IOT BASED HEALTH MONITORING SYSTEM

A Project report submitted in partial fulfilment of the requirements for

the award of the degree of

BACHELOR OF TECHNOLOGY

IN

ELECTRONICS AND COMMUNICATION ENGINEERING

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DEPARTMENT OF ELECTRONICS AND COMMUNICATION ENGINEERING

ANIL NEERUKONDA INSTITUTE OF TECHNOLOGY AND SCIENCES

(UGC AUTONOMOUS)

(*Permanently Affiliated to AU, Approved by AICTE and Accredited by NBA & NAAC with 'A' Grade*)

Sangivalasa, Bheemili Mandal, Visakhapatnam Dist. (A.P)

2021-2022

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CERTIFICATE

This is to certify that the project report entitled **"IOT BASED HEALTH MONITORING SYSTEM"** submitted by **B. Hemalatha (318126512008), T. Devi (318126512L03), R. Padma Priya (318126512043), N. Tarun Kumar (318126512034)** in partial fulfilment of the requirements for the award of the degree of **Bachelor of Technology** in **Electronics & Communication Engineering** of Andhra University, Visakhapatnam is a record of bonafide work carried out under my guidance and supervision.

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ABSTRACT

The system efficiently updates doctor about health of patient as well as accurately calculates the health parameter of patient. In the recent years of health care development, we witness huge amounts of data flow to track few parameters of a person and alert the guardian in case of any emergency of the patient. Heart diseases are becoming a big issue for the last few decades and many people die because of certain health problems. Therefore, heart disease cannot be taken lightly. By analyzing or monitoring the ECG signal at the initial stage this disease can be prevented. So we present this project, ECG Monitoring with AD8232 ECG Sensor & Arduino with ECG Graph. The AD8232 is a neat little chip used to measure the electrical activity of the heart. This electrical activity can be charted as an ECG or Electrocardiogram. Electrocardiography is used to help diagnose various heart conditions. This establishes a need for a single platform where users can monitor the data on a real time basis. This paper talks about health monitoring systems which allow patients to be monitored without having a need to visit the doctor which can be implemented with market sensors. For such critical conditions the Doctors need to have an all-time update patient’s health related parameters like their blood pressure, heart pulse and temperature. For this type of situations this IOT based system can bring about an automation that can keep the Doctors updated all time over internet. IOT places a vital role in the comma patient health monitoring. This system uses ARDUINO-UNO board as microcontroller and Cloud computing concept. So in this project, we will interface AD8232 ECG Sensor with Arduino and observe the ECG signal on a serial plotter or Processing IDE.

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CHAPTER 1

INTRODUCTION

PROJECT OBJECTIVE

As we are well aware that death and disability due to heart attacks is increasing day by day in India. The Registrar General of India reported that cardiovascular diseases led to 17% of total deaths and 26% of adult deaths in 2001-2003, which increased to 23% of total and 32% of adult deaths in 2010-2013 [1]. A government in each financial year allocates a huge amount of money for health budget which is utilized on performing various operations at subsidized rates. This system facilitates the process of performing diagnosis and treatment of patients suffering from heart diseases. Using this system the physician can use the cloud platform to diagnose patients at remote locations (like home). The patients can also access their medical records via this cloud service. Various kinds of ECG recorders are available in market manufactured by reputed organizations , but till date there are very less devices available which can record the ECG signals and transmit them to a remote database server on cloud .In this research paper we have proposed a system that will record ECG signals of patient using a sensor and also store the ECG signals to a database server .These signals can be analyzed by a doctor at remote location or can be saved and retrieved later for analysis. The conventional ECG monitors are used to measure electrical activity of heart for short time, there is high possibility that Heart related issues are not occurring at that time. So a real time system is required that can measure heart rate at any time.

The development of biomedical engineering is responsible for improving healthcare diagnosis, monitoring and therapy. The novel idea behind Health line is to provide quality health service to one and all. The idea is driven by the vision of a cable free biomedical monitoring system. On body sensors monitor the vital parameters (blood pressure, ECG, temperature and heart beat rate) and transmits the data to doctor‘s end via wireless communication network. Periodic health monitoring (or preventative care) allows people to discover and treat health problems early, before they have consequences.

Body Temperature: The below figure shows the changes in body temperature through the day. As you can be seen, body temperature peaks around the midday, when the human body is the most active and plummets during hours of sleep or rest. This was calculated assuming that daytime is the active half of the day.

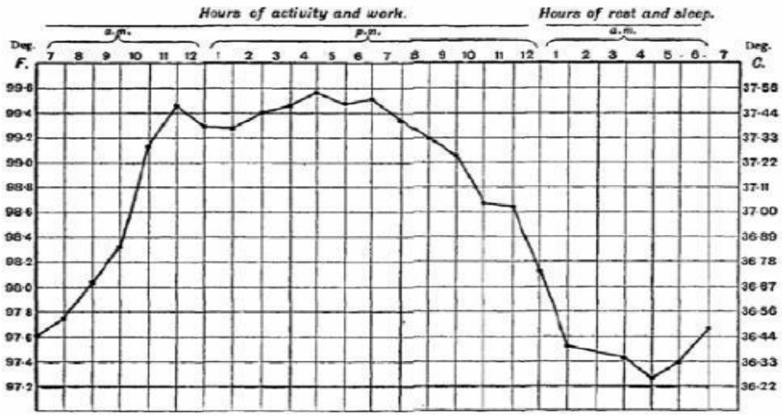


Table 1.1: Variation of Temperature

Heart Rate:

A pressure wave gets out along the arteries with a velocity of few meters per seconds when the heart beats which is faster than the actual flow of blood. One can feel the pressure wave at the wrist. But the pressure wave can rise up the volume of blood in the tissues.

AGE OF PERSON	RANGE OF HEART RATE	AVERAGE RATE
0-1 Month	100-180	140
2-3 Month	110-180	145
4-12 Month	80-180	130
1-3 Years	80-160	120
4-5 Years	80-120	100
6-8 Years	70-115	92.5
9-11 Years	60-110	85
12-16 Years	60-110	85
Above 16 Years	60-100	80

Table 1.2: Average Heart Rate

The medical implications of body temperature are profound. It is the foremost medical check to confirm the health status of a human body. The change in body temperature can be used as an indicator of various diseases and medical abnormalities, including hypothermia or heatstroke, both of which can be life threatening. Body temperature can also be used as an indication of infection or other diseases and also as a means of measuring the effectiveness of fever reducing medicine. Body temperature varies depending on the part of the body from which it is measured. However, it has become standard medical procedure to check body temperature from the skin under the armpit or from the mouth or rectum. The temperature measured from the skin is understandably slightly lower and less accurate than that measured from the cavities. Hence, the vital signs'Monitor is primarily used to monitor patients, it is crucial that this device measures the temperature in real time which is another aim of this project.

The main objective of our project is to make health monitoring system simple and accurate currently in our paper we are monitoring only body temperature and heart rate but we can further expand our system by measuring various parameters like ECG, blood pressure etc. Another objective of our research is to analyze these parameters to identify accurately the problem to give patient better cure as soon as possible and these analyze data can wirelessly transmit to the doctor anywhere in the world.

Electrocardiogram (ECG) is a common medical test for assessing cardiac function by measuring the electrical activity of the heart, although other tests may also be done. ECG is considered a fairly routine and sufficient indication of heart health and is performed with 3, 5, 12, or 15-lead ECG/EKG machines. AD8232 is a cost- effective, ECG analog sensor for measuring the electrical activity of the heart. Essentially, AD8232 is an integrated signal conditioning block for ECG and other bio-potential measurements. It's designed to extract, amplify, and filter small bio-potential signals in noisy conditions.

The IoT platform that we are using here is Ubidots. Ubidots is an IoT Platform empowering innovators and industries to prototype and scale **IoT projects** to production. Use the Ubidots platform to send data to the cloud from any Internet- enabled device. You can then configure actions and alerts based on your real-time data and unlock the value of your data through visual tools.

1.2 Project Outline

1.2.1 Existing System and its problems

Many existing system for Real Time Health Monitoring generally uses microcontroller ATMEL 89C51 (µc 8051). It does the same job by using additional devices. The microcontroller-controlled system contains essentially four parts, i.e., the process, the analog to digital converter, the control algorithm, and the clock. The times when the measured signals are converted to digital form are called the sampling instants; the time between successive samplings is called the sampling period and is denoted by h. The output from the process is a continuous time signal. The output is converted into digital form by the A – D converter. The conversion is done at the sampling times.

Problems associated with existing system:

Many existing systems for temperature and pulse monitoring generally uses micro-controller ATMEL 89C51 (µc 8051). Due to using micro controller 8051 the process of making whole device becomes not only very complex but also difficult and tedious. For operation it requires A-D converter, external clock, microcontroller development board.

Consequently, the problems are as follows: -

- It takes comparatively more time to process.
- It requires additional devices for operation.
- It requires external clock.
- Programming for micro-controller 8051 is difficult.
- Circuit size becomes large.
- For programming it requires development system

1.2.2Use of vital signals in health analysis

Chronic diseases have a significant influence on healthcare where cost of curing chance of attack is common among people. Changes in demographic structure and lack of health and social care personnel force us to study new innovations, which could over a relief to these challenges. Elderly people have to make frequent visits to their doctor to get their vital signs measured. Regular monitoring of vital signs is essential as they are primary indicators of an individual's physical wellbeing. These vital signs include,

a. Pulse rate

b. Blood pressure

c. Body temperature

The goal is to develop a low cost, low power, reliable, non-intrusive, and noninvasive vital signs monitor which collect different type of body and the sampled parameters are wireless. sensing and data conditioning system to acquire accurate heart rate, ECG, blood pressure, and body temperature readings. After processing of data we have to find a proper method of transmission and signal display. Remote patient monitoring (RPM) is a technology to enable monitoring of patients outside of conventional clinical settings (e.g. in the home), which may increase access to care and decrease healthcare delivery costs.

Gathering vital signals:

Pulse is the rate at which our heart beats. Our pulse is usually called our heart rate, which is the number of times our heart beats each minute (bpm). But the rhythm and strength of the heartbeat can also be noted, as well as whether the blood vessel feels hard or soft. Changes in our heart rate or rhythm, a weak pulse, or a hard blood vessel may be caused by heart disease or another problem. As our heart pumps blood through our body, we can feel a pulsing in some of the blood vessels close to the skin's surface, such as in our wrist, neck, or upper arm. Counting our pulse rate is a simple way to find out how fast our heart is beating. The normal core body temperature of a healthy, resting adult human being is stated to be at 98.6 degrees Fahrenheit or 37.0 degrees Celsius. Though the body temperature measured on an individual can vary, a healthy human body can maintain a fairly consistent body temperature that is around the mark of 37.0 degrees Celsius. The normal range of human body temperature varies due to an individual‘s metabolism rate; the higher (faster) it is the higher the normal body temperature or the slower the metabolic rate the lower the normal body temperature.

Other factors that might affect the body temperature of an individual may be the time of day or the part of the body in which the temperature is measured at. The body temperature is lower in the morning, due to the rest the body received, and higher at night after a day of muscular activity and after food intake. Body temperature also varies at different parts of the body. Oral temperatures, which are the most convenient type of temperature measurement, is at 37.0 °C. This is the accepted standard temperature for the normal core body temperature. Auxiliary temperatures are an external measurement taken in the armpit or between two folds of skin on the body. This is the longest and most inaccurate way of measuring body temperature, the normal temperature falls at

97.6 °F or 36.4 °C. Rectal temperatures are an internal measurement taken in the rectum, which fall at 99.6 °F or 37.6 °C. It is the least time consuming and most accurate type of body temperature measurement, being an internal measurement. But it is definitely, by far, not most comfortable method to measure the body temperature.

Remote Patient Monitoring:

Remote Patient Monitoring is a method that helps in healthcare delivery using the latest advances in IT. This is almost taking the major part of healthcare to the doorsteps instead of the patient having to visit the clinic or hospital. Remote Patient Technology uses specific devices that gather information about patient health to be conveyed to the doctor with the desired regularity.

The devices used in RPM are similar to Smart phones and tabs but are built to gather measurement and connect up with a specific facility or a doctor for data transmission. Patients would require wearing specific sensors that need to be hooked with these devices that transmit the physiological information to the doctor. The doctors then use this information to assess the patient condition and advise the next actions, medication, and care. RPM monitors can also be used to set reminders about medication, exercises, diet, sleep or even instructions to fight anxiety. Depending on the choice, the RPM devices also support self-monitoring technology that helps patients take care of their health by themselves by going through instructions, flow charts, and other information. In the cases of Home Healthcare providers, the visiting nurses or medical staff could be assisted with the RPM technology located at the patient‘s place. The concept of RPM is made possible with the widespread availability of wearable devices that provide physiological measurements to the doctors and the medical staff even from a remote location. This enables the patient‘s condition assessment without requiring patient proximity. Connected health devices run the gamut from wearable heart monitors, to Bluetooth-enabled scales, to Fit bits. They provide health measures of patients and transmit them back to providers – or in some cases are reported back to providers – to facilitate healthcare decisions from afar. Remote patient monitoring technologies are akin to telemedicine technologies, since they automatically observe and report on patients, often with chronic illnesses, so caregivers can remotely keep tabs on patients.

In the middle of the COVID-19 pandemic, connected health and RPM are more important than ever, because they enable physicians to monitor patients without having to come into contact with them, thus preventing the spread of the novel corona virus. They also keep patients with less severe cases out of hospitals, so preserving precious bed space for patients with severe cases. Hospitals across the nation are using connected health and RPM to great effect during the pandemic. Independent and convenient, healthy living is the aim of any human being no matter their age, gender, location or health status. However, there are limitations due to age, illness, medication, hospitalization, epidemic, pandemic and other circumstances. Health monitoring systems have evolved to assist convenient healthy living, more accessible communication between healthcare givers and patients for close monitoring, measurement of vital health parameters, routine consultation and overall healthy living. Moreover, with the recent advances in information and communication technologies (ICT) through the adoption of Internet of Things (IoT) technology, smart health monitoring and support systems now have a higher edge of development and acceptability for enhanced healthy living.

The study conducted by Zikali, revealed that with the rapid increase in the population of older or senior citizens, patients who require health monitoring have also increased exponentially. The same study predicts that by the year 2045 the number of senior citizens who are considered the most vulnerable in society will exceed the number of children and young adults as a recent population census shows an increase in older people. However, a shortage of home health helpers, nursing assistants and home healthcare givers is looming worldwide, which makes care for the elderly expensive. Therefore, a health monitoring system can play a vital role in lessening physical contact, hospitalization, consultation time, queuing list and overall health cost for a patient while also reducing workload, burden and stress on medical staff. Advancements in information and communication technologies for connectivity anywhere and anytime make a valuable contribution to the development of the modern healthcare system utilized in telemedicine solutions and other portable medical platforms.

The advent of smart home technologies proposes healthy living and improved quality of healthcare support services for the elderly and handicapped for independent and comfortable lifestyles while at home, instead of nursing homes, hospitals or other confinement facilities. The healthcare module, as a part of the smart home automation system, will improve healthcare facilities for patients while at home or in remote locations outside the hospitals. Thus, there is a reduction in depression that arises from loneliness in the hospital wards for patients. The doctors can monitor patients from their office, prescribe medication and view measured vital health parameters for a remote diagnosis. Also, the rapid improvement of software and hardware technologies in the smart home healthcare system, makes it possible for patients, especially the elderly or disabled, to control certain home appliances with ease from devices such as smart phones, tablets, laptops, internet, etc.

Incorporating RPM in chronic disease management can significantly improve an individual‘s quality of life. It allows patients to maintain independence, prevent complications, and minimize personal costs. RPM facilitates these goals by delivering care right to the home. In addition, patients and their family members feel comfort knowing that they are being monitored and will be supported if a problem arises. This is particularly important when patients are managing complex self-care processes such as home Hemo-dialysis. Physiological data such as blood pressure and subjective patient data are collected by sensors on peripheral devices. Examples of peripheral devices are: blood pressure cuff, pulse ox meter, and glucometer. The data are transmitted to healthcare providers or third parties via wireless telecommunication devices. The data are evaluated for potential problems by a healthcare professional or via a clinical decision support algorithm, and patient, caregivers, and health providers are immediately alerted if a problem is detected. As a result, timely intervention ensures positive patient outcomes. The newer applications also provide education, test and medication reminder alerts, and a means of communication between the patient and the provider.

A Remote health monitoring system is an extension of a hospital medical system where a patient’s vital body state can be monitored remotely. Traditionally the detection systems were only found in hospitals and were characterized by huge and complex circuitry which required high power consumption. Continuous advances in the semiconductor technology industry have led to sensors and microcontrollers that are smaller in size, faster in operation, low in power consumption and affordable in cost. This has further seen development in the remote monitoring of vital life signs of patients especially the elderly. The remote health monitoring system can be applied in the following scenarios:

1. A patient is known to have a medical condition with unstable regulatory body system. This is in cases where a new drug is being introduced to a patient.
2. A patient is prone to heart attacks or may have suffered one before. The vitals may be monitored to predict and alert in advance any indication of the body status.
3. Critical body organ situation
4. The situation leading to the development of a risky life-threatening condition. This is for people at an advanced age and maybe having failing health conditions.

5. Athletes during training. To know which training regimes will produce better results.

In recent times, several systems have come up to address the issue of remote health monitoring. The systems have a wireless detection system that sends the sensor information wirelessly to a remote server. Some even adopted a service model that requires one to pay a subscription fee. In developing countries, this is a hindrance as some people cannot use them due 2 to cost issue involved. There is also the issue of internet connectivity where some systems to operate, good quality internet for a real-time remote connection is required. Internet penetration is still a problem in developing countries. Many of the systems were introduced in the developed countries where the infrastructure is working perfectly. In most cases, the systems are adapted to work in developing countries. To reduce some of these problems there is need to approach the remote detection from a ground-up approach to suit the basic minimal conditions presently available in developing countries. A simple patient monitoring system design can be approached by the number of parameters it can detect. In some instances, by detecting one parameter several readings can be calculated. For simplicity considerations parameter detection are:

i) Single parameter monitoring system: In this instance, a single parameter is monitored e.g. Electrocardiogram (ECG) reading. From the ECG or heartbeat detection, several readings can be got depending on the algorithm used. An ECG reading can give the heart rate and oxygen saturation.

ii) Multi-parameter monitoring system: This has multiple parameters being monitored at the same time. An example of such a system can be found in High Dependency Units (HDU), Intensive Care Units (ICU), during the surgery at a hospital theatre or Post surgery recovery units in Hospitals. Several parameters that are monitored include the ECG, blood pressure, respiration rate. The Multiparameter monitoring system basically proof that a patient is alive or recovering. In developing countries, just after retiring from their daily career routine majority of the elderly age group, move to the rural areas. In developed countries, they may move to assisted living group homes. This is where a remote health monitoring system can come in handy.

Remote Patient Monitoring – Challenges and Barriers

There are many challenges and barriers related to the systems and regulations that must be overcome in order to successfully achieving a fool-proof functioning of an RPM system:

Network Availability and Connectivity:

The success of RPM (or even Tele-health) depends heavily on the availability of network and connectivity of the device, especially at any patient‘s premises. This is true for Tele-health in general and any type of network, Mobile, Wired, or any other type. Especially when large data packets are being transmitted over the network, interruptions could hamper the diagnosis; for example in any case that requires continuous monitoring such as the heart conditions or brain conditions, network interruptions at critical times may prove to be unwanted. The input devices often are situated close to the patients, so the patients need to ensure availability of the uninterrupted network for continuous communication with the EHR system. Depending on the adoption rate, Network providers could come up with network types that assure this.

Sensors and wearable devices:

An RPM system‘s chief differentiator is the inclusion of sensors and wearable devices. These could be available in various sizes and types which patients could be asked to wear on various parts of the body; it is the question of suitability, usability, comfort, and convenience. For example, a device like Fitbit (activity tracking watches) or such others may not be suitable for shower although it is water resistant. Many of the electronic devices are unsuitable for use near hot places like barbecues. Some of the battery operated devices could run out of power faster in cold weathers. In general, the design of devices especially the wearable ones, may require revision from time to time.

Training and Adaptability:

Even if the RPM devices are usable to a good extent, a multiplicity of sensors and complexity of devices may require some training to be imparted to the patients. The extent of training may depend on the patient‘s background and conditions.

Accuracy of data:

The success of the RPM system also depends on the data quality. Even if the system, the sensors, and the network are running fine, the reliability of the data provided to the diagnosing practitioner would be dependent on the accuracy of data from the system. This may need verification and calibration of the RPM system from time to time in order to maintain reasonable accuracy.

Security and Privacy:

Since the RPM systems work over digital networks they are prone to hacking and the associated breach of privacy and other security issues. Security standards normally applicable to other Healthcare management systems could become applicable to RPM systems also. HIPAA and similar other norms require patient privacy to be protected; although this could be part of information security and perceived as a larger subject requiring a healthy clinic-patient relationship.

FDA Approval:

The RPM systems and devices must meet the FDA regulation norms for health care use. FDA approval itself brings a challenge to the system providers; it could require security of manufacturing/development process , quality assurance, patient worthiness certification and life cycle assessments. While FDA approval itself may be beneficial to the patients which could ensure high device standards, it may eventually end up pushing the device costs higher due to related overheads.

Cost and Affordability:

The process overheads and extra approval steps may lead to increased costs thus making RPM devices expensive to adopt. However mass scale adoption in due course of time could make it affordable and even necessary.

CHAPTER 2

MOTIVATION

2.1 Internet of Things in health monitoring

The Internet of Things (IoT) and Smart Grid are of great importance in promoting and guiding development of information technology and economic. At Present, the application of the IoT develops rapidly, but due to the special requirements of some applications, the existing technology cannot meet them very good. Much research work is doing to build IoT . Wi-Fi- based Wireless Sensor Network(WSN) has the features of high bandwidth and rate, non-line- transmission ability, large-scale data collection and high cost-effective, and it has the capability of video monitoring, which cannot be realized with Zig-Bee. The research on Wi-Fi-based WSN and its application has high practical significance to the development of the Internet of Things and Smart Grid. Based on the current research work of applications in the Internet of Things and the characteristics of Wi-Fi-based WSN, this paper discusses the application of Wi-Fi-based WSN in Internet of Things, which includes Smart Grid, Smart Agriculture and Intelligent environment protection. Monitoring Systems and Sensors systems have increased in importance over the years. However, increases in measurement points mean increases in installation and maintenance cost. The development work of a Wi-Fi based Smart Wireless Sensor Network for monitoring an Agricultural Environment. The system is capable of intelligently monitoring agricultural conditions in a pre-programmed manner. The system consists of three stations: Sensor Node, Router, and Server. The system is designed for monitoring of the climate condition in an agricultural environment such as field or greenhouse, the sensor station is equipped with several sensor elements such as Temperature, humidity, light, air pressure, soil moisture and water level. In addition, investigation was performed in order to integrate a novel planar electromagnetic sensor for nitrate detection. The communication between the sensor node and the server is achieved via 802.11g wireless modules. Sensors are used for measurements and for acquisition of data but they require an effective data transfer mechanism to enable full-fledged applications that utilize the data they collect Embedded systems is one of the most important, yet overlooked subjects in the electronics world. When we think technology, mobile phones, tablets and laptops come to mind, but the devices that actually help us in our daily lives are not talked too much about. They‘re often confused with larger or more general purpose computers, and it‘s sometimes difficult to discern between one and the other.

The Internet of things (IoT) describes the network of physical objects—a.k.a. "things"—that are embedded with sensors, software, and other technologies for the purpose of connecting and exchanging data with other devices and systems over the Internet.

Things have evolved due to the convergence of multiple technologies, real-time analytics, machine learning, ubiquitous computing, commodity sensors, and embedded systems. Traditional fields of embedded systems, wireless sensor networks, control systems, automation (including home and building automation), and others all contribute to enabling the Internet of things. In the consumer market, IoT technology is most synonymous with products pertaining to the concept of the "smart home", including devices and appliances (such as lighting fixtures, thermostats, home security systems and cameras, and other home appliances) that support one or more common ecosystems, and can be controlled via devices associated with that ecosystem, such as smart phones and smart speakers. The IoT can also be used in healthcare systems.

There are a number of serious concerns about dangers in the growth of the IoT, especially in the areas of privacy and security, and consequently industry and governmental moves to address these concerns have begun including the development of international standards.

An IoT ecosystem consists of web-enabled smart devices that use embedded systems, such as processors, sensors and communication hardware, to collect, send and act on data they acquire from their environments. IoT devices share the sensor data they collect by connecting to an IoT gateway or other edge device where data is either sent to the cloud to be analyzed or analyzed locally.

Sometimes, these devices communicate with other related devices and act on the information they get from one another. The devices do most of the work without human intervention, although people can interact with the devices -- for instance, to set them up, give them instructions or access the given data.

The connectivity, networking and communication protocols used with these web-enabled devices largely depend on the specific IoT applications deployed. IoT can also make use of artificial intelligence (AI) and machine learning to aid in making data collecting processes easier and more dynamic.

The internet of things helps people live and work smarter, as well as gain complete control over their lives. In addition to offering smart devices to automate homes, IoT is essential to business. IoT provides businesses with a real-time look into how their systems really work, delivering insights into everything from the performance of machines to supply chain and logistics operations.

IoT enables companies to automate processes and reduce labor costs. It also cuts down on waste and improves service delivery, making it less expensive to manufacture and deliver goods, as well as offering transparency into customer transactions. As such, IoT is one of the most important technologies of everyday life, and it will continue to pick up steam as more businesses realize the potential of connected devices to keep them competitive.

Pros and cons of IoT:

Some of the advantages of IoT include the following:

- Ability to access information from anywhere at any time on any device;
- Improved communication between connected electronic devices;
- Transferring data packets over a connected network saving time and money; and
- Automating tasks helping to improve the quality of a business's services reducing the need for human intervention.

Some disadvantages of IoT include the following:

- As the number of connected devices increases and more information is shared between devices, the potential that a hacker could steal confidential information also increases.
- Enterprises may eventually have to deal with massive numbers -- maybe even millions -- of IoT devices, and collecting and managing the data from all those devices will be challenging.
- If there's a bug in the system, it's likely that every connected device will become corrupted.
- Since there's no international standard of compatibility for IoT, it's difficult for devices from different manufacturers to communicate with each other.

IoT standards and frameworks:

There are several emerging IoT standards, including the following:

- IPv6 over Low-Power Wireless Personal Area Networks (*6LoWPAN)* is an open standard defined by the Internet Engineering Task Force (IETF). The 6LoWPAN standard enables any low-power radio to communicate to the internet, including 804.15.4, Bluetooth Low Energy (BLE) and Z-Wave (for home automation).
- Zig-Bee is a low-power, low-data rate wireless network used mainly in industrial settings. Zig-Bee is based on the Institute of Electrical and Electronics Engineers (IEEE) 802.15.4 standard. The Zig-Bee Alliance created Dot-dot, the universal language for IoT that enables smart objects to work securely on any network and understand each other.
- LiteOS is a Unix-like operating system (OS) for wireless sensor networks. LiteOS supports

smart phones, wearables, intelligent manufacturing applications, smart homes and the internet of vehicles (IoV). The OS also serves as a smart device development platform.

- OneM2M is a machine-to-machine service layer that can be embedded in software and hardware to connect devices. The global standardization body, OneM2M, was created to develop reusable standards to enable IoT applications across different verticals to communicate.
- Data Distribution Service (DDS) was developed by the Object Management Group (OMG) and is an IoT standard for real-time, scalable and high performance M2M communication.
- Advanced Message Queuing Protocol (AMQP) is an open source published standard for asynchronous messaging by wire. AMQP enables encrypted and interoperable messaging between organizations and applications. The protocol is used in client-server messaging and in IoT device management.
- Constrained Application Protocol (CoAP) is a protocol designed by the IETF that specifies how low-power, compute-constrained devices can operate in the internet of things.
- Long Range Wide Area Network (LoRaWAN) is a protocol for WANs designed to support huge networks, such as smart cities, with millions of low-power devices.

IoT frameworks include the following:

- Amazon Web Services (AWS) IoT is a cloud computing platform for IoT released by Amazon. This framework is designed to enable smart devices to easily connect and securely interact with the AWS cloud and other connected devices.
- Arm Mbed IoT is a platform to develop apps for IoT based on Arm microcontrollers. The goal of the Arm Mbed IoT platform is to provide a scalable, connected and secure environment for IoT devices by integrating Mbed tools and services.
- Microsoft's Azure IoT Suite is a platform that consists of a set of services that enables users to interact with and receive data from their IoT devices, as well as perform various operations over data, such as multidimensional analysis, transformation and aggregation, and visualize those operations in a way that's suitable for business.
- Google's Brillo/Weave is a platform for the rapid implementation of IoT applications. The platform consists of two main backbones: Brillo, an Androidbased OS for the development of embedded low-power devices, and Weave, an IoT-oriented communication protocol that serves as the communication language between the device and the cloud.

- Calvin is an open source IoT platform released by Ericsson designed for building and managing distributed applications that enable devices to talk to each other. Calvin includes a development framework for application developers, as well as a runtime environment for handling the running application.

Consumer and enterprise IoT applications:

There are numerous real-world applications of the internet of things, ranging from consumer IoT and enterprise IoT to manufacturing and industrial IoT (IIoT). IoT applications span numerous verticals, including automotive, telecom and energy.

In the consumer segment, for example, smart homes that are equipped with smart thermostats, smart appliances and connected heating, lighting and electronic devices can be controlled remotely via computers and smart phones.

Wearable devices with sensors and software can collect and analyze user data, sending messages to other technologies about the users with the aim of making users' lives easier and more comfortable. Wearable devices are also used for public safety -- for example, improving first responders' response times during emergencies by providing optimized routes to a location or by tracking construction workers' or firefighters' vital signs at life-threatening sites.

In healthcare, IoT offers many benefits, including the ability to monitor patients more closely using an analysis of the data that's generated. Hospitals often use IoT systems to complete tasks such as inventory management for both pharmaceuticals and medical instruments.

Smart buildings can, for instance, reduce energy costs using sensors that detect how many occupants are in a room. The temperature can adjust automatically -- for example, turning the air conditioner on if sensors detect a conference room is full or turning the heat down if everyone in the office has gone home.

In agriculture, IoT-based smart farming systems can help monitor, for instance, light, temperature, humidity and soil moisture of crop fields using connected sensors. IoT is also instrumental in automating irrigation systems.

In a smart city, IoT sensors and deployments, such as smart streetlights and smart meters, can help alleviate traffic, conserve energy, monitor and address environmental concerns, and improve sanitation.

IoT security and privacy issues:

The internet of things connects billions of devices to the internet and involves the use of billions of data points, all of which need to be secured. Due to its expanded attack surface, IoT security and IoT privacy are cited as major concerns.

In 2016, one of the most notorious recent IoT attacks was Mirai, a botnet that infiltrated domain name server provider Dyn and took down many websites for an extended period of time in one of the biggest distributed denial-of-service (DDoS) attacks ever seen. Attackers gained access to the network by exploiting poorly secured IoT devices. Because IoT devices are closely connected, all a hacker has to do is exploit one vulnerability to manipulate all the data, rendering it unusable. Manufacturers that don't update their devices regularly or at all leave them vulnerable to cybercriminals. Additionally, connected devices often ask users to input their personal information, including names, ages, addresses, phone numbers and even social media accounts information that's invaluable to hackers.

Hackers aren't the only threat to the internet of things; privacy is another major concern for IoT users. For instance, companies that make and distribute consumer IoT devices could use those devices to obtain and sell users' personal data. Beyond leaking personal data, IoT poses a risk to critical infrastructure, including electricity, transportation and financial services.

2.2 Embedded Processors used in real time

An embedded processor is a type of microprocessor designed into a system to control electrical and mechanical functions. Embedded processors are usually simple in design, limited in computational power and I/O capabilities, and have minimal power requirements. At a basic level, embedded processors are a CPU chip placed in a system that it helps control. Embedded processors are often confused with microcontrollers. While they do perform similar functions, they integrate with their given system in different ways. The actual functions they perform can also be different as well.

Microcontrollers are the result of technological advances decreasing the size of controllers. Eventually, all of the components of a controller including I/O devices and memory evolved into a single chip, giving us the ―micro‖ in microcontrollers. These chips are small, self-contained devices that have all of the features necessary to control the system they are embedded in. This control autonomy is the primary difference between microcontrollers and embedded processors. Embedded processors require other external components such as integrated memory and peripheral interfaces to perform their designated functions. The two devices are frequently referred to as one device because embedded processors are often components within a microcontroller.

An embedded system is a computer system, made from a combination of hardware and software that is used to perform a specific task**.** A lot of embedded systems are created with time constraints in mind. In some situations, crossing time limits might not amount to much, but in some, it may actually be a disaster. For example, if the embedded system in a car‗s braking system doesn‗t strictly adhere to time, it may result in an accident. However, if a time limit is passed on something less severe, it may just result in reduced performance. The processors found in common personal computers (PC) are general-purpose or universal processors. They are complex in design because these processors provide a full scale of features and a wide spectrum of functionalities. They are designed to be suitable for a variety of applications. On the other hand, another class of embedded processors focuses on performance. These embedded processors are powerful and packed with advanced chip- design technologies, such as advanced pipeline and parallel processing architecture. These processors are designed to satisfy those applications with intensive computing requirements not achievable with general-purpose processors. Overall, system and application speeds are the main concerns. Data storage is the process of ensuring that research data is stored, archived or disposed of in a safe and secure manner during and after the conclusion of a research project. This includes the development of policies and procedures to manage data handled electronically as well as through nonelectronic means. Proper planning for data handling can also result in efficient and economical storage, retrieval, and disposal of data. In the case of data handled electronically, data integrity is a primary concern to ensure that recorded data is not altered, erased, lost or accessed by unauthorized users. All the above survey insist the need of real time health monitoring system which helps in critical situations.

2.3 Proposed System

An IoT-based health observation system works on the patient's body observation system such as pulse rate and body temperature. Heartbeat device hooked up to the patient's fingers and temperature the sensing element is additionally hooked up to the patient's body.

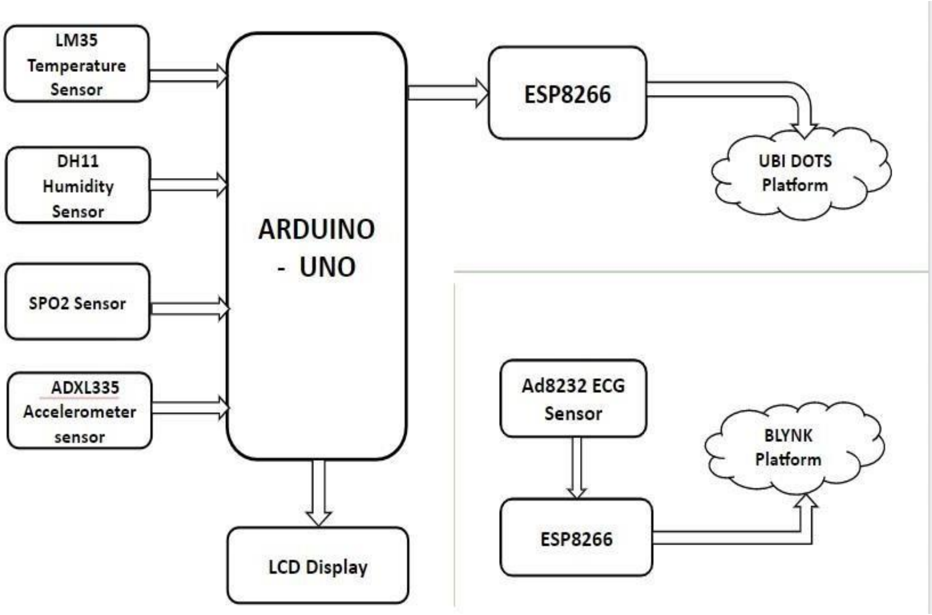


Figure 2.1: Block Diagram of Proposed System

Temperature sensing element could be a sensing element supported resistance its resistance is set by dynamic the patient's vital sign, and pulse rate sensing element, vibration sensing element or flow in its price it's transmitted within the variety of associate signalling. 2 the quantity of sensors obtained by Arduino UNO, nice or wise management of this when receiving these values, these values are saved showed on the display and at a similar time sent to the IoT system exploitation the Wi-Fi module with Wi-Fi modules within the IoT display system these numbers area unit for various websites and applications Wi-Fi sources, and chat area unit used for this employing a web site or app, doctors will track pulse rate and their patients from anyplace.

In this system two sensors are used for one heat sensor another heart rate sensor. To filter the details with drawings, we have used BLYNK Android app and data transfer to IoTcloud using mobile technology and IoT technology. To use this application user needs a Wi-Fi connection. Arduino board connects to Wi-Fi network functionality using Wi-Fi module. Arduino board learned sin from two senses. After that this installation is sent to IoT cloud with the help of Wi- Fi module. Rated inputs displayed on LCD screen. At the same time this data is sent to the IoT cloud and the measured data is displayed on the screen when the application is opened. The limit value range is set to system. If the available value is greater than or below the limit value range a notification message will be sent to the smartphone screen.

For temperature sensing, LM35, a precision IC, which produces an output voltage directly proportional to the temperature in Celsius has been used. It is better than thermistors because it shows a linear output and low output impedance with an output temperature range of -55°C - 150°C.

For ECG measurements, AD8232 is utilized. It is an integrated signal conditioning block for ECG measurement. It can extract, amplify and filter small bio-signals in noisy conditions as well. It can apply a two-pole high-pass filter to eliminate electrode half-cell potential and motion artefacts. It possesses a good Common Mode Rejection Ratio of 80dB. Figure 2.c represents the ECG module – AD8232.

CHAPTER 3
REQUIREMENT ANALYSIS

3.1 Hardware Requirement

This project is based on both hardware and software. The hardware requirements are as follows :-

3.1.1 Arduino Uno

Arduino is an open-source platform used for building electronics projects. Arduino consists of both a physical programmable circuit board (often referred to as a microcontroller) and a piece of software, or IDE (Integrated Development Environment) that runs on our computer, used to write and upload computer code to the physical board.

The Arduino platform has become quite popular with people just starting out with electronics, and for good reason. Unlike most previous programmable circuit boards, the Arduino does not need a separate piece of hardware (called a programmer) in order to load new code onto the board – we can simply use a USB cable. Additionally, the Arduino IDE uses a simplified version of C++, making it easier to learn to program. Finally, Arduino provides a standard form factor that breaks out the functions of the micro-controller into a more accessible package.

The Arduino is a microcontroller board based on the ATmega8. It has 14 digital

- input/output pins (of which 6 can be used as PWM outputs), 6 analog inputs, a 16 MHz ceramic resonator, a USB connection, a power jack, an ICSP header, and a reset button. It contains everything needed to support the microcontroller; simply connect it to a computer with a USB cable or power it with a AC-to-DC adapter or battery to get started. The Uno differs from all preceding boards in that it does not use the FTDI USB-to-serial driver chip. Instead, it features the Atmega16U2 (Atmega8U2 up to version R2) programmed as a USB-to-serial converter. Revision 2 of the Uno board has a resistor pulling the 8U2 HWB line to ground, making it easier to put into DFU mode. Revision of the board has the following new features:

- pinout: added SDA and SCL pins that are near to the AREF pin and two other new pins placed near to the RESET pin, the IOREF that allow the shields to adapt to the voltage provided from the board. In future, shields will be compatible with both the board that uses the AVR, which operates with 5V and with the Arduino Due that operates with 3.3V. The second one is a not connected pin,that is reserved for future purposes.
- Stronger RESET circuit.
- ATmega 16U2 replace the8U2.

Figure 3.1: Arduino

Each of the 14 digital pins and 6 analog pins on the Uno can be used as an input or output, under software control (using pinMode(), digitalWrite(), and digitalRead() functions). They operate at 5 volts. Each pin can provide or receive 20 mA as the recommended operating condition and has an internal pull-up resistor (disconnected by default) of 20-50K ohm. A maximum of 40mA must not be exceeded on any I/O pin to avoid permanent damage to the microcontroller. The Uno has 6 analog inputs, labeled A0 through A5; each provides 10 bits of resolution (i.e. 1024 different values). By default, they measure from ground to 5 volts, though it is possible to change the upper end of the range using the AREF pin and the analog Reference() function.

In addition, some pins have specialized functions:

- **Serial** / UART: pins 0 (RX) and 1 (TX). Used to receive (RX) and transmit (TX) TTL serial data. These pins are connected to the corresponding pins of the ATmega8U2 USB-to-TTL serial chip.
- **External interrupts**: pins 2 and 3. These pins can be configured to trigger an interrupt on a low value, a rising or falling edge, or a change in value.
- **PWM** (pulse-width modulation): pins 3, 5, 6, 9, 10, and 11. Can provide 8-bit PWM output with the analogWrite() function.

- **SPI** (Serial Peripheral Interface): pins 10 (SS), 11 (MOSI), 12 (MISO), and 13 (SCK). These pins support SPI communication using the SPI library.
- **TWI** (two-wire interface) / I^2C: pin SDA (A4) and pin SCL (A5). Support TWI communication using the Wire library.
- **AREF** (analog reference): Reference voltage for the analog inputs.

"Uno" means one in Italian and is named to mark the upcoming release of Arduino 1.0. The Uno and version 1.0 will be the reference version of Arduino, moving forward. The Uno is the latest in a series of USB Arduino boards, and the reference model for the Arduino platform.

Table 3.1 : Specifications of Arduino

Parameters For Arduino UNO	**Description**
Microcontroller	ATmega328
Operating Voltage	5V
Input Voltage (recommended)	7-12V
Input Voltage (limits)	6-20V
Digital I/O Pins	14 (of which 6 provide PWM output)
Analog Input Pins	6
DC Current per I/O Pin	40 mA
DC Current for 3.3V Pin	50 mA
Flash Memory	32 KB (ATmega328) of which 0.5 KB used by Bootloader
SRAM	2 KB (ATmega328)
EEPROM	1 KB (ATmega328)
Clock Speed	16 MHz
Length	68.6 mm
Width	53.4 mm
Weight	25 g

3.1.2 LM35 Temperature Sensor

Temperature is one of the most commonly measured parameter in the world. They are used in your daily household devices from Microwave, fridges, AC to all fields of engineering. Temperature sensor basically measures the heat/cold generated by an object to which it is connected. It then provides a proportional resistance, current or voltage output which is then measured or processed as per our application. Temperature sensor are basically classified into two types

- Non Contact Temperature Sensors: These temperature sensors use convection & radiation to monitor temperature
- Contact Temperature Sensors: Contact temperature sensors are then further sub divided into three type

1. Electro-Mechanical (Thermocouples).
2. Resistance Temperature Detectors (RTD).
3. Semiconductor based. (LM35, DS1820 etc).

The LM35 is a popular and inexpensive temperature sensor. It provides an output voltage of 10.0mV for each degree Centigrade of temperature from a reference voltage. The output of this device can be fed to A/D Converter; any microcontroller can be interfaced with any A/D Converter for reading and displaying the output of LM35. The circuit should be designed, so that output should be at 0V when the temperature is 0 degrees Centigrade and would rise to 1000mV or 1.0V at 100 degrees Centigrade.

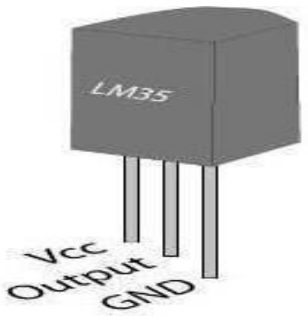
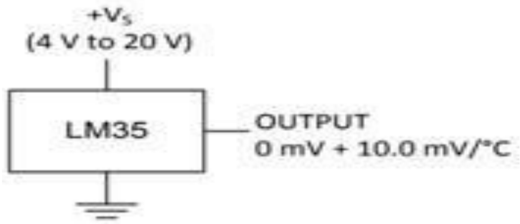


Figure 3.2: LM35 Temperature sensor

The LM35 series are precision integrated-circuit temperature devices with an output voltage linearly proportional to the Centigrade temperature. The LM35 device has an advantage over linear temperature sensors calibrated in Kelvin, as the user is not required to subtract a large constant voltage from the output to obtain convenient Centigrade scaling. The LM35 device does not require any external calibration or trimming to provide typical accuracies of ±¼°C at room temperature and ±¾°C over a full −55°C to 150°C temperature range. Lower cost is assured by trimming and calibration at the wafer level. The low output impedance, linear output, and precise inherent calibration of the LM35 device makes interfacing to readout or control circuitry especially easy. The device is used with single power 2 Applications supplies, or with plus and minus supplies. As the LM35 device draws only 60 μA from the supply, it has very low self-heating of less than 0.1°C in still air. The LM35 device is rated to operate over a −55°C to 150°C temperature range, while the LM35C device is rated for a −40°C to 110°C range (−10° with improved accuracy). The LM35-series devices are available packaged in hermetic TO transistor packages, while the LM35C, LM35CA, and LM35D devices are available in the plastic TO-92 transistor package.



If the temperature is 0°C, then the output voltage will also be 0V. There will be rise of 0.01V (10mV) for every degree Celsius rise in temperature. The voltage can converted into temperature using the below formulae.

$$V_{OUT} = 10 \text{ mv/°C} \times T$$

where

- V_{OUT} is the LM35 output voltage
- T is the temperature in °C

LM35 Temperature Sensor Applications:

- Measuring temperature of a particular environment
- Providing thermal shutdown for a circuit/component
- Monitoring Battery Temperature
- Measuring Temperatures for HVAC applications.

3.1.3 ESP8266 (Node MCU)

In 2014, an ESP8266 Wi-Fi module was introduced and developed by third-party manufacturers like AI thinkers, which is mainly utilized for IoT-based embedded applications development. It is capable of handling various functions of the Wi-Fi network from another application processor. It is a

SOC (System On-chip) integrated with a TCP/IP protocol stack, which can provide microcontroller access to any type of Wi-Fi network. This article deals with the pin configuration, specifications, circuit diagram, applications, and alternatives of the ESP8266 Wi-Fi module.

An ESP8266 Wi-Fi module is a SOC microchip mainly used for the development of end- point IoT (Internet of things) applications. It is referred to as a standalone wireless transceiver, available at a very low price. It is used to enable the internet connection to various applications of embedded systems.

Espressif systems designed the ESP8266 Wi-Fi module to support both the TCP/IP capability and the microcontroller access to any Wi-Fi network. It provides the solutions to meet the requirements of industries of IoT such as cost, power, performance, and design. It can work as either a slave or a standalone application. If the ESP8266 Wi-Fi runs as a slave to a microcontroller host, then it can be used as a Wi-Fi adaptor to any type of microcontroller using UART or SPI. If the module is used as a standalone application, then it provides the functions of the microcontroller and Wi-Fi network. The ESP8266 Wi- Fi module is highly integrated with RF balun, power modules, RF transmitter and receiver, analog transmitter and receiver, amplifiers, filters, digital baseband, power modules, external circuitry, and other necessary components. The ESP8266 Wi-Fi module is a microchip shown in the figure below.

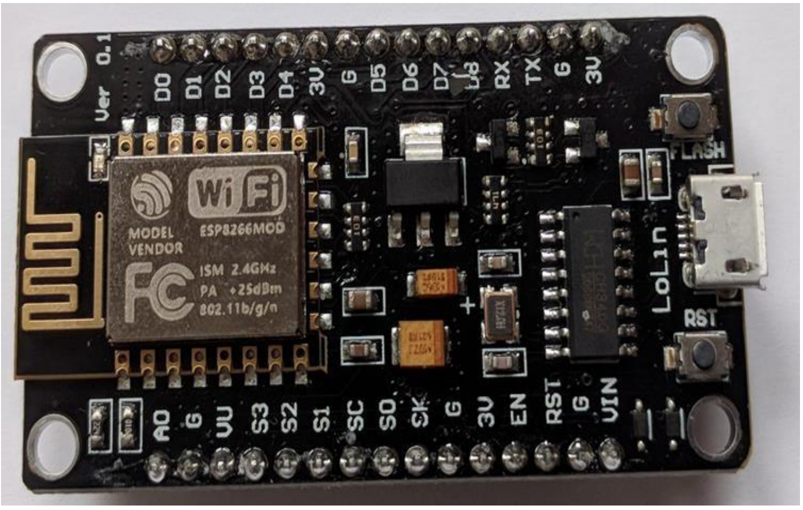


Figure 3.3: ESP8266 (Node MCU)

A set of AT commands are needed by the microcontroller to communicate with the ESP8266 Wi-Fi module. Hence it is developed AT commands software to allow the Arduino Wi-Fi functionalities, and also allows loading various software to design the own application on the memory and processor of the module. The processor of this module is based on the Tensilica Xtensa Diamond Standard 106 micro and operates easily at 80 MHz. There are different types of ESP modules designed by third-party manufacturers.

They are,

- ESP8266-01 designed with 8 pins (GPIO pins -2)
- ESP8266-02 designed with 8 pins (GPIO pins -3)
- ESP8266-03 designed with 14 pins (GPIO pins- 7)
- ESP8266-04 designed with 14 pins (GPIO pins- 7)

The ESP8266 Wi-Fi module comes with a boot ROM of 64 KB, user data RAM of 80 KB, and instruction RAM of 32 KB. It can support 802.11 b/g/n Wi-Fi network at 2.4 GHz along with the features of I2C, SPI, I2C interfacing with DMA, and 10-bit ADC..Interfacing this module with the microcontroller can be done easily through a serial port. An external voltage converter is required only if the operating voltage exceeds 3.6 Volts. It is most widely used in robotics and IoT applications due to its low cost and compact size.

Pin Configuration/Pin Diagram

The **ESP8266 Wi-Fi module pin configuration/pin diagram** is shown in the figure below. The ESP8266-01 Wi-Fi module runs in two modes. They are;

Figure 3.4: Pin Configuration of ESP8266

Flash Mode: When GPIO-0 and GPIO-1 pins are active high, then the module runs the program, which is uploaded into it.

UART Mode: When the GPIO-0 is active low and GPIO-1 is active high, then the module works in programming mode with the help of either serial communication or Arduino board.

ESP8266 Wi-Fi Module Specifications

The **ESP8266 Wi-Fi module specifications or features** are given below.

- It is a powerful Wi-Fi module available in a compact size at a very low price.
- It is based on the L106 RISC 32-bit microprocessor core and runs at 80 MHz
- It requires only 3.3 Volts power supply
- The current consumption is 100 m Amps
- The maximum Input/Output (I/O) voltage is 3.6 Volts.
- It consumes 100 mA current
- The maximum Input/Output source current is 12 mA
- The frequency of built-in low power 32-bit MCU is 80 MHz
- The size of flash memory is 513 kb
- It is used as either an access point or station or both
- It supports less than 10 microAmps deep sleep.
- It supports serial communication to be compatible with several developmental platforms such as Arduino.
- It is programmed using either AT commands, Arduino IDE, or Lua script.
- It is a 2.4 GHz Wi-Fi module and supports WPA/WPA2, WEP authentication, and open networks.
- It uses two serial communication protocols like I2C (Inter-Integrated Circuit) and SPI (Serial Peripheral Interface).
- It provides 10- bit analog to digital conversion
- The type of modulation is PWM (Pulse Width Modulation)
- UART is enabled on dedicated pins and for only transmission, it can be enabled on GPIO2.
- It is an IEEE 802.11 b/g/n Wi-Fi module with LNA, power amplifier, balun, integrated TR switch, and matching networks.
- GPIO pins – 17
- Memory Size of instruction RAM – 32 KB and instruction cache RAM – 32 KB
- Size of User-data RAM- 80 KB
- Size of ETS systems-data RAM – 16 KB

The other standalone modules like ESP-12 and ESP-32 are also commonly used for IoT applications development and to achieve internet connection to the project.

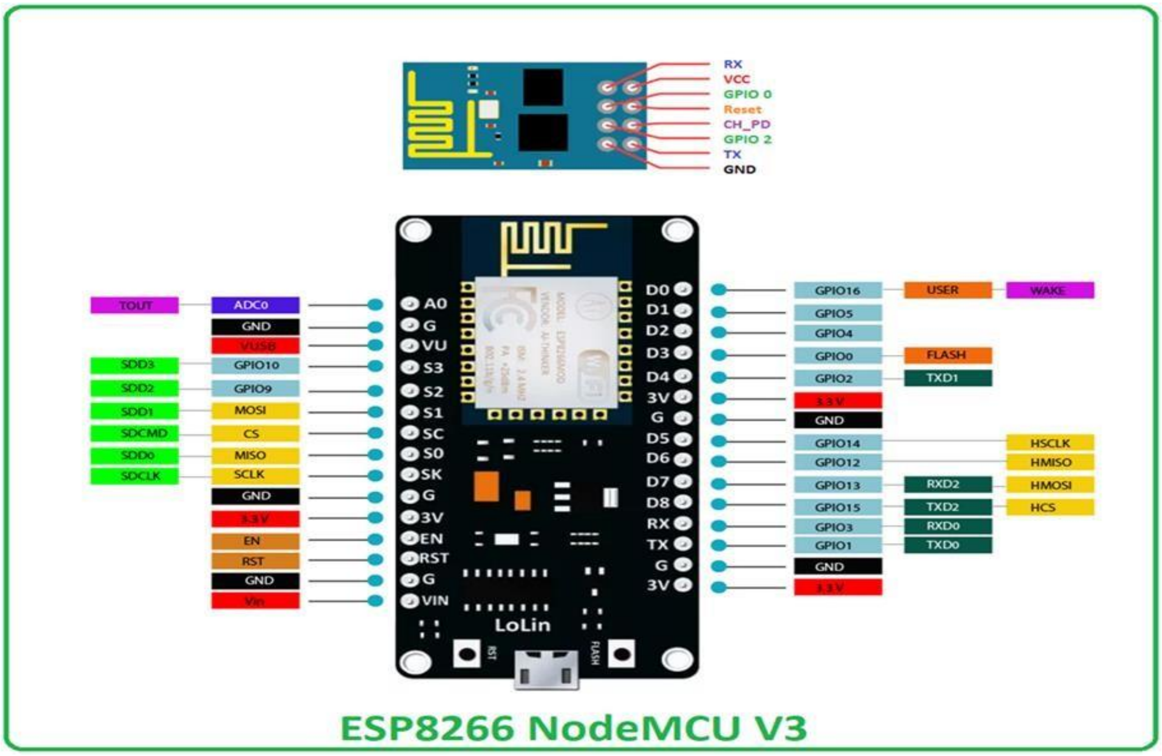


Figure 3.5: Overview of Pin Configuration of ESP8266

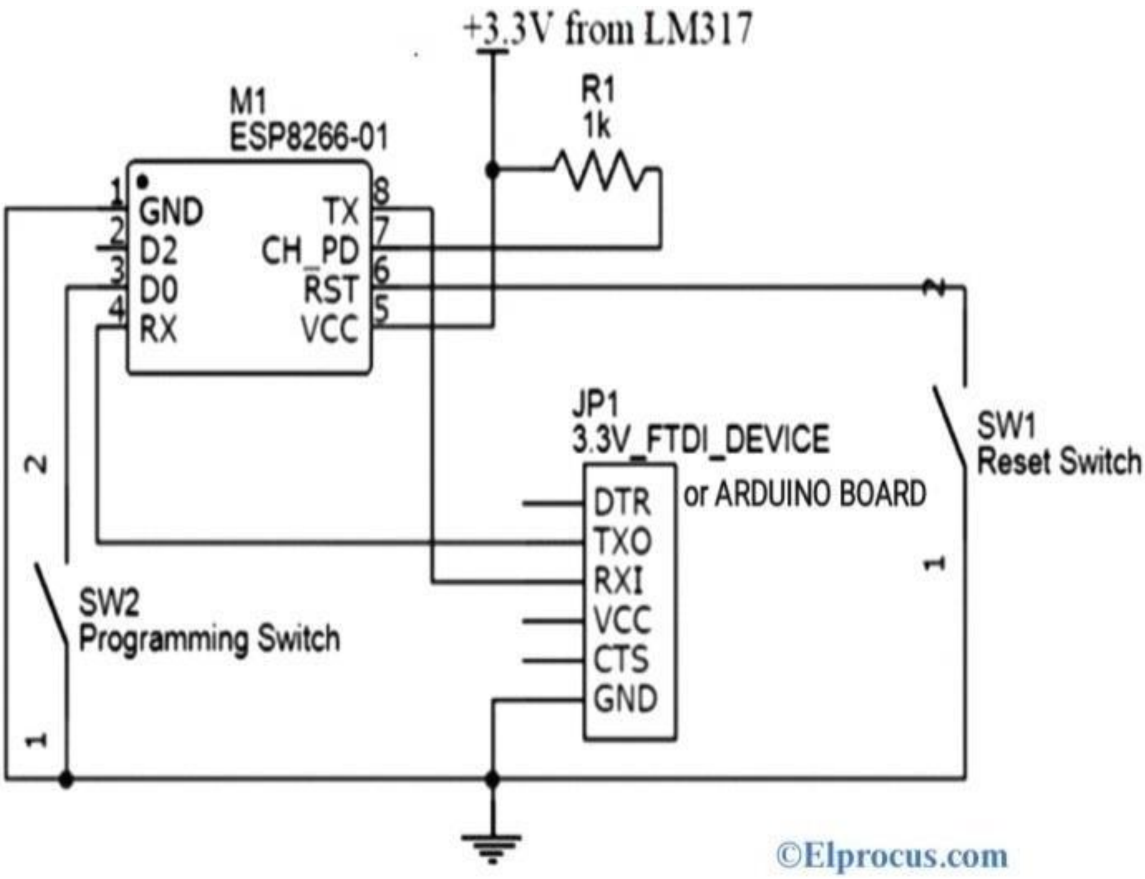


Figure 3.6: Circuit Diagram ESP8266 (Node MCU)

The power supply required for the ESP8266 module is only 3.3 Volts. If it is more than 3.7 Volts, then the module gets damaged, and this leads to circuit failure. Hence it is necessary to program the ESP-01 Wi-Fi module by using either Arduino board or FTDI device, which supports the programming 3.3 Volts supply. It is recommended for the user to buy either one FTDI device or an Arduino board.

The most common issue with the ESP-01 module is the powering up issue. The 3.3 Volts pin on the Arduino board is used to power up this module or simply we can use the potential divider. So, to provide a minimum current of 500 mA, the voltage regulator that supports 3.3 Volts is mandatory. The LM317 voltage regulator does this work very easily and effectively. The programming switch SW2 is pressed to connect the GPIO-0 pin to the GND (Ground). This is the programming mode to upload the code by the user. After uploading the code, the switch is released.

Applications of ESP8266 Wi-Fi Module

The **Applications of the ESP8266 Wi-Fi module** are given below
Access points portals

- IoT projects
- Wireless data logging
- Used in learning the networking fundamentals
- Sockets and smart bulbs
- Smart home automation systems

The **ESP32 is an alternative ESP8266 Wi-Fi module**. It is a standalone and most powerful module.

3.1.4 Pulse Oximeter

Pulse Oximeters are low cost non-Invasive medical sensors used to continuously measure the Oxygen saturation (SPO2) of hemoglobin in blood. It displays the percentage of blood that is loaded with oxygen**.** The sensor is integrated pulse oximetry and heart-rate monitor sensor solution. It combines two LED's, a photodetector, optimized optics, and low-noise analog signal processing to detect pulse and heart-rate signals. It operates from 1.8V and 3.3V power supplies and can be powered down through software with negligible standby current, permitting the power supply to remain connected at all times.

Each Pulse oximeter sensor probe contains two light emitting diodes one emitting red light and the other emitting near infrared light, it also has a photo-detector. The photo- detector measures the intensity of transmitted light at each wavelength. And using the differences in the reading the blood oxygen content is calculated. The probe is placed on a suitable part of the body, usually a fingertip or ear lobe.

Methods for Monitoring Oxygen Saturation in Blood.

Two different methods are used for transmitting light through the transmitting medium**.**

Transmission Method

In the transmission method the transmitter i.e. the LED & the receiver i.e. the photo- detector are placed on opposite side of the finger. In this method this finger will be placed between the LED's & the photo-detector. When the finger is placed a part of the light will be absorbed by the finger and some part will reach the photo detector. Now with each heart beat there will be increase in volume of blood flow this will result in more light getting absorbed by the finger so less light reaches the photo-detector. Hence if we see the waveform of received light signal it will consist of peaks in between heart beats and trough (bottom) at each heartbeat. This difference between the trough & the peak value is the reflection value due to blood flow at heart beat.

Figure 3.7: Transmission method

Reflectance Method

In Reflective method the LED & the photo-detector are placed on the same side i.e. next to each other.In the reflective method there will be some fixed light reflection back to the sensor due to finger. With each heart-beat there will be an increase in blood volume in the finger this will result in more light reflection back to the sensor. Hence if we see the waveform of the received light signal it will consist of peaks at each heartbeat. A fixed low value reading is there in between the heart beats this value can be considered as constant reflection and this difference of the peak subtracted from the constant reflection value is the reflection value due to blood flow at heart beat. In both above cases you can see the troughs/peaks in reflected light occur at each heartbeat the duration between two spikes can be used to measure the persons Heart Rate. Hence a typical Heart beat sensor module consists of only on Transmitter LED (mostly infrared) and one photo-detector.

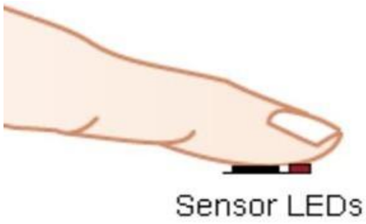


Figure 3.8: Reflectance method

Principle of Pulse oximeter

The principle of pulse oximetry is based on the differential absorption characteristics of oxygenated and the de-oxygenated hemoglobin. Oxygenated hemoglobin absorbs more infrared light and allows more red light to pass through. Whereas Deoxygenated hemoglobin absorbs more red light and allowing more infrared light to pass through.

Oximeters work by the principles of spectrophotometry: the relative absorption of red (absorbed by deoxygenated blood) and infrared (absorbed by oxygenated blood) light of the systolic component of the absorption waveform correlates to arterial blood oxygen saturations. Measurements of relative light absorption are made multiple times every second and these are processed by the machine to give a new reading every 0.5-1 second that averages out the readings over the last three seconds.

Two light-emitting diodes, red and infrared, are positioned so that they are opposite their respective detectors through 5-10 mm of tissue. Probes are usually positioned on the fingertip, although earlobes and forehead are sometimes used as alternatives. One study has suggested that the ear lobe is *not* a reliable site to measure oxygen saturations. However, a more recent study advocated their use in patients admitted to intensive care units for coronary artery bypass surgery. Probes tend to use 'wrap' or 'clip' style sensors.

Using an oximeter

Resting readings should be taken for at least five minutes.Poor perfusion (due to cold or hypotension) is the main cause of an inadequate pulse wave. A sharp waveform with a dicrotic notch indicates good perfusion whilst a sine wave-like waveform suggests poor perfusion.If a finger probe is used, the hand should be rested on the chest at the level of the heart rather than the affixed digit held in the air (as patients commonly do) in order to minimise motion artefact.

Checking that the displayed heart rate correlates to a manually checked heart rate (within 5 beats per minute) generally rules out significant motion artefact.

Emitters and detectors must oppose one another and light should not reach the detector except through the tissue. Ensure the digit is inserted fully into the probe and that flexible probes are attached correctly. Appropriately sized probes should be used for children and infants.

Oximeter accuracy should be checked by obtaining at least one simultaneous blood gas, although this rarely happens. Oximeters may correct average oximeter bias based on pooled data but this does not eliminate the possibility of larger individual biases.

Which finger is best for the pulse oximeter?

The right middle finger and right thumb have statistically higher values, making them perfect for a pulse oximeter.A total of 370 SpO2 measurements from 37 volunteers were obtained. The highest average SpO2 value was measured from right middle finger (98.2 %
± 1.2) and it was statistically significant when compared with right little finger and left middle finger. The second highest average SpO2 value was measured from right thumb and it was statistically significant only when compared with left middle finger (the finger with the lowest average SpO2 value) ($p < 0.05$). SpO2 measurement from the fingers of the both hands with the pulse oximetry, the right middle finger and right thumb have statistically significant higher value when compared with left middle finger in right-hand dominant volunteers. We assume that right middle finger and right thumb have the most accurate value that reflects the arterial oxygen saturation.

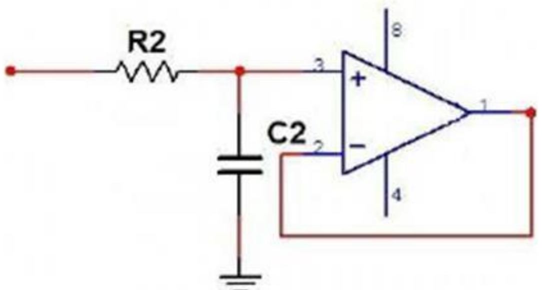


Figure 3.9: Schematic Representation of SPO2 Sensor

A normal level of oxygen is usually 95% or higher. Some people with chronic lung disease or sleep apnea can have normal levels around 90%. The “SpO2” reading on a pulse oximeter shows the percentage of oxygen in someone's blood. If your home SpO2 reading is lower than 95%, call your health care provider. The oxygen saturation as determined by the oximeter is calculated using the ratio of Oxy-Hb/Deoxy-Hb. This is a useful piece of data to determine whether a patient is able to transfer oxygen into the bloodstream, however 100% saturation on the oximeter does not guarantee that tissues are sufficiently oxygenated

Figure 3.10: MAX30100 Sensor

Features:

- Consumes very low power (operates from 1.8V and 3.3V)
- Ultra-Low Shutdown Current (0.7µA, typ)
- Fast Data Output Capability
- Interface Type: I2C

Working:

Oxygen enters the lungs and then is passed on into blood. The blood carries oxygen to the various organs in our body. The main way oxygen is carried in our blood is by means of hemoglobin. During a pulse oximetry reading, a small clamp-like device is placed on a finger, earlobe, or toe.Small beams of light pass through the blood in the finger, measuring the amount of oxygen. It does this by measuring changes in light absorption in oxygenated or deoxygenated blood.

Working of MAX30100 Pulse Oximeter and Heart-Rate Sensor

The device has two LEDs, one emitting red light, another emitting infrared light. For pulse rate, only infrared light is needed. Both red light and infrared light are used to measure oxygen levels in the blood. When the heart pumps blood, there is an increase in oxygenated blood as a result of having more blood. As the heart relaxes, the volume of oxygenated blood also decreases. By knowing the time between the increase and decrease of oxygenated blood, the pulse rate is determined.

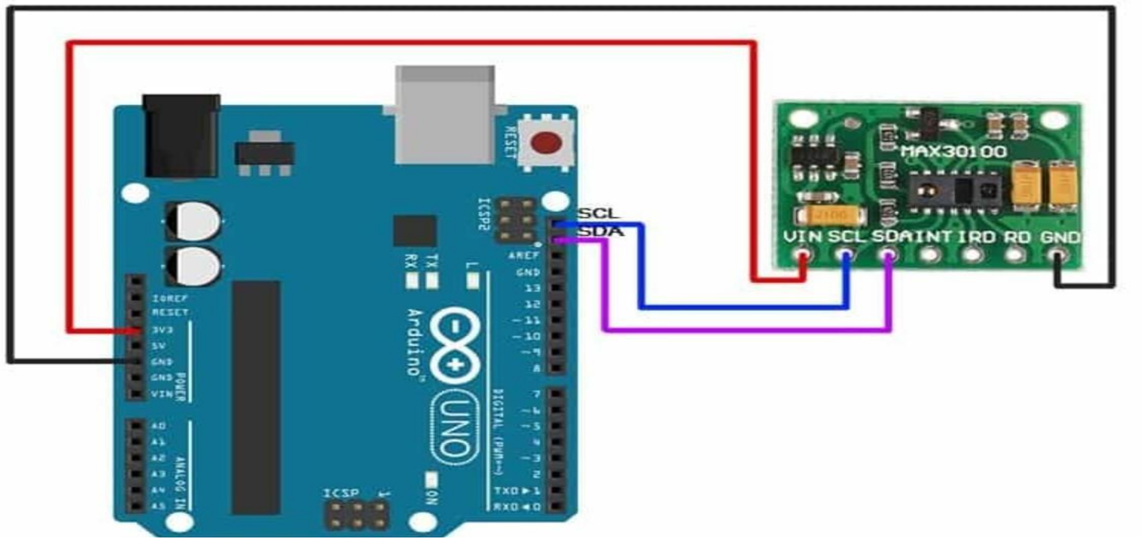


Figure 3.11: Interfacing of pulse sensor with arduino

It turns out, oxygenated blood absorbs more infrared light and passes more red light while deoxygenated blood absorbs red light and passes more infrared light. This is the main function of the MAX30100: it reads the absorption levels for both light sources and stores them in a buffer that can be read via I2C communication protocol

Some benefits of pulse oximetry include:

- Monitoring oxygen saturation over time
- Alerting to dangerously low oxygen levels, particularly in newborns
- Offering peace of mind to people with chronic respiratory conditions
- Assessing the need for supplemental oxygen
- Monitoring oxygen saturation levels in people under anesthesia
- Indicating dangerous side effects in people taking drugs that affect breathing or oxygen saturation

3.1.5 AD8232 ECG SENSOR

The electrocardiography or ECG is a technique for gathering electrical signals which are generated from the human heart. When someone experiences physiological arousal then the ECG sensor allows us to recognize the level, however, it is also used for understanding the psychological state of humans. So an AD8232 sensor is used to calculate the electrical activity of the heart. This is a small chip and the electrical action of this can be charted like an ECG (Electrocardiogram). Electrocardiography can be used to help in diagnosing different conditions of the heart. This article provides an overview of the AD8232 ECG Sensor.

Heart diseases are becoming a big issue for the last few decades and many people die because of certain health problems. Therefore, heart disease cannot be taken lightly. By analyzing or monitoring the ECG signal at the initial stage this disease can be prevented. So we present this project, i.e ECG Monitoring with AD8232 ECG Sensor & Arduino with ECG Graph. The AD8232 is a neat little chip used to measure the electrical activity of the heart. This electrical activity can be charted as an ECG or Electrocardiogram. Electrocardiography is used to help diagnose various heart conditions. So in this project, we will interface AD8232 ECG Sensor with Arduino and observe the ECG signal on a serial plotter or Processing IDE.

What isECG?

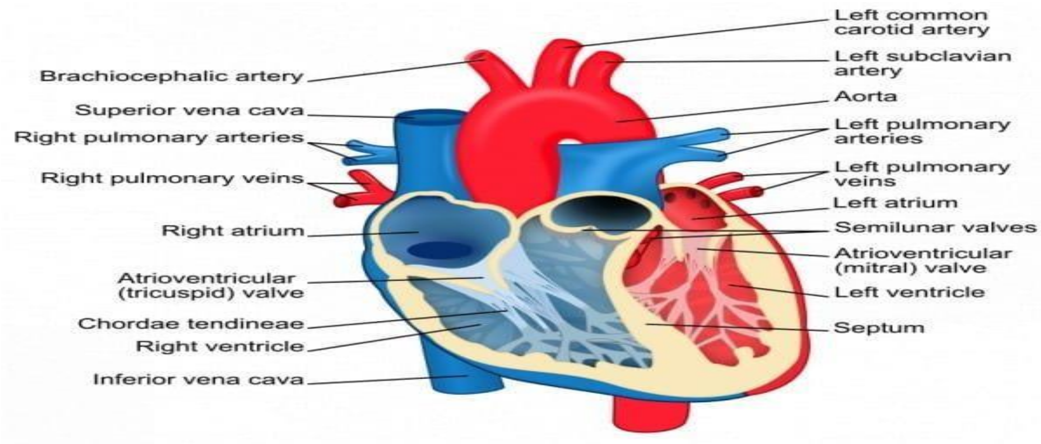


Figure 3.12: ECG

An ECG is a paper or digital recording of the electrical signals in the heart. It is also called an electrocardiogram or an EKG. The ECG is used to determine heart rate, heart rhythm, and other information regarding the heart’s condition. ECGs are used to help diagnose heart arrhythmias, heart attacks, pacemaker function, and heart failure.

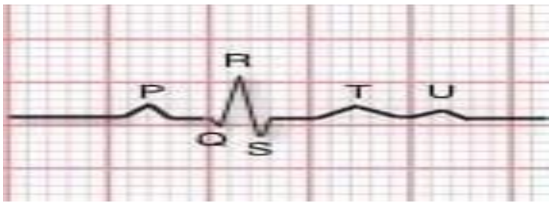


Figure 3.13: ECG Representation

ECG can be analyzed by studying components of the waveform. These waveform components indicate cardiac electrical activity. The first upward of the ECG tracing is the P wave. It indicates atrial contraction.

What is an AD8232 ECG Sensor?

The AD8232 ECG sensor is a commercial board used to calculate the electrical movement of the human heart. This action can be chart like an Electrocardiogram and the output of this is an analog reading. Electrocardiograms can be very noisy, so to reduce the noise the AD8232 chip can be used. The **working principle of the ECG sensor** is like an operational amplifier to help in getting a clear signal from the intervals simply.

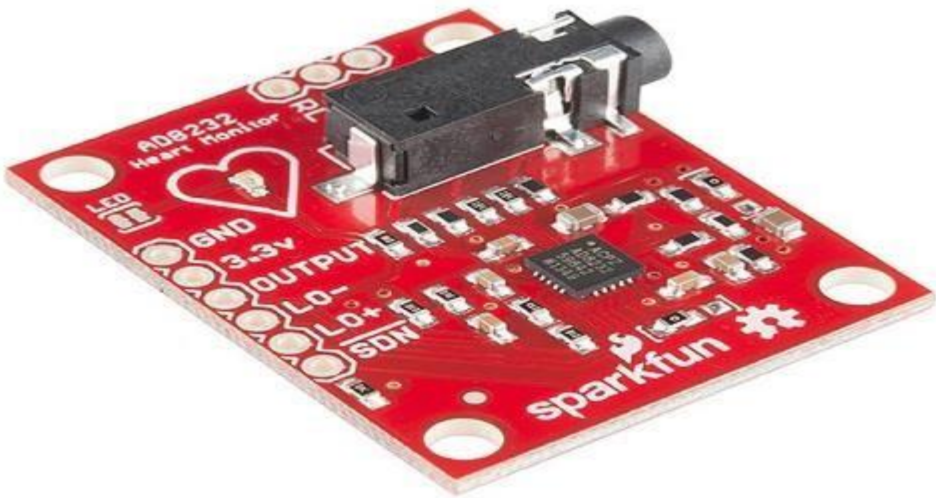


Figure 3.14: ECG SENSOR

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.

AD8232 Pin Configuration

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 we can connect this IC to development boards like Arduino by soldering pins.

Additionally, this board includes pins like the right arm (RA), left arm (LA) & right leg (RL) 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. This sensor is accessible in a 4 mm × 4 mm size, and the package of this sensor is 20-lead LFCSP. It operates from −40°C -to- +85°C but the performance is specified from 0°C -to- 70°C.

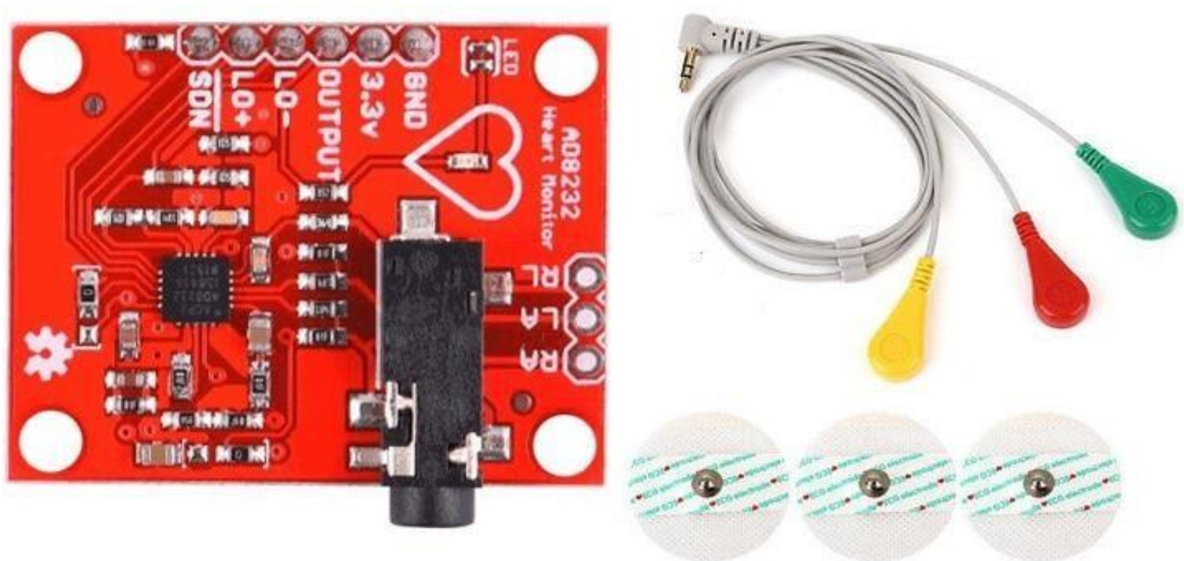


Figure 3.15: AD8232 ECG SENSOR

Circuit Diagram/Connection between Arduino and ECG Sensor AD8232

The AD8232 Heart Rate Monitor breaks out nine connections from the IC. We traditionally call these connections "pins" because they come from the pins on the IC, but they are actually holes that you can solder wires or header pins to. We'll connect five of
the nine pins on the board to Arduino. The five pins you need are labeled GND, 3.3v, OUTPUT, LO-, and LO+.

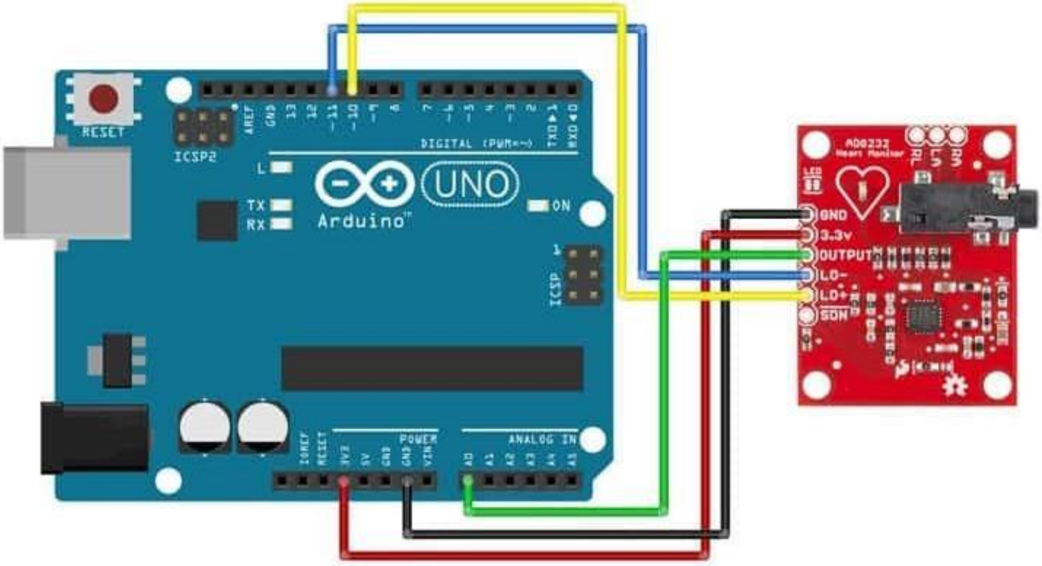


Figure 3.16: Interfacing AD8232 Sensor with Arduino

Board Label	Pin Function	Arduino Connection
GND	Ground	GND
3.3v	3.3v Power Supply	3.3v
OUTPUT	Output Signal	A0
LO-	Leads-off Detect -	11
LO+	Leads-off Detect +	10
SDN	Shutdown	Not used

Table 3.2 Pins of Aurdino

Features and Specifications

The features of this sensor mainly include the following.

- Operation of single supply ranges from 2V to 3.5V
- The front end is integrated fully with only lead ECG
- The virtual ground can be generated through integrated reference
- RFI filter is used internally
- The current supply is low like 170 µA
- The output is rail to rail

- Electrocardiogram (ECG) is a common medical test for assessing cardiac function by measuring the electrical activity of the heart, although other tests may also be done. ECG is considered a fairly routine and sufficient indication of heart health and is performed with 3, 5, 12, or 15-lead ECG/EKG machines.

- Interestingly, it’s also possible to design a low-cost ECG machine using Arduino and an AD8232 ECG sensor.

- AD8232 is a cost-effective, ECG analog sensor for measuring the electrical activity of the heart. Essentially, AD8232 is an integrated signal conditioning block for ECG and other biopotential measurements. It’s designed to extract, amplify, and filter small biopotential signals in noisy conditions.

- A three-electrode ECG cable can be attached to this sensor board, which easily interfaces with Arduino or Raspberry Pi to efficiently monitor ECG signals — which is what this project entails.

- However, please note that AD8232 is *not* an industry-grade, medical device. It should *not* be used to diagnose or treat any medical condition. It’s simply an op-amp device that measures biopotential signals and can offer a fairly accurate ECG graph. Be sure to visit your doctor for a true medical assessment.

- By interfacing AD8232 with Arduino, it’s also possible to monitor an ECG graph on Arduino IDE’s Serial Plotter in the Processing IDE and on a laptop or PC.

- Shutdown pin
- CMRR is 80 dB
- Incorporated RLD amplifier (right leg drive
- Electrode configurations are 2 or 3
- The operational amplifier is uncommitted
- It accepts half cell potential up to ±300 mV
- Three-pole adaptable LPF with adaptable gain
- The signal gain is high using DC blocking capacity
- Filter settling can be improved by quick restore
- Two-pole adaptable HPF
- 4 mm × 4 mm and 20-lead LFCSP package.

Applications of AD8232 ECG Sensor

The applications of the AD8232 ECG sensor include the following.

- Monitoring of heart and fitness activity
- Handy ECG
- Monitoring of remote health
- Used in gaming devices
- Acquisition of biopotential signal
- Biometrics
- Physiology studies
- Prototyping of biomedical instruments
- Variability of heart rate
- Interaction of human-computer
- Psychophysiology

3.1.6 Accelerometer Sensor

What is an Accelerometer Sensor?

The rate of change of velocity of the body with respect to time is called acceleration. According to relative theory, depending upon the relative object taken to measure acceleration, there are two types of acceleration.

The proper acceleration, which is the physical acceleration of the body relative to inertia or the observer who is at rest relative to the object being measured. The coordinate acceleration depends upon the choice of coordinate system and choice of observers. This is not equal to proper acceleration. Accelerometer sensor is the electromechanical device used to measure the proper acceleration of the object.

Working Principle

The basic underlying working principle of an accelerometer is such as a dumped mass on a spring. When acceleration is experienced by this device, the mass gets displaced till the spring can easily move the mass, with the same rate equal to the acceleration it sensed. Then this displacement value is used to measure the give the acceleration.

Accelerometers are available as digital devices and analog devices. Accelerometers are designed using different methods. Piezoelectric, piezoresistive and capacitive components are generally used to convert the mechanical motion caused in accelerometer into an electrical signal.

Piezoelectric accelerometers are made up of single crystals. These use the piezoelectric effect to measure the acceleration. When applied to stress, these crystals generate a voltage which is interpreted to determine the velocity and orientation

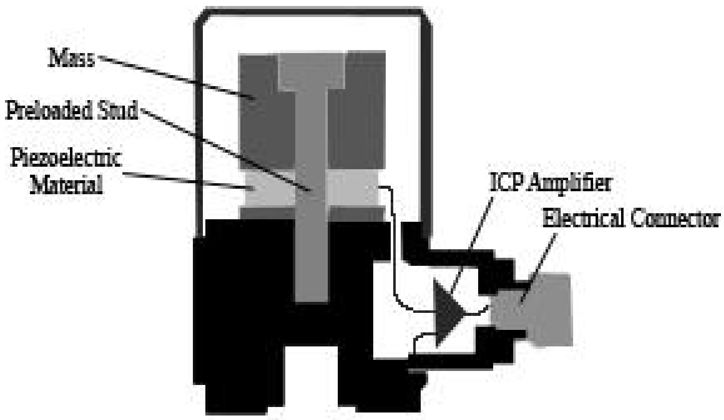


Figure 3.17: Accelerometer Working

Dynamic acceleration forces are non-uniform, and the best example is vibration or shock. A car crash is an excellent example of dynamic acceleration. Here, the acceleration change is sudden when compared to its previous

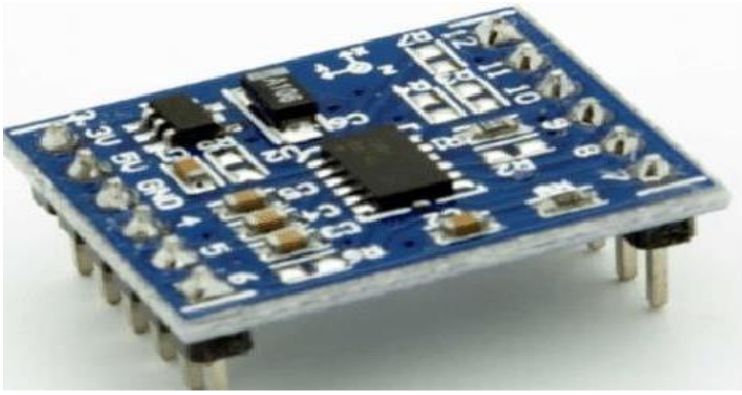


Figure 3.18: Accelerometer Sensor

Modern accelerometers are the smallest MEMS, consisting of a cantilever beam with proof mass. Accelerometers are available as two-dimensional and three-dimensional forms
to measure velocity along with orientation. When the upper-frequency range, high- temperature range, and low packaged weight are required, piezoelectric accelerometers are the best choice.

Applications:

The Applications of Accelerometer sensor are as follows:

- For inertial navigation systems, highly sensitive accelerometers are used.
- To detect and monitor vibrations in rotating machinery.
- To display images in an upright position on screens of digital cameras.
- For flight stabilization in drones.
- Accelerometers are used to sense orientation, coordinate acceleration, vibration, shock.
- Used to detect the position of the device in laptops and mobiles.
- High-frequency recording of biaxial and triaxial acceleration in biological applications for discrimination of behavioral patterns of animals.
- Machinery health monitoring.
- To detect faults in rotator machines.
- These are also used for building and structural monitoring to measure the motion and vibration of the structure when exposed to dynamic loads.
- To measure the depth of CPR chest compressions.
- Navigation systems make use of accelerometer sensors for knowing the direction.
- Remote sensing devices also use accelerometers to monitor active volcanoes.

3.1.7 DH11 Humidity and Temperature Sensor

Humidity is the measure of water vapour present in the air. The level of humidity in air affects various physical, chemical and biological processes. In industrial applications, humidity can affect the business cost of the products, health and safety of the employees. So, in semiconductor industries and control system industries measurement of humidity is
very important. Humidity measurement determines the amount of moisture present in the gas that can be a mixture of water vapour, nitrogen, argon or pure gas etc… Humidity sensors are of two types based on their measurement units. They are a relative humidity sensor and Absolute humidity sensor. DHT11 is a digital temperature and humidity sensor.

The DHT11 is a basic, ultra low-cost digital temperature and humidity sensor. It uses a capacitive humidity sensor and a thermistor to measure the surrounding air, and spits out a digital signal on the data pin (no analog input pins needed). Its fairly simple to use, but requires careful timing to grab data. You can get new data from it once every 2 seconds, so when using the library from Adafruit, sensor readings can be up to 2 seconds old.
Comes with a 4.7K or 10K resistor, which you will want to use as a pullup from the data pin to VCC.

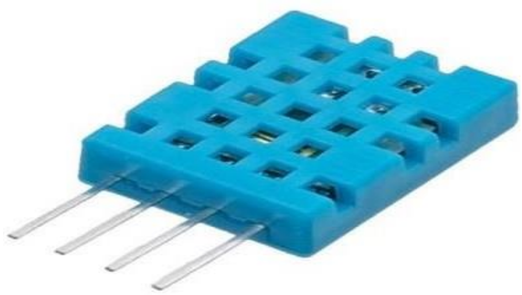


Figure 3.19: DH11 Humidity and Temperature Sensor

DHT11 sensor has four pins- VCC, GND, Data Pin and a not connected pin. A pull-up resistor of 5k to 10k ohms is provided for communication between sensor and micro- controller.

Applications

This sensor is used in various applications such as measuring humidity and temperature values in heating, ventilation and air conditioning systems. Weather stations also use these sensors to predict weather conditions. The humidity sensor is used as a preventive measure in homes where people are affected by humidity. Offices, cars, museums, greenhouses and industries use this sensor for measuring humidity values and as a safety measure.

3.1.8 Liquid Crystal Display (LCD)

The term LCD stands for liquid crystal display. It is one kind of electronic display module used in an extensive range of applications like various circuits & devices like mobile phones, calculators, computers, TV sets, etc. These displays are mainly preferred for multi-segment light-emitting diodes and seven segments. The main benefits of using this module are inexpensive; simply programmable, animations, and there are no limitations for displaying custom characters, special and even animations, etc.

The liquid crystal display screen works on the principle of blocking light rather than emitting light. LCDs require a backlight as they do not emit light them. We always use devices which are made up of LCD's displays which are replacing the use of cathode ray tube. Cathode ray tube draws more power compared to LCDs and is also heavier and bigger.

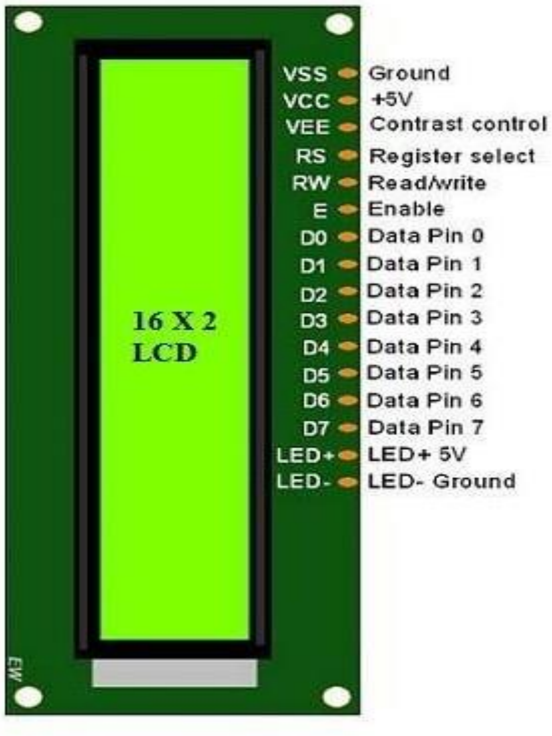


Figure 3.20 Pin diagram of LCD

The 16×2 LCD pinout is shown above.

- Pin1 (Ground/Source Pin): This is a GND pin of display, used to connect the GND terminal of the microcontroller unit or power source.
- Pin2 (VCC/Source Pin): This is the voltage supply pin of the display, used to connect the supply pin of the power source.
- Pin3 (V0/VEE/Control Pin): This pin regulates the difference of the display, used to connect a changeable POT that can supply 0 to 5V.
- Pin4 (Register Select/Control Pin): This pin toggles among command or data register, used to connect a microcontroller unit pin and obtains either 0 or 1(0 = data mode, and 1 = command mode).
- Pin5 (Read/Write/Control Pin): This pin toggles the display among the read or writes operation, and it is connected to a microcontroller unit pin to get either 0 or 1 (0 = Write Operation, and 1 = Read Operation).
- Pin 6 (Enable/Control Pin): This pin should be held high to execute Read/Write process, and it is connected to the microcontroller unit & constantly held high.
- Pins 7-14 (Data Pins): These pins are used to send data to the display. These pins are connected in two-wire modes like 4-wire mode and 8-wire mode. In 4-wire mode, only four pins are connected to the microcontroller unit like 0 to 3, whereas in 8-wire mode, 8-pins are connected to microcontroller unit like 0 to 7.
- Pin15 (+ve pin of the LED): This pin is connected to +5V
- Pin 16 (-ve pin of the LED): This pin is connected to GND.

Features of LCD16x2

The features of this LCD mainly include the following.

The operating voltage of this LCD is 4.7V-5.3V

- It includes two rows where each row can produce 16-characters.
- The utilization of current is 1mA with no backlight
- Every character can be built with a 5×8 pixel box
- The alphanumeric LCDs alphabets & numbers
- Is display can work on two modes like 4-bit & 8-bit
- These are obtainable in Blue & Green Backlight

- It displays a few custom generated characters

Registers of LCD

A 16×2 LCD has two registers like data register and command register. The RS (register select) is mainly used to change from one register to another. When the register set is ‗0‘, then it is known as command register. Similarly, when the register set is ‗1‘, then it is known as data register.

Command Register:

The main function of the command register is to store the instructions of command which are given to the display. So that predefined tasks can be performed such as clearing the display, initializing, set the cursor place, and display control. Here commands processing can occur within the register.

Data Register:

The main function of the data register is to store the information which is to be exhibited on the LCD screen. Here, the ASCII value of the character is the information which is to be exhibited on the screen of LCD. Whenever we send the information to LCD, it transmits to the data register, and then the process will be starting there. When register set =1, then the data register will be selected.

3.1.6 Power Supply and Connecting Wires

A power supply is an electronic device that supplies electric energy to an electrical load. The primary function of a power supply is to convert one form of electrical energy to another and, as a result, power supplies are sometimes referred to as

electric power converters. Some power supplies are discrete, stand-alone devices, whereas others are built into larger devices along with their loads. Here, we use 5v dc power or sometimes power is given to the circuit directly from computer. A Wire is a single usually cylindrical, flexible strand or rod of metal. Wires are used to bear mechanical loads or electric and telecommunication signals. Wire is formed by drawing the metal through a hole in a die or drawplate.

3.2 Software Requirement

As explained earlier our project requires two-part hardware and software. Hardware parts are explained above and software requires as follows:-

Arduino IDE

The open-source Arduino Software (IDE) makes it easy to write code and upload it to the board. It runs on Windows, Mac OS X, and Linux. The environment is written in Java and based on Processing and other open-source software. This software can be used with any Arduino board. The Arduino development environment 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 hardware to upload programs and communicate with them.

Software written using Arduino are called sketches. These sketches are written in the text editor. Sketches are saved with the file extension .ino. It has features for cutting/pasting and for searching/replacing text. The message area gives feedback while saving and exporting and also displays errors. The console displays text output by the Arduino environment including complete error messages and other information. The bottom right-hand corner of the window displays the current board and serial port. The toolbar buttons allow us to verify and upload programs, create, open, and save sketches, and open the serial monitor.

The source code for the IDE is released under the GNU General Public License, version 2. The Arduino IDE supports the languages C and C++ using special rules of code structuring. The Arduino IDE supplies a software library from the Wiring project, which provides many common input and output procedures. User-written code only requires two basic functions, for starting the sketch and the main program loop, that are compiled and linked with a program stub *main()* into an executable cyclic executive program with the GNU tool chain, also included with the IDE distribution. The Arduino IDE employs the program *avrdude* to convert the executable code into a text file in hexadecimal encoding that is loaded into the Arduino board by a loader program in the board's firmware. By default, avrdude is used as the uploading tool to flash the user code onto official Arduino boards.

Arduino IDE is a derivative of the Processing IDE, however as of version 2.0, the Processing IDE will be replaced with the Visual Studio Code-based Eclipse Theia IDE framework.

With the rising popularity of Arduino as a software platform, other vendors started to implement custom open source compilers and tools (cores) that can build and upload sketches to other microcontrollers that are not supported by Arduino's official line of microcontroller.

Blynk App

The mobile application used here is Blynk App displays the data obtained from the sensors, through micro-controller. This application will even store data, visualize it and can use it for future use. Using this application, we can monitor a patient from anywhere. In this application various LCD Displays, charts, gauges as shown in Fig. 3 used for displaying the sensed real-time data presents the health constraints of a patient. Through this application doctor or any person can monitor a person's health conditions from anywhere they are. As a future scope of project call can also be done in any emergency conditions from the parameters obtained which are sensed. The applications were connected to an IoT cloud and figured the real time data by an LCD display

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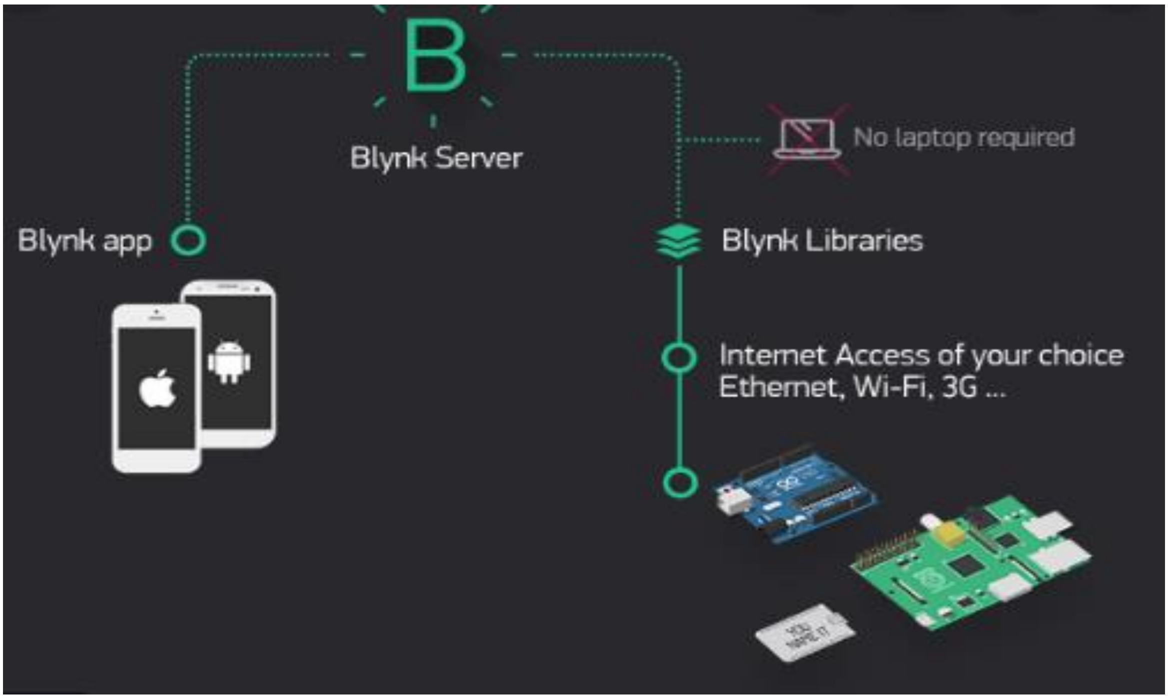

CHAPTER 4
DESIGN AND PLANNING

4.1 Process Model

In this section we design structure of the system before implementation of circuit. we use advanced microcontroller called Arduino (ATmega8). It has in built with many components like analog to digital converter, clock of 16 MHz, shift registers.

In this system we use temperature sensor IC LM35 and Pulse sensor, todetect temperature and heart beat into appropriate voltage. This voltage is given to Arduino. According to program it process the analog signal into digital and send it via SMS to the concerned people as output (i.e. surrounding temperature of LM35) in both degree centigrade and Fahrenheit units.

CHAPTER 5
IMPLEMENTATION

5.1 Hardware Implementation

In this section we design our project Real Time Health Monitoring System using Arduino and with the help of temperature sensor IC LM35 and pulse Sensor. The signals sensed from the patients is milli volt but the sensors volt will be 5v sensors will have the amplifiers the sensed signals is amplified and it won‘t cause harm to human health then the signals are sent to the Arduino. Here we use Arduino (ATmega8) as a controller. This signal is given to the Analog port (A0) and (A1) of the Arduino UNO. Arduino UNO reads analog input and converts this analog voltage into digital bits form using inbuilt A to D converter. It converts analog voltage level in any number between 0 to 1023. It uses 10 bits for processing. This is given to the ATmega328 Micro controller, it then processes the digital data into the respective degree centigrade for temperature and to BHP for the heart rate. Using GSM Module the results will be continuously transmit to medical officials and the data will be stored directly to the database.

5.2 Software Implementation

Software Requirements

1. Open source Android app
2. Embedded C
3. Arduino IDE

1. Open Source Android App (Blynk) Blynk is an open source android app which is designed and developed in order to control the hardware via internet of things (IOT). This digitally displays sensor data, it can accumulate and visualize the data. Plus it can also do other parameters such as: o Blynk App –this app gives us to create amazing interfaces for a project using multiple widgets which is an in build app. o Blynk Server It acts as an interface between the smartphone and hardware which is responsible for the communication. We can also use blynk cloud or compile our private blynk server It’s an open source that can control any number of devices plus can also be launchedon Raspberry Pi. Blynk Libraries – for all the standard hardware platforms, supports communication with the server and the complete progression of incoming and outgoing instructions.

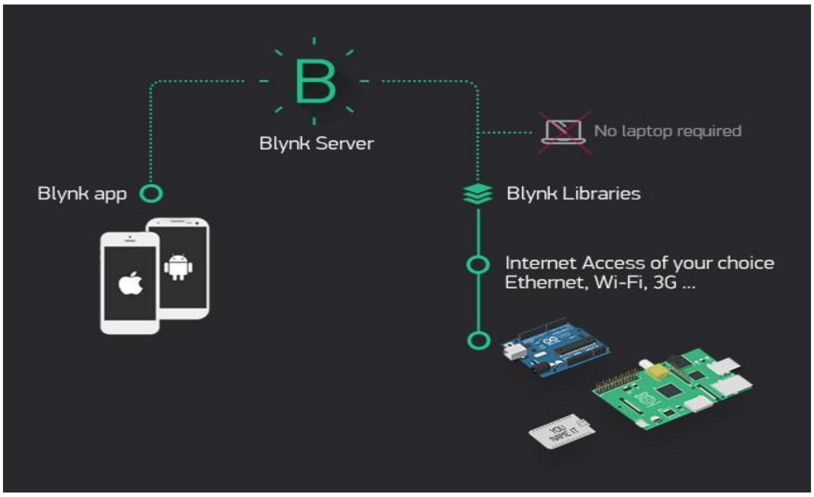

Fig 4.1: Blynk server

2. Embedded C It is mainly used for the purpose of real time response. RTS (real time response) is designed and developed as a device which corrects based on the time of response. The advanced version of RTS (real time response) follows the concept of responding with delay is fine. For instance this includes railway platform which displays schedule system.

3. Arduino IDE Arduino IDE where IDE (Integrated Development Environment). This is basically a open source app where one can code, compile, and upload a file in an Arduino device. In fact any Arduino modules are adapted by this software, which has in build features by default .It is available for operating systems for instance MAC, Windows, Linux, and runs on the java software. A range of Arduino modules, consist of Arduino Uno, Arduino Mega, Arduino Leonardo, Arduino Micro etc. Every module contains a microcontroller on the board which is in build by default

CHAPTER 6

RESULTS AND DISCUSSION

The ageing healthcare monitoring system is a challenging approach that will provide healthcare for older people to avoid hospitalization. There is much demand for effective health care product solutions to monitor older people at home in real time. The system helps us to provide convenience, safe social care for disabled chronic, and aged people. The continuous real-time monitoring remotely, will provide liveliness of healthcare. In emergencies or in critical situation of patients' health information, is reported to the family doctor. The hardware interfacing module is implemented using ESP8266, which is a wireless-based health monitoring system to sense heartbeat, body temperature, Blood pressure, and Respiration. The sensed information is sent to the cloud wirelessly. The hardware module helps in real-time health monitoring systems at home gives the information and provides quick service if needed. Thus, the overall system can be optimized with ultra-low power consumption, ease of use, simple to implement, cost effective and portable to the user. The system may be helpful to monitor the patient remotely but may not be suitable for clinical purpose.

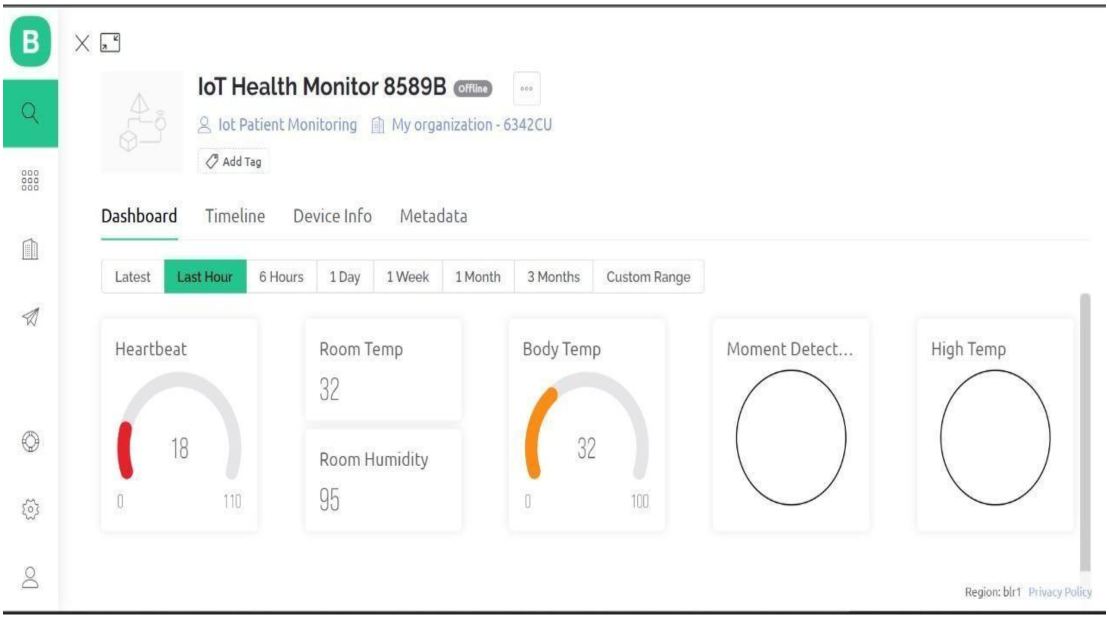

Figure 6.1:Blynk app results of vital parameter

Figure 6.2: Output of ECG monitoring

The project requires three inputs. The inputs are as follows:-

A) Power supply:-

Power supply is the basic need of any electronic circuit. Here we use 5v dc battery to give power Arduino and sometimes we can give power directly from the computer.

B) Temperature:-

It uses Body temperature as input.

C) Pulse :

Pulse Sensor fits over a fingertip and uses the amount of infrared light reflected by the blood circulating inside to do just that. When the heart pumps, blood pressure rises sharply, and so does the amount of infrared light from the emitter that gets reflected back to the detector.

CHAPTER 7
CONCLUSION AND FURTHER ENHANCEMENTS

Remote Patient Monitoring systems are especially useful because they let the patients live their life while at the same time afford constant medical attention. The need for visiting the clinic/doctor is pushed to only deserving cases. Offline or online RPM devices are effective patient companions at all times.RPM systems can be used by even seemingly healthy people who may foresee health problems in the future. RPM systems will continue to evolve with increasing awareness, utilization and improving technologies.

The progress in bio medical engineering, science and technology paved way for new inventions and technologies. As we are moving towards miniaturization, handy electronic components are in need. New products and new technology are being invented. ARDUINO was found to be more compact, user friendly and less complex, which could readily be used in order to perform several tedious and repetitive tasks. Simulation is performed using Arduino software by placing appropriate sensors like temperature and heart beat rate for sensing the health condition and the results are analyzed under normal conditions and abnormality conditions.

This project can be further enhanced by sensing and displaying other vital statistics of a patient like ECG, blood pressure, glucose level etc. the other thing which is to add is presently we are monitoring the data in Arduino IDE in future we can monitor data in web page using internet of thing technology. In future, a portable health monitoring system can be designed using Arduino.

Remote Patient Monitoring comes with a lot of promise and has evolved into a finer service than Telehealth. It is going to continue evolving with time in terms of growth and innovation. The following trends are foreseen in the future for Remote Patient Monitoring:

- Increased adoption of Remote Patient Monitoring in Practice Management and Research.
- Consolidation and convergence of technologies participating in RPM.
- Increasing patient participation in RPM adoption and utilization.
- Improvements in devices and technologies with increasing utilization and information share.
- Application of analytics leading to a better study of patient condition information and the related assessments.

RPM system could find applications in numerous healthcare cases some of which are quoted below:

Heart Patients:

Recovering heart patients could require continuous monitoring to assess the conditions and quick care/medication. Devices which include heart resynchronization therapy and pacemakers are especially useful in preventing problems for heart patients. The diagnostic software combined with the device capabilities could almost double-up as a doctor in the vicinity.

Senility or Dementia Problems:

Old age people often suffer from senility and forgetfulness; this could bring some problems such as losing the way or such people falling down at some places. The surveillance and assistance provided by RPM devices could help such people; if these are GPS enabled, they could even help track their locations.

Diabetes and Hypertension Control:

Diabetic or high BP patients require continuous monitoring and control of blood pressure and blood sugar; this can be achieved by an RPM system that not only monitors but could also provide alerts for controlling them. The diagnostic software could provide not only the condition but even advice the diet control or medication necessary to bring the blood sugar to acceptable levels.

Clinical Trials:

In specific clinical trials, which may require long-term observation of the subjects during and after the trials, this may be achieved with the RPM systems.

CHAPTER 8

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