noise cancellation and amplification.

The LED is located above a vein in a human body like ear tip or fingertip, however, it must be located on top of a layer directly. Once the LED is located on the vein, then the LED starts emitting light. Once the heart is pumping, then there will be a flow of blood within the veins. So if we check the blood flow, then we can check the heart rates also.

If the blood flow is sensed then the ambient light sensor will receive more light as they will be reproduced by the flow of blood. This small change within obtained light can be examined over time to decide our pulse rates.

2.7 Sd card reader

A Secure Digital card is a tiny flash memory card designed for high capacity memory and various portable devices, such as car navigation systems, cellular phones, ebooks, PDAs, smartphones, digital cameras, music players, digital video camcorders and personal computers. A memory card reader is a device for accessing the data on a memory card such as a CompactFlash, Secure Digital or MultiMediaCard. Most card readers also offer write capability, and

Figure 2.7: SD card reader

together with the card, this can function as a pen drive.

2.8 Software Details

2.8.1 Raspbian Software:

Raspberry Pi OS(formerly Raspbian) a Debian-based operating system for Raspberry Pi. Since 2015, it has been officially provided by the Raspberry Pi Foundation as the primary operating system for the Raspberry Pi family of compact single-board computers.[4] The first version of Raspbian was created by Mike Thompson and Peter Green as an independent project. Pi is based on a Broadcom SoC (System of Chip) with an ARM processor [700 MHz], a GPU and 256 to 512 MB RAM. The boot media is an SD card [which is not included], and the SD card can also be used for persist data.
Storage: SD Card.
Computer: A Raspberry Pi
Display: An TV/Monitor with DVI or HDMI port.

Many operating systems are available to run on your Raspberry Pi. These include the recommended Raspberry Pi OS, Ubuntu, along with OS for Kodi, RetroPie, and many other projects. Our list of operating systems for the Raspberry Pi will give you a flavor of what is available the choice is huge.

Figure 2.8: Raspbian Software

2.8.2 Installing OS on Raspberry pi:

Available from the official Raspberry Pi website, Raspberry Pi Imager is a utility that writes an operating system to your Pi SD card. A list of operating systems is included in the app, such as Raspberry Pi OS and other desktops, media players, and emulation and gaming OS.

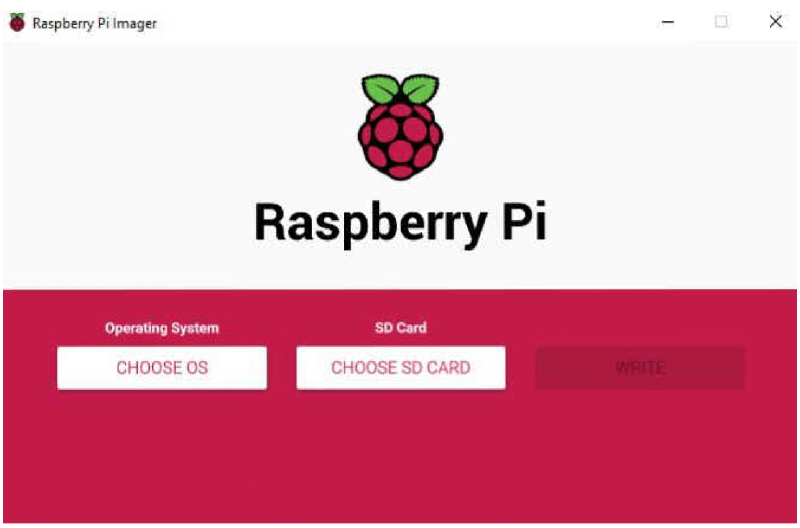


Figure 2.9: Raspbian OS

Under Operating System click Choose OS. Browse the list for your preferred OS and select the one you want. Click Ctrl+Shift+X to preconfigure advanced options. Next, click Choose

Storage to select the SD card, Click Write.

With Etcher installed and running, you will notice three buttons: Select Image, Select Drive, and Flash. To flash an image with Etcher: Click Select Image Browse to the downloaded ISO or IMG file Next, click Select Drive Confirm the correct SD card is selected Finally, click Flash to begin writing the data. Wait while the data is written to the SD card and verified, then click OK to finish and exit Etcher. Eject the SD card, and insert it into your powered off Raspberry Pi. Connect the power cable and wait as the computer boots the operating system.

2.8.3 Node MCU dumping process:

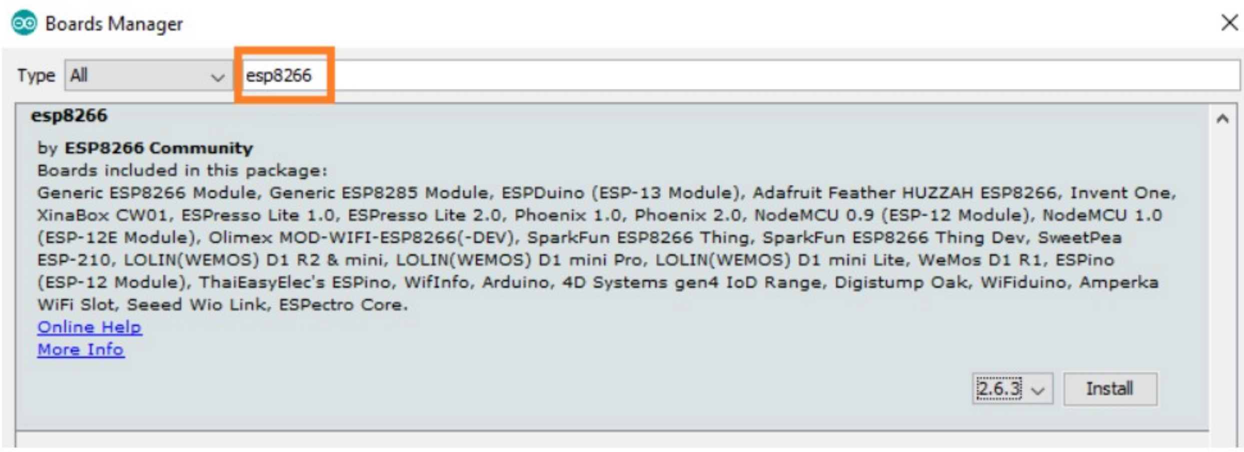


Figure 2.10: Node MCU code dumping

Step 1: Configuring Arduino First we will configure Arduino IDE. It has been a great help since Arduino supports a wide range of development boards for programming and uploading codes.Download Arduino IDE from the above link as per the OS platform and architecture. Once downloaded the install Arduino IDE on your laptop or computer.

Step 2 : Connection and Board Selection You need a USB to micro USB cable to establish connection between computer and NodeMCU module. NodeMCU boards are have a micro USB port. You need a USB to micro USB cable to connect NodeMCU to the computer. Once you power on NodeMCU for the first time, the build-in LED will quickly blink and it will turn off. Some NodeMCU boards are preloaded with LED blink program once it is powered on.

Step 3: Verify button to compile and check for errors. If compilation is successful without any errors then click on Upload.

Step 4: Testing Once you upload the code successfully in NodeMCU the blue led will start blinking with a interval of 1 sec. If you get this result then you have successfully uploaded your first code in NodeMCU. Host this was easy tutorial on easy nodemcu programming with simple steps.

Chapter 3

Design and Implementation

3.1 General Introduction

Keeping a patient at close observation and monitoring critical signs such as heart rate, blood pressure and body temperature etc. is a major significant phenomenon in the healthcare monitoring systems. Majority of the monitoring devices are available at critical or intensive care units and operating rooms. These devices show measured values at the adjacent display only. It is quite possible that doctor has not been alerted at emergency situation when patients condition comes down at a critical stage in spite of 24 hours close observations. Also, after getting discharged from hospital and taken to home, a patient needs to be kept at close observation and report any health injury to doctor too. Reason behind not sharing these data remotely with specialized doctors and family members immediately is that the technology that combines all these features is not affordable and accessible by mass people in developing countries while the technology is available and developed already. All the thing required is implementing the technology and IoT is the best solution so far to make it possible using IoT as the technology combining doctor and patient, it is also possible to keep a record of the patients health status. This will help the doctor to understand that patient more accurately. The arrangement of the paper is as follows, introduction is included in the. IoT in healthcare related significant previous works is discussed. The proposed system is described that includes design methodology, block diagram and system architecture. equipment used in the system is descried. the performance measurements and finally it makes the conclusion.

3.2 Block Diagram

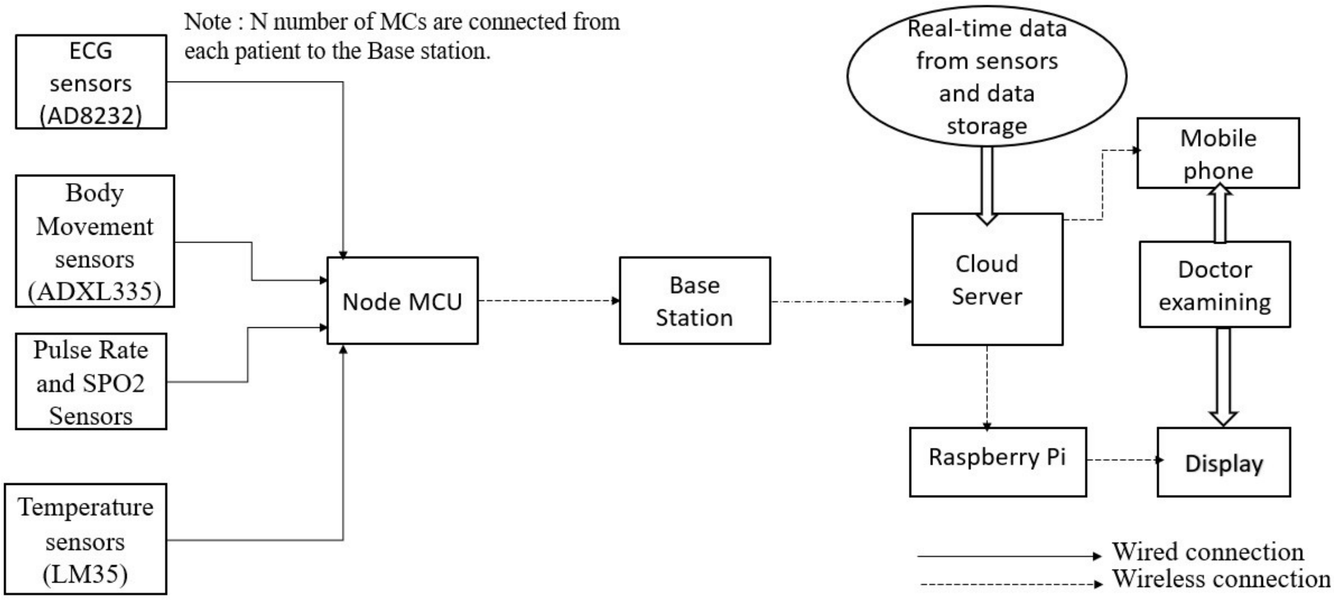


Figure 3.1: Block diagram of proposed system

The pulse sensor working principle is very simple. This sensor has two surfaces, on the first surface, the light-emitting diode and ambient light sensor is connected. Similarly, on the second surface, the circuit is connected which is accountable for the noise cancellation and amplification. Accelerometer is an analog accelerometer therefore it works on the principle of capacitive sensing. In capacitive sensing accelerometer, when it is moved in any direction then its capacitance is changed.ECG sensor is a cost-effective board used to measure the electrical activity of the heart. This electrical activity can be charted as an ECG or Electrocardiogram output as an analog reading. ECGs can be extremely noisy, the AD8232 Single Lead Heart Rate Monitor acts as an op-amp to help obtain a clear signal from the PR and QT Intervals easily and connected to Node MCU.

After inserting your network credentials, channel number and API key, upload the code to your board. Open the Serial Monitor at a baud rate of 115200, and press the on-board RST button. After 30 seconds, it should connect to Wi-Fi and start publishing the readings to cloud.

All the data are stored in the server and real time data is monitored by the doctors at all the time.

3.3 Implementation

3.3.1 Sensors on Patient

First of all our wearable device containing both heart rate and temperature sensors are being attached with patients body. After the setup of the device in patients body, the microcontroller will begin to measure the data and it will send the final data to the server. Figure shows the implemented wearable device in patients hand.

Figure 3.2: Implementation of sensors on patient body

Date&Time	Tempareture	Heart Rate
2018-07-23 23:12:31	98.00 °F	82.00 bit per minute
2018-07-23 23:15:01	99.00 °F	80.00 bit per minute
2018-07-23 23:17:31	98.00 °F	81.00 bit per minute
2018-07-23 23:20:01	98.00 °F	79.00 bit per minute

Figure 3.3: Real-time data sample

Figure shows displaying of multiple patients real-time data to an authorized and specialized doctor. By clicking on the patient id doctors will able to see the whole data and shows the all-time data of a single patient in a table manner. At the bottom an option for both doctors and patients is given to upload their ECG/Blood Group.

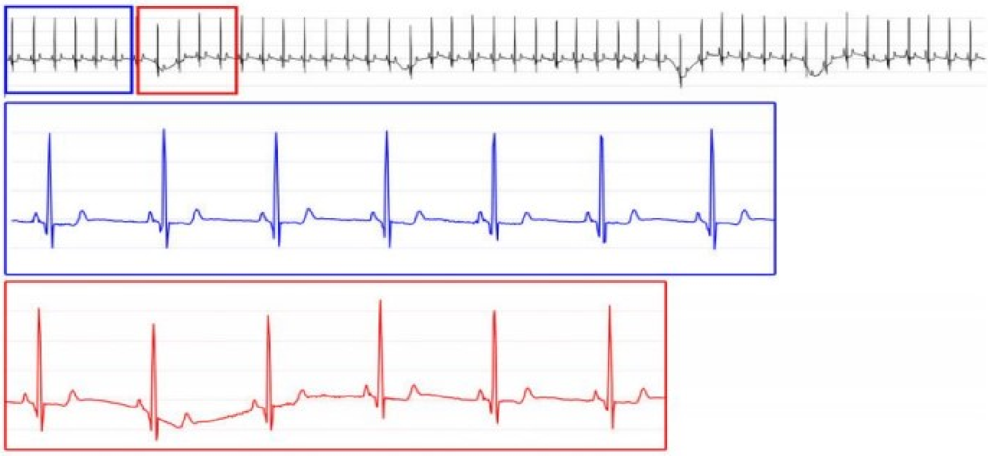


Figure 3.4: Sample ECG signals

Figure clarifies ECG data using graphical form. Figure shows the alert message sent to patients emergency contact number to minimize patients health risk. At the same time buzzer also gives a sound signal to a nearby person to help the patient.

Figure 3.5: SMS alert sample

Chapter 4

Results and Discussion

High temperatures or extreme humidity can negatively impact one's physical health, particularly those afflicted with cardiovascular disease. For those suffering with cardiovascular disease, these conditions can have catastrophic effects and in some cases can lead to the formation of deadly blood clots (called thrombosis). The electrical activity of the heart rhythm is continuously monitored for a volunteer plotted in the front panel of Serial Plotter software using the ECG sensor AD-8232.

This framework will be beneficial for a cardiac patient to ensure their heart functions whether found normal or not in single lead ECG graph. The changes in body posture such as on-bed to on-foot, right to left and left to right, causes changes on the amplitude of QRS waves in ECG graph. For instance, when posture changes from on bed to on-foot, QT interval is reduced from its normal value that leads to tachycardia.

It causes greater heart rate over 100 bpm. The fast heart beats reduced the effusion fraction ratio (EF rate) which leads to sudden cardiac arrest and death. The above study is used to observe various clinical causes and help for the diagnosis to Patient may suffer dizziness because of the narrow blood flow to brain due to the drop in blood pressure. The effect of fever by means of viral infection is the most cause of 20 acute myocarditis which can lead to DCM. It can be monitored by body temperature sensor.

The temperature Sensor is used to observe the body temperature of the patient which has interfaced with the Arduino and output result is viewed on the LCD display. A single chip temperature and humidity sensor is used for respiratory therapy while controlling, monitoring and maintaining humidity. This is important for patient comfort and even more imperative for safety in medical facilities and other critical environments.

The overall experimental setup is implemented for the proposed system.Likewise, the data of room parameters such as temperature and humidity are also continuously monitored. The results are viewed on the webpage of local server.

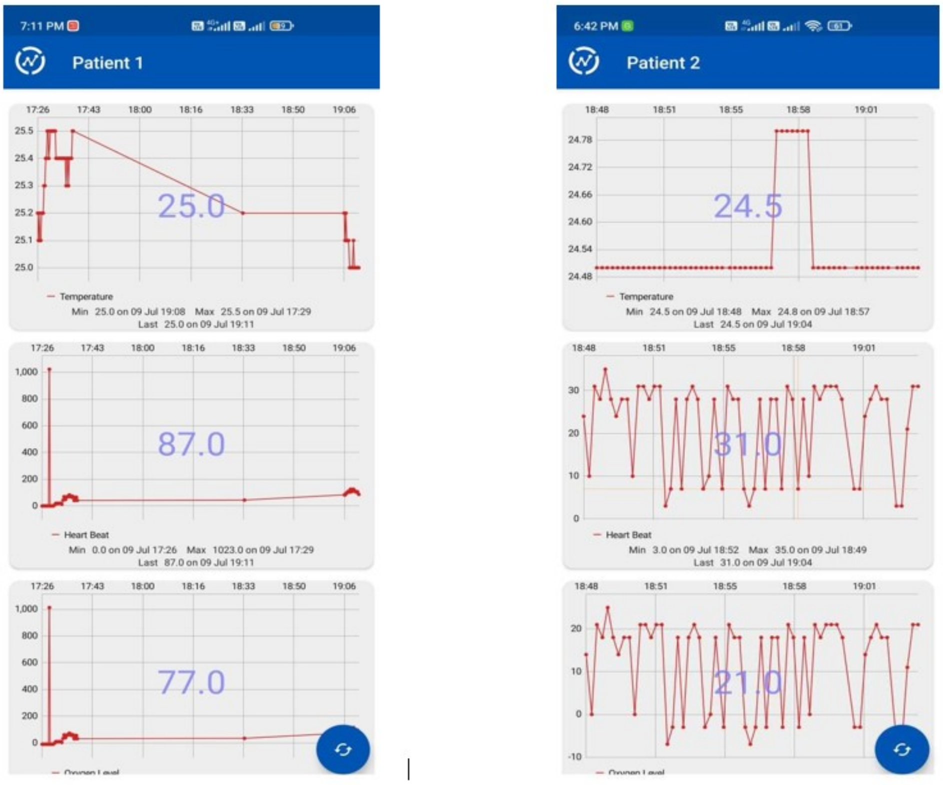


Figure 4.1: Patient 1 and 2 health condition from cloud data

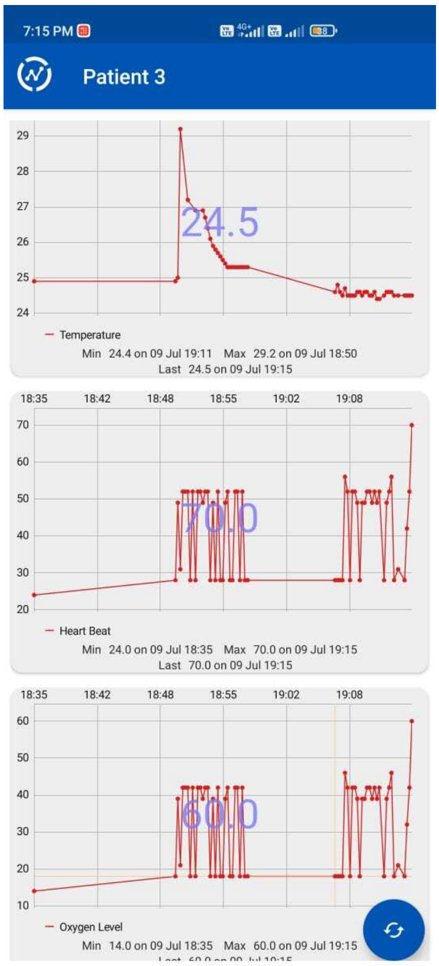


Figure 4.2: Patient 3 health condition from cloud data

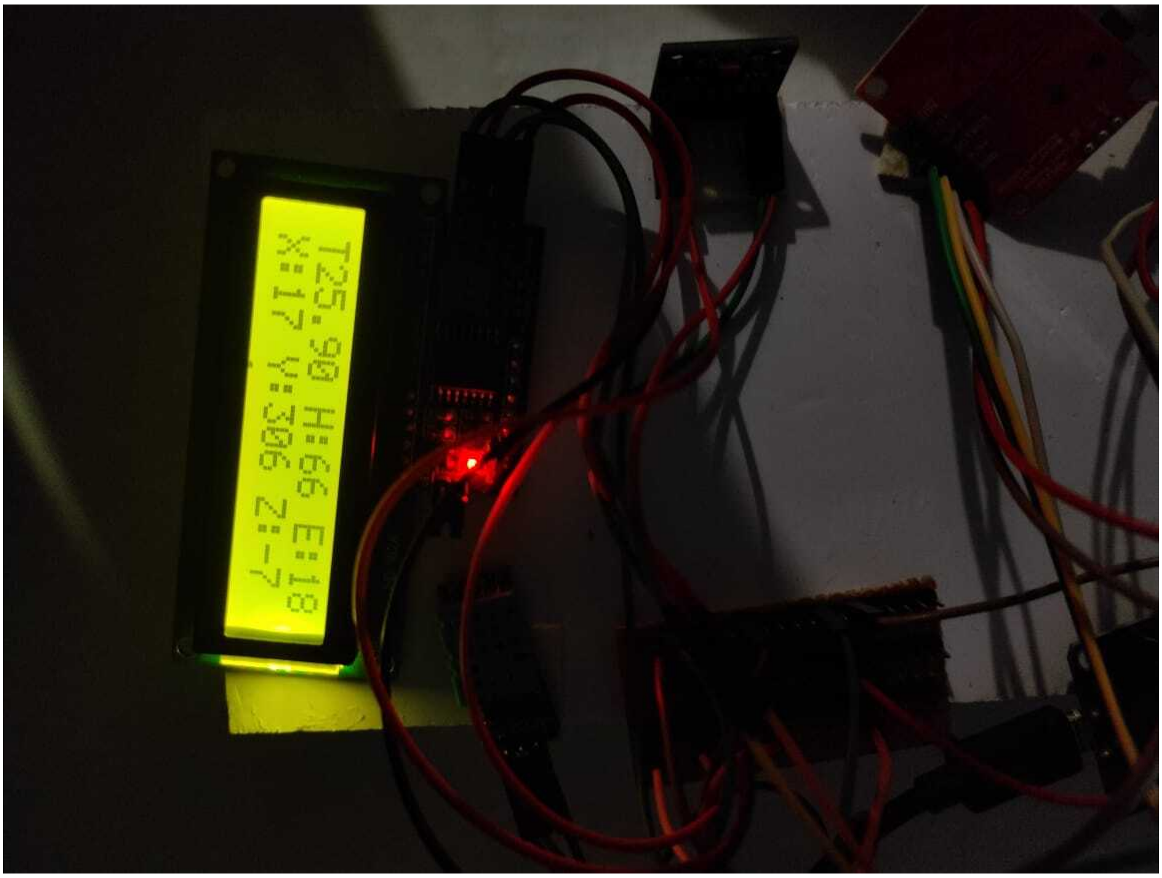


Figure 4.3: Local Display

Chapter 5

Conclusion

The proposed system offers remote capabilities that support the patients who feel discomfort for the regular health check-up and long stay in the clinics which minimises the cost. It also facilitates to track the environmental progress to enable patient in the comfort at their home. The patients data can be collected and accessed from any location remotely as well as efficiently using web app. The entire prototype framework can be converted as self-health care service for clinical monitoring such as body temperature, body posture, ECG, heart rate and environmental parameters at the patient. The above parameters can also be visualized on the display screen of LCD in the Slave circuit near the patient. Physicians can view the result on the webpage of personal server / mobile device. A GSM SIM800 module can also be incorporated to get alert messages as SMS in mobile device if data reaches abnormality value. In future work, the role of Nano Sensor modules under machine learning based decision model will be focused via Advanced ZigBee connectivity to predict the accuracy in Datasets and efficiency of monitoring the physiological parameters. The security measure can also be promoted in thing speak loud. The system can be implemented with cloud server in future to clinics / hospitals for immediate treatment with necessary intensive care.

Appendix

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A Novel Continuous Blood Pressure Estimation Approach Based on Data Mining Techniques

Fen Miao, Nan Fu, Yuan-Ting, Zhang, *Fellow, IEEE*, Xiao-Rong Ding, Xi Hong, Qingyun He, and Ye Li

***Abstract*—Continuous blood pressure (BP) estimation using pulse transit time (PTT) is a promising method for unobtrusive BP measurement. However, the accuracy of this approach must be improved for it to be viable for a wide range of applications. This study proposes a novel continuous BP estimation approach that combines data mining techniques with a traditional mechanism-driven model. First, 14 features derived from simultaneous electrocardiogram and photoplethysmogram signals were extracted for beat-to-beat BP estimation. A genetic algorithm-based feature selection method was then used to select BP indicators for each subject. Multivariate linear regression and support vector regression were employed to develop the BP model. The accuracy and robustness of the proposed approach were validated for static, dynamic, and follow-up performance. Experimental results based on 73 subjects showed that the proposed approach exhibited excellent accuracy in static BP estimation, with a correlation coefficient and mean error of 0.852 and -0.001 ± 3.102 mmHg for systolic BP, and 0.790 and -0.004 ± 2.199 mmHg for diastolic BP. Similar performance was observed for dynamic BP estimation. The robustness results indicated that the estimation accuracy was lower by a certain degree one day after model construction but was relatively stable from one day to six months after construction. The proposed approach is superior to the state-of-the-art PTT-based model for an approximately 2-mmHg reduction in the standard derivation at different time intervals, thus providing potentially novel insights for cuffless BP estimation.**

***Index Terms*—Continuous blood pressure (BP), feature selection, multivariate linear regression (MLR), support vector regression (SVR).**

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I. Introduction

HYPERTENSION is one of the most critical predictors of cardiovascular disease (CVD), which is the leading cause of death worldwide. Each incremental elevation of 20/10 mmHg in systolic blood pressure/diastolic blood pressure (SBP/DBP) over 115/75 mmHg doubles the risk of CVD [1]. Ambulatory blood pressure (BP) and related BP variability have been shown to be more reliable predictors of CVD than BP measured in a clinical setting [2], [3]. Although traditional 24-hour BP devices can monitor BP at regular intervals through repeated inflation with a cuff, such methods are discontinuous and unsuitable for daily use. Developing an unobtrusive device for high-resolution BP monitoring is thus of great significance for real-time hypertension detection and would thus benefit CVD prevention [4].

Several continuous BP measurement methods have been proposed, but all of them are performed either manually or with a cuff and are thus impractical for constant monitoring [5], [6]. Pulse transit time (PTT) is a potential indicator for BP estimation, referring to the time for a pulse wave to travel between two locations in the cardiovascular system. PTT can be calculated from two pulse signals generated by the cardiovascular system, such as electrocardiogram (ECG) and photoplethysmogram (PPG) signals [7]. The mechanism-driven BP estimation approach of using PTT has been extensively studied over the past 15 years [8]–[13]. In 2001, Chan *et al.* proposed a linear model for estimating BP with PTT [8]. A nonlinear model was proposed by Poon *et al.* [10] in 2005, and it attained an accuracy of 0.6 ± 9.8 mmHg for SBP and 0.9 ± 5.6 mmHg for DBP. In 2015, Ding *et al.* [14] proposed the PPG intensity ratio (PIR) as a crucial DBP indicator. In that study, the combination of PIR with PTT (PTT+PIR) outperformed previous PTT algorithms, achieving an accuracy of -0.37 ± 5.21 mmHg for SBP, -0.08 ± 4.06 mmHg for mean BP, and -0.18 ± 4.13 mmHg for DBP. In a 24-hour correlation study between BP and PTT [13], PTT correlated closely with BP at night time, but the correlation was limited during the daytime because of confounding factors such as vascular tone [15] and the pre-ejection period (PEP) [16]. Therefore, extant mechanism-driven BP estimation approaches that use PTT have limited accuracy. Additionally, frequent calibrations must be performed to ensure the estimation accuracy [17]. In that study, the impact of the length of the calibration interval on the estimation accuracy of the PTT-based BP approach was also studied over 15-min, 2-week, and 1-month

Figure A.1: Paper 1

This full text paper was peer-reviewed at the direction of IEEE Instrumentation and Measurement Society prior to the acceptance and publication.

Continuous Heart Rate Monitoring System as an IoT edge device

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***Abstract*—Detection of atrial fibrillation is done by checking the variations in the period of the heart rate, if a patient has atrial fibrillation then the period between each heart beat will vary. A light-based sensor can be used to detect these variations in heart rate; this is done by using Photoplethysmography (PPG) sensor which is non-invasive. The sensor consists of a LED with a photodetector and is able to detect the variations in blood volume or blood flow in the body and directly correlates to heart rate. The detected signal needs to be amplified and filtered as the signal contains a lot of high frequency noise as well as low frequency motion artifacts. The benefits of compact low-cost Wi-Fi module can be harnessed to develop a wireless continuous heart rate monitoring system enhancing possibility of atrial fibrillation detection.**

Keywords- Light-based sensor, amplification, arrhytmia, filtering, Photoplethysmography, IoT, Wi-Fi.

I. Introduction

Photoplethysmography refers to the non-invasive measurement of blood volume in a specified region (wrist). The volume of blood in a specified region increases in the systole phase and decreases in the diastole phase during the cardiac cycle of the heart. This changing blood volume can be directly used to calculate the heart rate and also to measure other characteristics of cardiovascular functions. It uses LEDs and their corresponding sensor as pairs in retrieving information in the form of electrical signals which a low in amplitude. This electrical signal known as the blood volume pulse signal has to be filtered from high frequency noise sources such as sunlight and ambient light, the signal also contains low frequency noise in the form of motion artifacts. The high frequency noise can be eliminated from the signal completely with the help of an active low pass filter. Most of the low frequency noise contributed by the motion artifacts can be eliminated with the use of a passive high pass filter. The problem with motion artifacts is that they overlap with the blood volume pulse and is difficult to get rid of completely. To get rid of the motion artifacts completely more complex methods will have to implement such as Discrete Saturation Transform, Adaptive Noise Cancellation etc. This project will not try to completely get rid of motion artifacts as this is an on-going research area which has not yet found a comprehensive solution as yet. After the filtering and amplification stage the signal is fed to a microcontroller where the heart rate will be calculated and the period between heart beats will be analyzed to determine the presence of atrial fibrillation. Interfacing the controller with a Wi-Fi module allows the transfer of the measured PPG signal and heart rate provided an access point (AP) with internet. A vast number of physical object are given internet access using a small and low power Wi-Fi module hence realizing the concept of Internet of Things (IoT) which refers to the interconnection of "things" and can integrate wireless sensor network with the internet [12]. The application of IoT in healthcare can provide a consequent improvement in healthcare by exploiting its wireless nature as well as the mostly preferred cloud computing and analytics offered by the IoT platform.

An alternative to this method is the photoplethysmographic (PPG) technique used in existing pulse-oximeters. A none invasive method of continuous heart rate monitoring coupled with internet access via a Wi-Fi module allows the wireless monitoring annexed with the cloud computing platform of IoT can offer the possibility of detecting atrial fibrillation for the PPG sensor wearers in the healthcare context where it is assumed little movement during the measuring period in an initial phase.

II. Methodology

A. Heart rate measurement

Photoplethysmography is a method used to determine and register the variations in blood volume or blood flow in the body. This is achieved by directing light to the surface of the skin (finger, wrist) which is absorbed differently by various bodies like pigments in the skin, bone and arterial and venous blood [1]. The arterioles and arteries is where the changes in blood flow are significant. For instance, during the systolic phase the arteries contain more blood volume than the diastolic phase. Therefore, the amount of light absorbed by the blood during the systolic phase is higher than in the diastolic phase, PPG sensors optically detect these variations, by

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Figure A.2: Paper 2

Solid State Technology
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Arduino & IoT Based Health Surveillance Systems: A Review

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***Abstract* -**
Healthcare is an essential and significant part for all countries. In order to maintain the health of patients, it is necessary to surveillance them constantly. This process (monitor) becomes even further crucial when persons reach a certain age and are not capable to track their health condition correctly without special medical staff or advanced equipment to accomplish the monitoring. The older human acquires the broader spectrum of potential diseases and unpredicted emergency conditions might happen. In order to bypass this, the patients must be transferred to the hospital for the purpose of noticing by medical staff and provided with direct help if some of the important parameters are abnormal. In many cases, even a little delay might lead to serious consequences including the death of patient. Therefore, it became necessary to go to surveillance using modern devices that possess a various number of capabilities and can assist personnel in the hospital to work with old or disabled human. For this reason, a number of medical devices and sensors that operate within monitoring systems will be presented and illustrated through this research.
Keyword: *Patients' surveillance system, heat sensor, heart beat sensor, ECG sensor, Arduino, IOT.*

1. Introduction

Health is considered one of the big problems for humanity[1] . The process of patient health surveillance needs, For example, a medical expert (doctor) and health workforce (nurses) to visit the patients over a particular time interval, two or three times each day based on the patient's conditions. At per visit, particular health parameters called vital signs or information are taken. It contains: heart rate, heat of person body, pressure of blood, and respiratory rate. All these signs are gathering and maintain in the manual records.

18468

Figure A.3: Paper 3

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April 18, 2018

HEALTH RECORD MONITORING SYSTEM

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I . ABSTRACT

Cloud computing is emerging as a promising paradigm for computing and is drawing the attention from both academia and industry. The cloud-computing model shifts the computing infrastructure to third-party service providers that manage the hardware and software resources with significant cost reductions. It is emerging as a new computing paradigm in the medical sector besides other business domains. Large numbers of health organizations have started shifting the electronic health information to the cloud environment. Introducing the cloud services in the health sector not only facilitates the exchange of electronic medical records among the hospitals and clinics, but also enables the cloud to act as a medical record storage center. Moreover, shifting to the cloud environment relieves the healthcare organizations of the tedious tasks of infrastructure management and also minimizes development and maintenance costs. Storing the medical data in cloud makes the treatment efficient by retrieving patient's medical history from the database before going for the treatment and get to know about the health issues of the patient.

II. INTRODUCTION:

Cloud computing is a type of Internet-based computing that provides shared computer processing resources and data to computers and other devices on demand. It is a model for enabling ubiquitous, on-demand access to a shared pool of configurable computing resources. Cloud computing and storage solutions provide users and enterprises with various capabilities to store and process their data in either privately owned, or third-party data centers. A system which handles the medical history of each individual of the country and provides access to all registered hospitals to read or update the data. The hospital which accesses the database must be registered and must have got a license. The license number is used as a unique code to access the database. The details of the patients will be stored and an identification number will be generated when their data are stored into the database for the first time after the implementation of the system.

III. EXISTING SYSTEM:

SYSTEM DESCRIPTION:

Cloud based health system's main focus is the patient's data collection, storage, access, analysis, and presentation etc. The current patient data collection techniques are time consuming, inefficient, laborious. It is also obvious that currents technique is violating the real time data access for monitoring the patients.In m-health care social networks, the personal health information is always shared among the patients located in respective social communities suffering from the same disease for mutual support, and across distributed health care providers equipped with their own cloud servers for medical consultant.

Figure A.4: Paper 4

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SURVEY PAPER FOR HEALTH RECOMMENDER SYSTEM

Ujwala Lahamge, Priyanka Phatale, Dhananjay Shimpi, Swapnali Walke, Ayesha Butalia

Department of Information Technology, PGMCOE, Wagholi Savitribai Phule Pune University, (India)

ABSTRACT

At times, it is a challenge to take care of adolescent health especially in the present times of compet- itiveness. Some behavioral pattern during their schooling period can be captured and recorded that can directly or indirectly relate to their well being. In the present paper, we have proposed a Health Moni- toring System (HMS) which has the capability to spontaneously monitor physiological parameters of the attributes of adolescent. The HMS mainly consists of sensors, Wi-Fi module (ESP8266) and software. The Wireless Body Sensors (WBS) is attached on adolescent body to sense physiological parameters and enclose respective statistics on Server. HMS can detect the thoughtful conditions, if emergency arises then notify to concern person. The amplified and filtered signals from the sensors are input into the Wi-Fi module (ESP8266) where acts as the control unit of the business logic. A graphical user interface (GUI) has been designed to communicate with the hardware as well as to display real-time emotion(s) for the monitored period. The monitoring provide analysis report, mines appropriate symptoms and provide recommender system than can be useful to the parents as well as the concerned doctor/family physician.

Keywords: Health, Health Monitoring System(HMS)Disorder,Symptoms, Wireless Body Sensor, Wi-Fi module (ESP8266).

I INTRODUCTION

Improving human health has been the subject of many research investigations. In this paper we are providing a monitoring system which has the capability to spontaneously monitor physiological parameters of adolescent and scholar and according to that generate analysis report. The sensors are attached on victims body in the form of wireless body sensor network(WBSN) this Wireless Body Sensor (WBS) are able to sense physiological parameter such as heart rate, temperature and pulses and send this information to server. This system can detect the normal and abnormal conditions, if any issue then notify to concern person using message/email. Information contained in e-mail/message the health-care professional can provide necessary medical advising. Victims temperature, heart beat rate, and pulses data are monitored, displayed, and stored by our system. The system mainly consists of sensors, the data acquisition unit, micro-controller and software.The motivation for this project is to build a successful design which

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Figure A.5: Paper 5

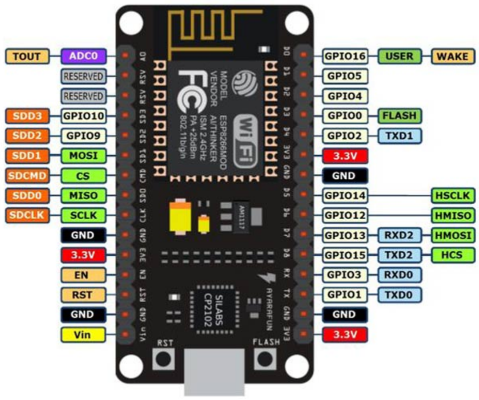

Figure A.6: Node MCU Pin configuration

Pin Category	Name	Description
Power	Micro-USB, 3.3V, GND, Vin	**Micro-USB:** NodeMCU can be powered through the USB port **3.3V:** Regulated 3.3V can be supplied to this pin to power the board **GND:** Ground pins **Vin:** External Power Supply
Control Pins	**EN, RST**	The pin and the button resets the microcontroller
Analog Pin	A0	Used to measure analog voltage in the range of 0-3.3V
GPIO Pins	GPIO1 to GPIO16	NodeMCU has 16 general purpose input-output pins on its board
SPI Pins	SD1, CMD, SD0, CLK	NodeMCU has four pins available for SPI communication.
UART Pins	TXD0, RXD0, TXD2, RXD2	NodeMCU has two UART interfaces, UART0 (RXD0 & TXD0) and UART1 (RXD1 & TXD1). UART1 is used to upload the firmware/program.
I2C Pins		NodeMCU has I2C functionality support but due to the internal functionality of these pins, you have to find which pin is I2C.

Figure A.7: NodeMCU Development Board Pinout Configuration

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