

**ENHANCED MEDICAL DATA ENCRYPTION METHOD FOR IOT BASED
HEALTH CARE MANAGEMENT SYSTEM**

Submitted in partial fulfillment of the requirements for the award of Bachelor of
Engineering Degree in Electronics and Communication Engineering

By

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SATHYABAMA

**INSTITUTE OF SCIENCE AND TECHNOLOGY
(DEEMED TO BE UNIVERSITY)**

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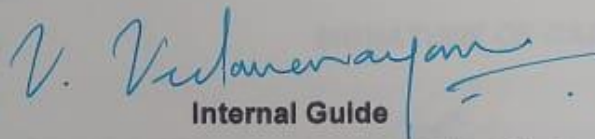
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BONAFIDE CERTIFICATE

This is to certify that this Project Report is the bonafide work of **HARSH TIWARI (40130079)**, **ISHI GUPTA (40130082)** who carried out the project entitled **"ENHANCED MEDICAL DATA ENCRYPTION METHOD FOR IOT BASED HEALTH CARE MANAGEMENT SYSTEM"** under the supervision from November 2023 to April 2024.



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DECLARATION

We **HARSH TIWARI (40130079)** and **ISHI GUPTA (40130082)** hereby declare that the Project Report entitled "**ENHANCED MEDICAL DATA ENCRYPTION METHOD FOR IOT BASED HEALTH CARE MANAGEMENT SYSTEM**" done by us under the guidance of **DR. V. VEDANARAYANAN** Associate Professor, Department of Electronics and Communication Engineering at Sathyabama Institute Of Science And Technology, Chennai, is submitted in partial fulfillment of the requirements for the award of Bachelor of Engineering Degree in Electronics and Communication Engineering.

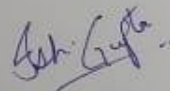
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ABSTRACT

Medical field has grown very fast and more new techniques, electronic gadgets were incorporated into medical science to provide better and enhanced health care to the community. IoT based monitoring system is one such area which has revolutionized the hospital management system itself. New technologies also bring with them the same security needs. Medical data needs to be properly handled and safely stored. It should be out of the hands of the hacking community. In this research work we proposed a new enhanced encryption algorithm to securely transfer the medical data from patients' hospital to the personal assistant of doctors or patient attendees etc.

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CHAPTER 1

INTRODUCTION

The Internet of things (IoT) describes the network of physical objects “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. There are a number of serious concerns about dangers in the growth of 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. The Internet of Medical Things (IoMT) is an application of the IoT for medical and health related purposes, data collection and analysis for research, and monitoring. The IoMT has been referenced as "Smart Healthcare" as the technology for creating a digitized healthcare system, connecting available medical resources and healthcare services.

The IOT is generally considered as connecting objects to the Internet and using that connection for control of those objects or remote monitoring. But this definition was referred only to part of IOT evolution considering the machine-to-machine market today. But actual definition of IOT is creating a brilliant, invisible network which can be sensed, controlled and programmed. The products developed based on IOT include embedded technology which allows them to exchange information, with each other or the Internet and it is assessed that about 8 to 50 billion devices will be connected by 2020. Since these devices come online, they provide better life style, create safer and more engaged communities and revolutionized healthcare. The entire concept of IOT stands on sensors, gateway and wireless network which enable users to communicate and access the application/information.

Specialized sensors can also be equipped within living spaces to monitor the health and general well-being of senior citizens, while also ensuring that proper treatment is being administered and assisting people regain lost mobility via therapy as well. These sensors create a network of intelligent sensors that are able to collect, process, transfer, and analyze valuable information in different environments, such as connecting in-home monitoring devices to hospital-based systems. Other consumer devices to encourage healthy living, such as connected scales or

wearable heart monitors, are also a possibility with the IoT.

The application of the IoT in healthcare plays a fundamental role in managing chronic diseases and in disease prevention and control. Remote monitoring is made possible through the connection of powerful wireless solutions. The connectivity enables health practitioners to capture patient's data and applying complex algorithms in health data analysis.

Health is a fundamental element of people's need for a better life. Unfortunately, the global health problem has created a dilemma because of certain factors, such as poor health services, the presence of large gaps between rural and urban areas, physicians, and nurses' unavailability during the hardest time. The Healthcare industry remains among the fastest to adopt the Internet of Things. The reason for this trend is that integrating IoT features into medical devices greatly improves the quality and effectiveness of service, bringing especially high value for the elderly, patients with chronic conditions, and those requiring constant supervision. According to some estimates, spending on the Healthcare IoT solutions will reach a staggering \$1 trillion by 2025 and, hopefully, will set the stage for highly personalized, accessible, and on- time Healthcare services for everyone. Networked sensors, either worn on the body or embedded in our living environments, make possible the gathering of rich information indicative of our physical and mental health. Captured on a continual basis, aggregated, and effectively mined, such information can bring about a positive transformative change in the health care landscape. The IoT is used by clinical care to monitor physiological statuses of patients through sensors by collecting and analyzing their information and then sending analyzed patient's data remotely to processing centers to make suitable actions. Not only for patients, it also useful for normal people to check the health status by using wearable devices with sensors.

Health has prime importance in everyone's life. currently, attention and eudaimonia management is one every of the foremost promising applications of knowledge technology. Among the applications that the Internet of Things (IoT) beyond any doubt reworking the attention trade, in general, IoT has been wide accustomed to interconnect advanced medical resources and to supply sensible and effective attention services to the individuals. In recent years the Internet of Things (IoT) plays a key role in the healthcare industry. The world population is

increasing continuously. In many parts of our country, people are not getting medical facilities at right time. Due to covid 19, many people unable to go to the hospital because of that people are unable to do their routine check-ups for their blood pressure and body temperature.

Also, many peoples are not going because of a lot of lengthy processes or because of not availability of doctors. So, we are doing this project for reducing time consumption. In recent years the application of IoT in healthcare is increasing. so, having a smart patient health monitoring system is observed that it will reduce time, cost, and reduce efficiency. People can easily monitor themselves and can get the report at the same time. Because of that, it is easy for the early prediction of diseases. The body temperature, heartbeat rate, blood pressure are the main factors or parameters to diagnose the disease. This project gives temperature, pulse rate, and ECG data.

1.1 BACKGROUND

The Future Internet goal is to provide an infrastructure to have an immediate access to information about the physical world and its objects. Physical objects can be applicable to different application domains, such as e-health, warehouse management, etc. Each application domain may have different types of physical devices. Each physical device can have its own specifications, which is required to use in order to interact with it. To achieve the future Internet goal, a layered vision is required that can facilitate data access. Internet of Things (IoT) is a vision that aims to integrate the virtual world of information to the real world of devices through a layered architecture.

The term „Internet of Things“ consists of two words, namely *Internet* and *Things*. *Internet* refers to the global network infrastructure with scalable, configurable capabilities based on interoperable and standard communication protocols. *Things* are physical objects or devices, or virtual objects, devices or information, which have identities, physical attributes and virtual personalities, and use intelligent interfaces . For instance, a virtual object can represent an abstract unit of sensor nodes that contains metadata to identify and discover its corresponding sensor nodes. Therefore, IoT refers to the *things* that can provide information from the physical

environment through the Internet.

Middleware is as an interface between the hardware layer and the application layer, which is responsible for interacting with devices and information management. The role of a middleware is to present a unified programming model to interact with devices. Middleware is in charge of masking the heterogeneity and distribution problems that we face when interacting with devices.

1.2 MOTIVATION

IoT-based system is in charge of providing knowledge from an environment to a non-expert user. IoT-based system can be used in different environments, so it needs to be able to address many heterogeneous devices. Thus, a major concern within developing an IoT-based system is how to handle the interaction with the heterogeneous devices for non-expert users. This concern can be addressed by a middleware layer between devices and non-expert users. This layer is responsible to hide the diversity of devices from the user perspective and provides access transparency to the devices for the end users.

The idea of creating abstractions of devices been addressed in the literature. The middleware we found in the literature can provide satisfaction by facilitating the interaction with devices, but they do not support low-level device configuration. Modern health care system introduces new technologies like wearable devices or cloud of things. It provides flexibility in terms of recording patients monitored data and send it remotely via IOT. In storage stage, data is stored, updated for future use. In data retrieving stage, retrieve data from cloud.

1.3. IoT DEFINITION

In this section, we explain some of the IoT definitions. Also, we explain the layered architecture for IoT.

Internet of Things (IoT) has increasingly gained attention in industry to interact with different types of devices. IoT can have influence on industry and society by integrating physical devices into information networks. IoT impacts can be on different perspectives, namely for private and business users. From the perspective of a private user, IoT has effect on both working and personal fields, such as smart

homes and offices, e-health and assisted living. From the aspect of a business user the impacts would be in fields such as automation and industrial manufacturing, logistics, businessprocess management, intelligent transportation of people and goods. IoT integrates physical things into information networks. IoT covers the overall infrastructure, including software, hardware and services, which is used to support these information networks. The integrated physical things can exchange data about the physical properties and information that they sense in their environment. To identify devices, we can use identification technologies like for example RFID, which allow each device be uniquely identified

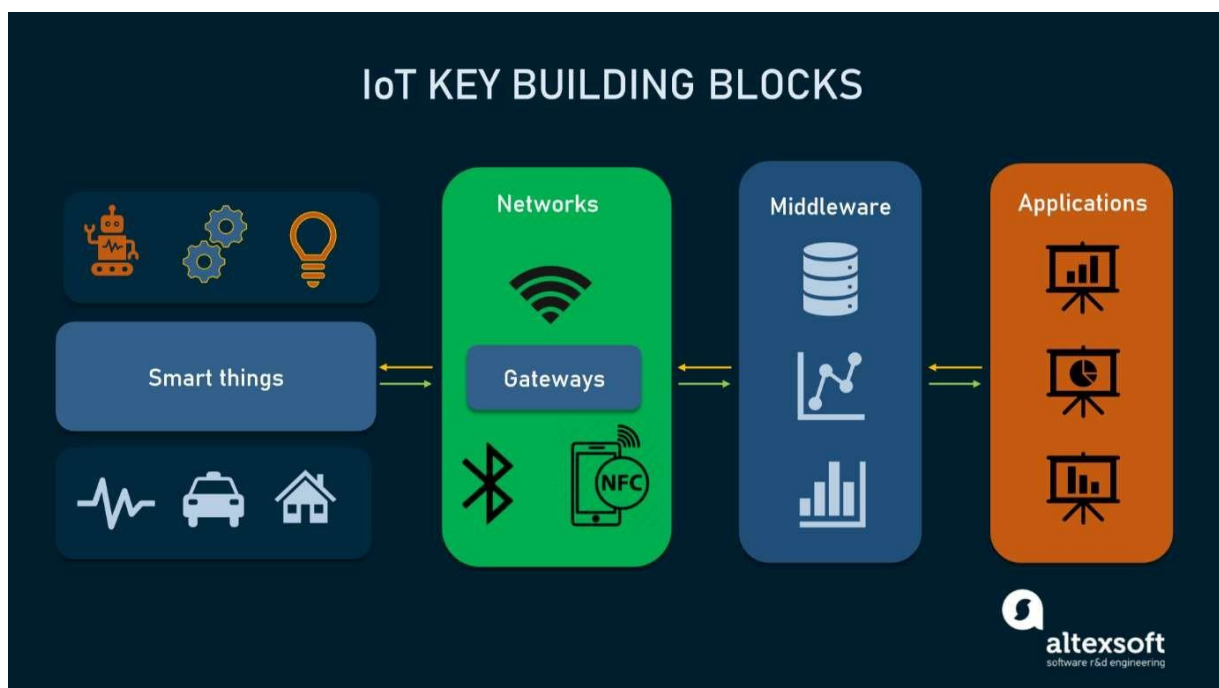


FIG 1.1 IoT Architecture

International Telecommunication Union (ITU) defines IoT as “A global infrastructure for the Information Society, enabling advanced services by interconnecting (physical and virtual) things based on, existing and evolving, interoperable information and communication technologies”.

IoT has a layered architecture designed to answer the demands of various industries, enterprises and society. It shows a generic layered architecture for IoT that consist offve layers, which are discussed, in the following:

- ***Edge Technology layer***

This is a hardware layer that consists of embedded systems, RFID tags, sensor networks and all the other sensors in different forms. This hardware layer can perform several functions, such as collecting information from a system or an environment, processing information and supporting communication.

- ***Access Gateway layer***

This layer is concerned with data handling, and is responsible for publishing and subscribing the services that are provided by the *Things*, message routing, and hovelling the communication between platforms.

- ***Middleware layer***

This layer has some critical functionalities, such as aggregating and filtering the received data from the hardware devices, performing information discovery and providing access control to the devices for applications.

- ***Application layer***

This layer is responsible for delivering various application services. These services are provided through the middleware layer to different applications and users in IoT-based.

CHAPTER 2

LITERATURE SURVEY

Wimalyn Bovenizer and Paitoon Chetthamrongchaicorrespondin (2023) proposed a IoT-based healthcare systems and the methodology was This investigation produced a graphical mapping of the bibliometric data using the VOS viewer software. Scopus data were utilized in this study since it has the majority of the literature on IoT healthcare systems.

HedishSajediet.al (2019) proposed a paper with which the increase in the volume of medicinal information, the security in its maintenance has become the necessity. This paper proposes the importance in information hiding and presents various algorithms that can be used to provide security. It also proposes the challenges in implementing the security of healthcare systems.

Ayman Tajaldeem and Arafat Abu Mallouh (2019) proposed A Survey of Internet of Things (IoT) in Healthcare: Security and Privacy Issues and the methodology is the security and privacy challenges associated with IoT in healthcare. It discusses potential threats and presents security mechanisms and privacy-preserving techniques to safeguard patient data.

Rameswari.Ret.al (2018) proposed a smart health care monitoring system. This paper is about finding the specialists in specific healthcare area by utilizing android application. It finds out the number of patients in clinics around the area. Further, it chooses the specialist or expert from the given information. The patients data will be sent to the medicinal expert by sensors through arduino. The conventions used here to send data to the cloud are TCP/IP, UDP or MQTT.

Ho-Murmur Kao et.al (2018) has incorporated a framework for versatile wellbeing application. the executed versatile table care engineering incorporates a home box associated with a circulatory strain check, an android so advanced mobile phone related with inescapable registering, a UI in the PDA and a cloud-based silverware data framework. The framework can perform information observing and

administration of patient imperative signs and day by day action, giving a powerful interface between clinical staff and remotely helped patients. The 16 framework mostly centres around the self-administration and in enhancing the telecare systems.

Pawan Singh et.al (2018) proposed the paper on opportunities and challenges in IoT healthcare monitoring system. In this research paper, the challenges behind communicating the collected information to the doctor and making accurate decision based on the data collected was represented. And the benefits and technological solutions of IoT healthcare was discovered.

Nidhi Sharma et.al (2018) proposes the WSN based healthcare applications. To overcome the issues with security, this paper has proposed a privacy preservation scheme for the same which uses the principles of multiple routing, secret sharing and hashing.

Shivleelapatil et.al (2018) proposed to develop a system which gives body temperature and heart rate using microcontroller and sensor. These sensors are interfaced with controller Arduino Uno board. Wireless data transmission done by Arduino through Wi-Fi module.ESP8266 is used for wireless data transmission on IoT platform i.e. thing speak. Data visualization is done on Thing speak. So that record of data can be stored over period of time on web server so that it can see to who logged.

Shubham Banka et.al (2018) proposed the system contains multiple medical devices such as sensors and web based or mobile based applications which communicate via network connected devices. This helps for surveillance and record patients' health data and medical information. The results of this paper is to get the real-time medical information about a patient via the wearable devices given in the kit using a raspberry pi microcontroller. Processing and classification of information gathered about the patient. To predict any disease or disorder in primary stage itself using the data mining techniques that will also provide the approach advantageous for decision making. To provide Internet of Things based healthcare solutions at anytime and anywhere.

CHAPTER 3

AIM AND SCOPE OF PRESENT INVESTIGATION

3.1 AIM

The primary goal of this project is to develop a smart patient health monitoring system in such a way that we can get all the necessary and detailed information of the disease. The proposed system measures the body temperature, pulse rate and ECG data. Health is always a major concern in every growth the human race is advancing in terms of technology. Like the recent corona virus attack that has ruined the economy of China to an extent is an example how health care has become of major importance. In such areas where the epidemic is spread, it is always a better idea to monitor these patients using remote health monitoring technology. Remote Patient Monitoring arrangement empowers observation of patients outside of customary clinical settings (e.g. at home), which expands access to human services offices at bring down expenses. The fundamental element of people's needs is health. Humans face a haul of surprising death and plenty of diseases because of varied diseases that are a result of lack of treatment to the patients at right time. The main objective of this project is to develop a reliable sensible patient health observance system victimization IoT so the attention professionals will monitor their patients. The sensors will be either worn or be embedded into the body of the patients, to unendingly monitor their health. the knowledge collected in such a fashion will behold on, analyzed, and well-mined to try and do the first prediction of diseases. The concept of the Internet of things is recent and is defined as the integration of all devices that connect to the network, which can be managed from the web and in turn provide information in real time, to allow interaction with people they use it. Another concept of IoT "is the general idea of things, especially everyday objects, which are readable, recognizable, locatable, addressable and controllable via the Internet - either through RFID, wireless LAN, wide area network, or by other means". IoT The term itself was first mentioned by Kevin Ashton in 1998 and aims at the exchange of information. On the other hand, the Internet of things can be seen from three paradigms, which are Internet-oriented middleware, things sensors oriented and knowledge-oriented semantics. Therefore, it is appropriate, such delimitation because of the interdisciplinary nature of the subject. However, the

usefulness of the IoT is reflected when crossing between the three paradigms in the development of applications⁹. The Internet of Things has a number of challenges that are still working. IoT driven Fog Computing is developed in the healthcare industry that can expedite facilities and services among the mass population and help in saving billions of lives. The new computing platform, founded as fog computing paradigm may help to ease latency while transmitting and communicating signals with remote servers, which can accelerate medical services in spatial-temporal dimensions. The latency reduction is one of the necessary features of computing platforms which can enable completing the healthcare operations, especially in large-size medical projects and in relation to providing sensitive and intensive services. Reducing the cost of delivering data to the cloud is one of the research objectives.

3.2 OBJECTIVES

- To develop a reliable patient health monitoring system.
- To measure the body temperature, heartbeat rate and ecg.
- To design a system to store patient data.
- To do analysis of collected data of sensors.
- To get health related information in understandable format.

3.3 SCOPE

This project will help in monitoring the patient's health which will be helpful for doctors and patients both. It will help in reducing and early prediction of disease. The core objective of this project is the design and implementation of a smart patient healthtracking system that uses Sensors to track patient health and uses internet to inform their loved ones in case of any issues. The objective of developing monitoring systems is to reduce health care costs by reducing physician office visits, hospitalizations, and diagnostic testing procedure Each of our bodies utilizes temperature and also pulse acknowledging to peruse understanding wellbeing. The sensors are linked to a microcontroller to track the status which is thus interfaced to a LCD screen and additionally remote association with have the capacity to exchange alarms. If framework finds any sudden changes in understanding heart beat or body temperature, the framework consequently alarms the client about the

patient's status over IOT and furthermore indicates subtle elements of pulse and temperature of patient live in the web. In this manner IOT set up tolerant wellbeing following framework viably utilizes web to screen quiet wellbeing measurements and spare persists time. The increased use of mobile technologies and smart devices in the area of health has caused great impact on the world. Health experts are increasingly taking advantage of the benefits these technologies bring, thus generating a significant improvement in health care in clinical settings and out of them. Likewise, countless ordinary users are being served from the advantages of the MHealth (Mobile Health) applications and E-Health (health care supported by ICT) to improve, help and assist their health. Applications that have had a major refuge for these users, so intuitive environment. The Internet of things is increasingly allowing to integrate devices capable of connecting to the Internet and provide information on the state of health of patients and provide information in real time to doctors who assist. It is clear that chronic diseases such as diabetes, heart and pressure among others, are remarkable in the world economic and social level problem. The aim of this article is to develop an architecture based on an ontology capable of monitoring the health and workout routine recommendations to patients with chronic diseases. Through connected devices, it becomes easy for doctors and physicians to monitor patients' health. Also, real-time monitoring can save lives in a medical emergency like diabetic attacks, heart failure, asthma attacks, etc.

By means of a smart medical device connected to the smartphone app, collecting medical and other required health data will not be challenging. IoT devices collect and transfer health data like- blood pressure, oxygen, and blood sugar levels, weight, and ECGs.

Data collected from these devices are stored in the cloud and can be used by an authorized person, who could be a physician, insurance company, a participating health firm or an external consultant, regardless of their place, time, or device. Another objective of IoT in healthcare enables operability, machine-to-machine communication, information exchange, and data movement that ultimately makes the healthcare facility delivery effective and efficient. Through connectivity protocols like Bluetooth LE, Wi-Fi, Z-wave, ZigBee, and other modern protocols, healthcare personnel can change the way they spot illnesses and ailments in patients and also innovating the ways of treatment.

Consequently, a technology-driven setup can cut regular visits to the health personnel while lowering the cost factor. Without the cloud, it is impossible to store a vast amount of data collected from healthcare mobile applications and devices. Also, for healthcare personnel, it is quite tough to acquire data originating from various devices and sources. In such a situation, IoT devices can collect, report and analyze the data in real-time while cutting the need to store the raw data. In life-threatening circumstances, on-time alerts become quite critical.

To combat such situations, medical IoT devices and applications can gather vital data and transfer it to doctors and health personnel for real-time tracking. Also, these mobile applications and IoT devices can also send notifications regarding a patient's critical conditions irrespective of place, time. By using IoT enabled devices, doctors can monitor patients in real-time. Thus, the process of real-time monitoring at distinct places can help patients cut down not-so-necessary visits to doctors, hospital stays and re-admissions. Devices like Aude mix reduce manual work which a doctor has to do during patient charting.

The device is powered by voice commands and also captures the patient's data. While doing so, it makes the patient's data accessible for review.

CHAPTER 4

SYSTEM DESIGN

4.1 EXISTING SYSTEM

- The system used before in health observance is that the fastened observance system, which might be detected only the patient is within the hospital or bed. It takes abundant time for doctors additionally as patients. Within the existing system, the patient has to get hospitalized for normal observance or routine medical.
- The systems are mensuration the health parameter of the patient and send by it through totally different platform like Bluetooth protocol many more.
- These are used for under short-range communication to transfer the information. The doctor cannot fetch all the small print in the slightest degree of times.

4.2 PROBLEM STATEMENT

- In rural hospitals, the facilities for health caring are limited. The poor quality of health management enables issues in health care system.
- In developing countries there is lack of resources and management to reach out the problems of individuals.
- A common man cannot afford the expensive and daily checkup for his health.

4.3 SOLUTION

- Instant notification to hospital in case of any fluctuation in condition.
- Instant medical support to the patient.
- Instant information to the patient family.
- Secure data of patient.

4.4 PROPOSED SYSTEM

- In our proposed system, we are using the Arduino Uno, Temperature Sensor, Pulse Sensor, Thingspeak IoT platform, Wi-Fi Module, Power supply.

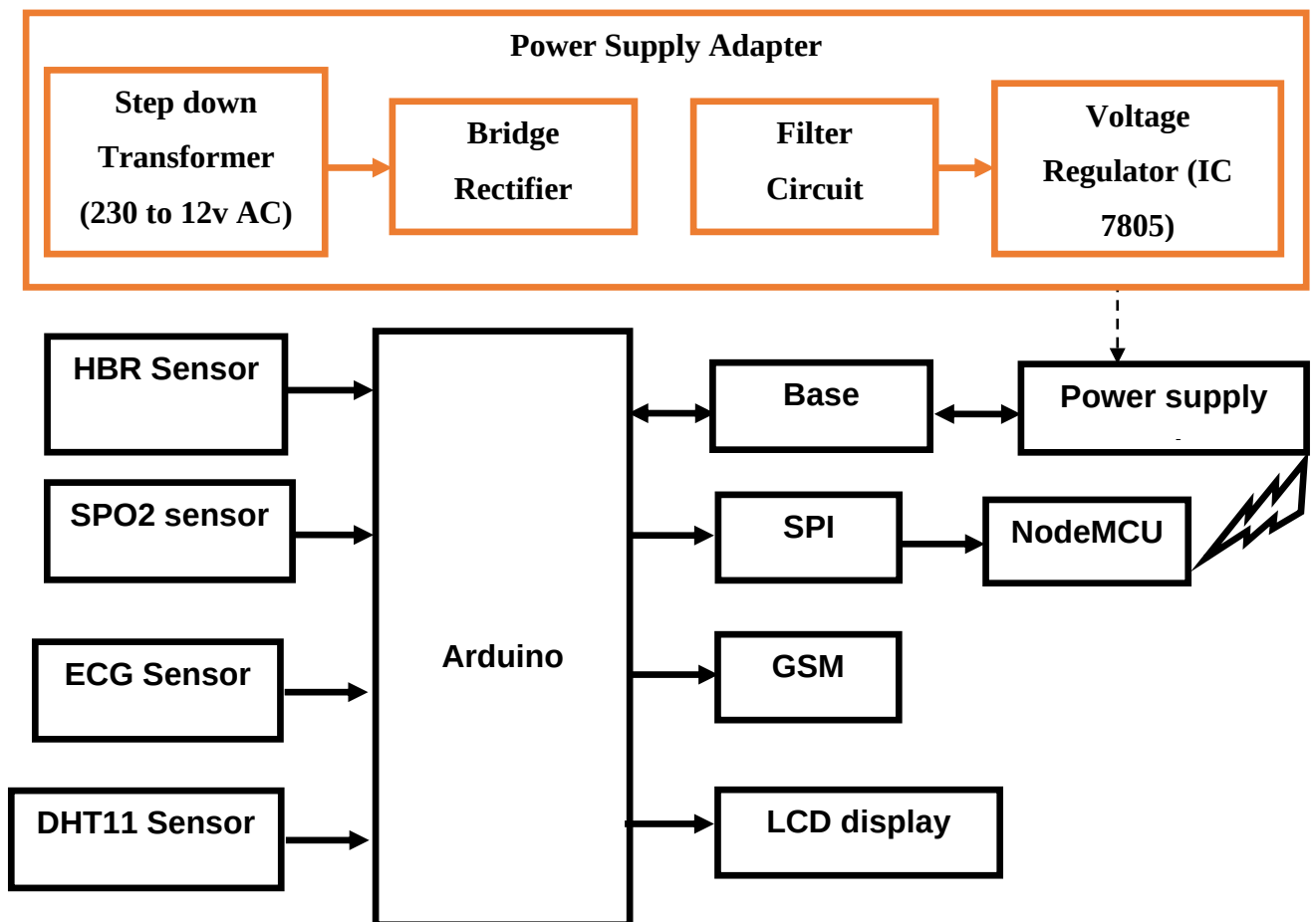
- A Smart patient health Monitoring System will not only help in maintaining health but also reducing the work of doctors and saving the time of patients.
- The proposed method of patient monitoring system monitors patient's health parameters using Arduino Uno. After connecting internet to the Arduino uno, it is connected to cloud database system which acts as a server. Then the server automatically sends data to the receiver system. Hence, it enables continuous monitoring of the patient's health parameters by the doctor. Any abrupt increase or decrease in these parameter values can be detected at the earliest and hence necessary medications can be implemented by the doctor immediately.
- Various varieties of sensors are interfaced with the microcontroller Arduino Uno to create the system smart. The info will display on both LCD and in their webpage.
- The most ideal of the system is to transmit the knowledge through the webpage to continuous monitoring of the patient over the internet. Such a system would constantly detect the important body parameters like temperature, vital signs and would compare it against a predetermined range set and if these values cross the particular limit, it will immediately alert the doctor, during this system, a microcontroller is employed to transmit the info.
- The doctor will simply access the patients health anytime from anyplace. An LCD is additionally connected to the microcontroller for the patients to look at their health status live.
- Encrypt the data to secure it and store all data on cloud.

4.5 ADVANTAGES

- Simple system to monitor the health parameters
- Response time is too good

- Immediately update in the IOT cloud web server
- Easy to implement.
- Cost effective system.

4.6 BLOCK DIAGRAM



4.7 Project Implementation

The system is implemented using the combination of hardware components. The smart patient health monitoring system will have sensors to detect body temperature, pulse rate and ECG data. The health monitoring sensors are used to collect health related data i.e. for data acquisition. Communication can be done by controller for sending data on internet wirelessly. Data processing has been done at server. All data collected and aggregated at server point. To get health related information in understandable format it can be shown on web page using Thing Speak IOT. All theses data will be accessible in real time scenario for continuous

monitoring. Health monitoring is the major problem in today's world. Due to lack of proper health monitoring, patient suffer from serious health issues. There are lots of IoT devices nowadays to monitor the health of patient over internet. Health experts are also taking advantage of these smart devices to keep an eye on their patients. With tons of new healthcare technology start-ups, IoT is rapidly revolutionizing the healthcare industry.

Here in this project, we will make an **Enhanced Medical Data Encryption Method for IOT Based Health Care Management System** which records the patient heart beat rate and body temperature and also send an email/SMS alert whenever those readings goes beyond critical values. Pulse rate and body temperature readings are recorded over Thingspeak and Google sheets so that patient health can be monitored from anywhere in the world over internet. A panic will also be attached so that patient can press it on emergency to send email/SMS to their relatives. Here we also secure the data of patients by encrypting it.

4.8 HARDWARE REQUIREMENTS

- Arduino UNO
- Temperature Sensor
- HBR Sensor
- GSM Module
- WI-FI Module
- SPO₂ sensor
- Power Supply
- LCD
- ECG sensor
- Connecting Cable

4.9 HARDWARE DESCRIPTION

4.9.1 Arduino Uno and Its Programming

Arduino is a tool for making computers that can sense and control more of the physical world than your desktop computer. It's an open-source physical computing platform based on a simple microcontroller board, and a development environment

for writing software for the board. Arduino can be used to develop interactive objects, taking inputs from a variety of switches or sensors, and controlling a variety of lights, motors, and other physical outputs. Arduino projects can be stand-alone, or they can communicate with software running on your computer.

The boards can be assembled by hand or purchased preassembled; the open-source IDE can be downloaded for free. The Arduino programming language is an implementation of Wiring, a similar physical computing platform, which is based on the Processing multimedia programming environment. The USB connection with the PC is necessary to program the board and not just to power it up. The Uno automatically draw power from either the USB or an external power supply. Connect the board to your computer using the USB cable. The green power LED (labelled **PWR**) should go on. 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 -- you 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. Arduino is a great tool for people of all skill levels. However, you will have a much better time learning along side your Arduino if you understand some basic fundamental electronics beforehand. We recommend that you have at least a decent understanding of these concepts before you dive in to the wonderful world of Arduino.

Arduino Uno:



Fig 4.1 ARDUINO UNO

Overview

The Arduino microcontroller is an easy to use yet powerful single board computer that has gained considerable traction in the hobby and professional market. The Arduino is open-source, which means hardware is reasonably priced and development software is free. This guide is for students in ME 2011, or students anywhere who are confronting the Arduino for the first time. For advanced Arduino users, prowl the web; there are lots of resources.

The Duemilanove board features an Atmel ATmega328 microcontroller operating at 5V with 2 Kb of RAM, 32 Kb of flash memory for storing programs and 1 Kb of EEPROM for storing parameters. The clock speed is 16 MHz, which translates to about executing about 300,000 lines of C source code per second. The board has 14 digital I/O pins and 6 analog input pins. There is a USB connector for talking to the host computer and a DC power jack for connecting an external 6-20 V power source, for example a 9 V battery, when running a program while not connected to the host computer. Headers are provided for interfacing to the I/O pins using 22 g solid wire or header connectors. The Arduino programming language is a simplified version of C/C++. If you know C, programming the Arduino will be familiar. If you do not know C, no need to worry as only a few commands are needed to perform useful functions.

An important feature of the Arduino is that you can create a control program on the host PC, download it to the Arduino and it will run automatically. Remove the USB cable connection to the PC, and the program will still run from the top each time you push the reset button. Remove the battery and put the Arduino board in a closet for six months. When you reconnect the battery, the last program you stored will run. This means that you connect the board to the host PC to develop and debug your program, but once that is done, you no longer need the PC to run the program.

The Arduino Uno is a microcontroller board based on the ATmega328. 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.

Summary:

- 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

Pin Configuration

The Arduino Uno can be powered via the USB connection or with an external power supply. The power source is selected automatically.

External (non-USB) power can come either from an AC-to-DC adapter (wall- wart) or battery. The adapter can be connected by plugging a 2.1mm center-positive plug into the board's power jack. Leads from a battery can be inserted in the Gnd and Vin pin headers of the POWER connector.

The board can operate on an external supply of 6 to 20 volts. If supplied with less than 7V, however, the 5V pin may supply less than five volts and the board may be unstable. If using more than 12V, the voltage regulator may overheat and damage the board. The recommended range is 7 to 12 volts.

The power pins are as follows:

- **VIN.** The input voltage to the Arduino board when it's using an external power source (as opposed to 5 volts from the USB connection or other regulated power source). You can supply voltage through this pin, or, if supplying voltage via the power jack, access it through this pin.
- **5V.** this pin outputs a regulated 5V from the regulator on the board. The board can be supplied with power either from the DC power jack (7 - 12V), the USB connector (5V), or the VIN pin of the board (7-12V). Supplying voltage via the 5V or 3.3V pins bypasses the regulator, and can damage your board.
- **3V3.** A 3.3 volt supply generated by the on-board regulator. Maximum current draw is 50 mA.
- **GND.** Ground pins.

- **IOREF.** This pin on the Arduino board provides the voltage reference with which the microcontroller operates. A properly configured shield can read the IOREF pin voltage and select the appropriate power source or enable voltage translators on the outputs for working with the 5V or 3.3V.

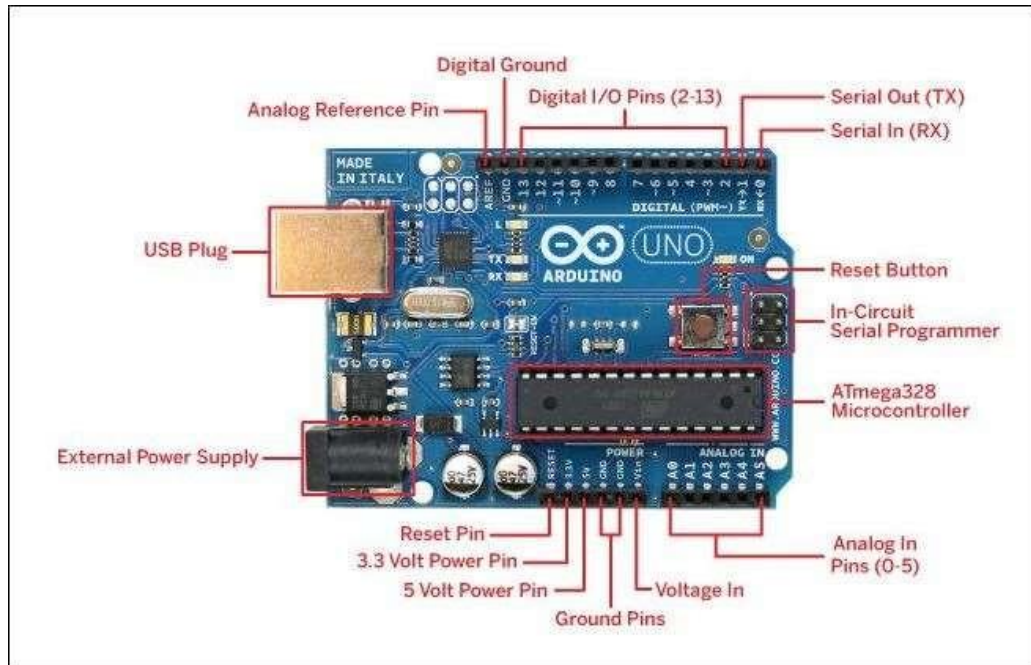


Fig- 4.2 Pin Diagram

4.9.2 TEMPERATURE SENSOR

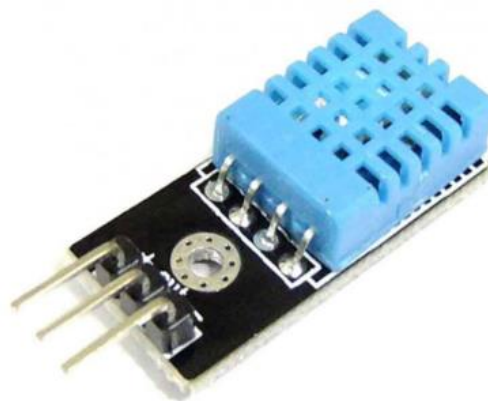


Fig 4.3: Temperature Sensor

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

Working Principle of DHT11 Sensor

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

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

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

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.

4.9.3 GSMMODULE

GSM Modules are frequently used in IoT projects since it has the ability to send and receive data remotely. The GSM Modules doesn't have much dependency like the Wi-Fi modules. While other wireless modules such Wi-Fi or ZigBee have cons such as short range and cost, the GSM Module have the reliability, long range Since only one SIM card is required with valid plan. Though the GSM modules cannot send a vast amount of data generated by sensors, it is ideal for applications where small reasonable amount of data to be sent. GSM module will be interfaced with Arduino mega 2560 microcontroller to send and receive Text Messages (SMS) from the cellular mobile number configured in the program. The on-board Regulated Power supply allows you to connect a wide range of unregulated power supply. Using this modem, you can make audio calls, SMS, Read SMS; attend the incoming calls and internet, etc through simple AT commands.

SIM900A is a widely used GSM Module with a serial interface modem which runs in between 3.4V-4.4V Voltage level. SIM900A is a Quad-band GSM/GPRS Module which is used in embedded applications where the remote data transfer is required. SIM900A works on 850/900/1800/1900MHz. It can also receive & transmit Voice Call, SMS with low power consumption. The module is controlled by using AT commands. It supports one SIM card interface and has UART (TX & RX) pins along with one RS232 Serial Protocol that can be used to interface with different microcontrollers in embedded applications.



Fig 4.4 GSM SIM900A

Specifications

- Quad-band 850/900/1800/1900MHz.
- GPRS multi-slot class 12/10.
- GPRS mobile station class B.
- Compliant to GSM phase 2/2+
- Class 4 (2 W @ 850/900MHz)
- Class 1 (1 W @ 1800/1900MHz)
- Control via AT commands.
- (3GPP TS 27.007, 27.005 and SIMCom enhanced AT Commands).
- Low power consumption.

Applications

- Industrial automation.
- GPRS based data logging.
- GPRS and GPS application.
- Home automation.
- Health monitoring.
- Agriculture automation.
- Vehicle tracking.
- Remote monitoring and controlling.
- GPRS based Weather report logging.
- GSM GPRS based Security alert.
- GPRS based remote terminal for file transfer.
- Bulk SMS sending etc.

4.9.4 Node MCU



Fig 4.5: Node MCU

The ESP8266 is a low-cost Wi-Fi microchip, with a full TCP/IP stack and microcontroller capability. The chip first came to the attention of Western makers in August 2014 with the ESP-01 module, made by a third-party manufacturer Ai-Thinker. This small module allows microcontrollers to connect to a Wi-Fi network and make simple TCP/IP connections using Hayes-style commands. However, at first there was almost no English-language documentation on the chip and the commands it accepted. The very low price and the fact that there were very few external components on the module, which suggested that it could eventually be very inexpensive in volume, attracted many hackers to explore the module, the chip, and the software on it, as well as to translate the Chinese documentation. The ESP8285 is an ESP8266 with 1 MiB of built-in flash, allowing the building of single chip devices capable of connecting to Wi-Fi. These microcontroller chips have been succeeded by the ESP32 family of devices, including the pin-compatible ESP32-C3. The ESP8266 WiFi Module is a self contained SOC with integrated TCP/IP protocol stack that can give any microcontroller access to your WiFi network. The ESP8266 is capable of either hosting an application or offloading all WiFi networking functions from another application processor. Each ESP8266 module comes pre-programmed with an AT command set firmware, meaning, you can simply hook this up to your Arduino device and get about as much WiFi-ability as a WiFi Shield offers (and that's just out of the box)! The ESP8266 module is an extremely cost effective board with a huge, and ever growing, community.

This module has a powerful enough on-board processing and storage capability that allows it to be integrated with the sensors and other application specific devices through its GPIOs with minimal development up-front and minimal loading during runtime. Its high degree of on-chip integration allows for minimal external circuitry, including the front-end module, and is designed to occupy minimal PCB area. The ESP8266 supports APSD for VoIP applications and Bluetooth co-existence interfaces, it contains a self-calibrated RF allowing it to work under all operating conditions and requires no external RF parts.

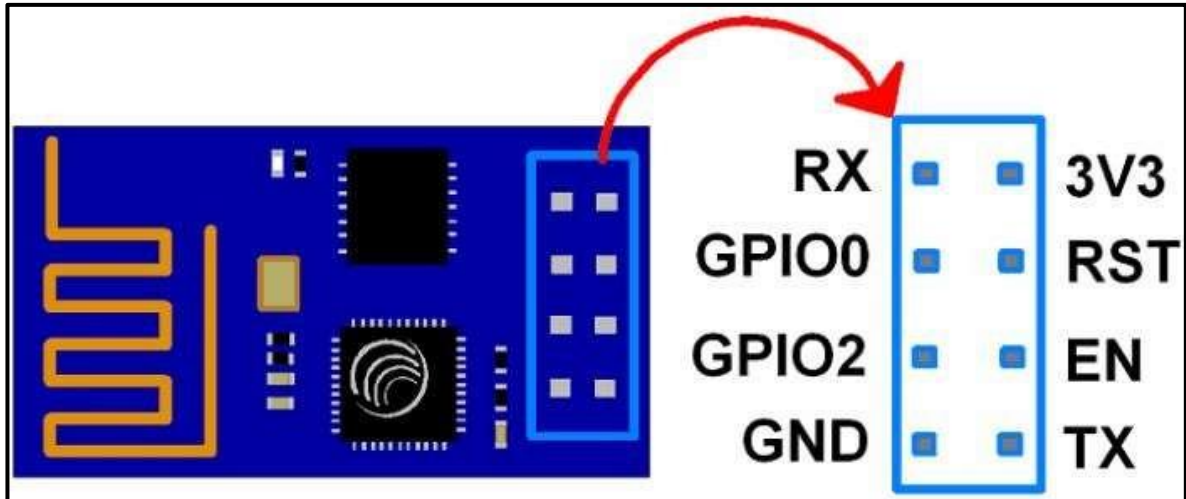


FIG.4.6 Wi-Fi Module

ESP8266-01 Module Pin Description

- **3V3:** - 3.3 V Power Pin.
- **GND:** - Ground Pin.
- **RST:** - Active Low Reset Pin.
- **EN:** - Active High Enable Pin.
- **TX:** - Serial Transmit Pin of UART.
- **RX:** - Serial Receive Pin of UART.
- **GPIO0 & GPIO2:** - General Purpose I/O Pins. These pins decide what mode (boot or normal) the module starts up in. It also decides whether the TX/RX pins are used for Programming the module or for serial I/O purpose. To program the module using UART, Connect GPIO0 to ground and GPIO2 to VCC or leave it open. To use UART for normal Serial I/O leave both the pins open (neither VCC nor Ground).

ESP8266 comes with capabilities of

- 2.4 GHz Wi-Fi (802.11 b/g/n, supporting WPA/WPA2),
- general-purpose input/output (16 GPIO),
- Inter-Integrated Circuit (I²C) serial communication protocol,
- analog-to-digital conversion (10-bit ADC)
- Serial Peripheral Interface (SPI) serial communication protocol,

- I²S (Inter-IC Sound) interfaces with DMA(Direct Memory Access) (sharing pins with GPIO),
- UART (on dedicated pins, plus a transmit-only UART can be enabled on GPIO2), and
- pulse-width modulation (PWM).

It employs a 32-bit RISC CPU based on the Tensilica Xtensa L106 running at 80 MHz (or overclocked to 160 MHz). It has a 64 KB boot ROM, 64 KB instruction RAM and 96 KB data RAM. External flash memory can be accessed through SPI.

ESP8266 module is low cost standalone wireless transceiver that can be used for end-point IoT developments.

To communicate with the ESP8266 module, microcontroller needs to use set of AT commands. Microcontroller communicates with ESP8266-01 module using UART having specified Baud rate.

Working

The ESP8266 is a very user friendly and low cost device to provide internet connectivity to your projects. The module can work both as a Access point (can create hotspot) and as a station (can connect to Wi-Fi), hence it can easily fetch data and upload it to the internet making Internet of Things as easy as possible. It can also fetch data from internet using API's hence your project could access any information that is available in the internet, thus making it smarter. Another exciting feature of this module is that it can be programmed using the Arduino IDE which makes it a lot more user friendly.

However, this version of the module has only 2 GPIO pins (you can hack it to use up to 4) so you have to use it along with another microcontroller like Arduino, else you can look onto the more standalone ESP-12 or ESP-32 versions. So if you are looking for a module to get started with IOT or to provide internet connectivity to your project then this module is the right choice for you.

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The **ESP8266 module** works with 3.3V only, anything more than 3.7V would kill the module hence be cautious with your circuits. The best way to program an **ESP-01** is by using the FTDI board that supports 3.3V programming. If you don't have one it is recommended to buy one or for time being you can also use an Arduino board. One common problem that everyone faces with ESP-01 is the powering up problem. The module is a bit power hungry while programming and hence you can power it with a V pin on Arduino or just use a potential divider. So it is important to make a small voltage regulator for 3.3V that could supply a minimum of 500mA. One recommended regulator is the LM317 which could handle the job easily.

Applications

- IOT Projects
- Access Point Portals
- Wireless Data logging
- Smart Home Automation
- Learn basics of networking
- Portable Electronics
- Smart bulbs and Sockets

4.9.5 SpO₂

A SpO₂ sensor is a detector for blood oxygen concentration. The pulse oximeter sensor measures the amount of hemoglobin attached to oxygen molecules.

Pulse oximetry uses the Beer-Lambert Law of light absorption. A SpO₂ sensor consists of red and infrared LEDs and photo sensors or photodiodes. The LED emits light at fixed wavelengths, and the photosensor measures the amount of light transmitted through a pulsatile arterial bed.

The absorption of LED light by oxygenated and deoxygenated hemoglobin differs. So a photodiode on the opposite side of the light tracks changes in light absorption by pulsations in arterial blood flow. Finally, a microprocessor calculates the oxygen saturation before the monitor displays the result.

Which Sensor Is Used for SpO₂?

Pulse oximetry sensors use red and infrared LEDs to determine oxygen saturation in your body. There are two technologies used during pulse oximetry: transmissive and reflective.

Transmissive technology: This is the most common of the two. Here, the sensor is positioned on a slender body part like an infant's foot, finger, or earlobe. The red and infrared light is then passed through the application site to a photodetector.

Reflective technology: Here, the transmitter and receiver are on the same side, unlike in the transmissive method. You can place these sensors on other body parts, such as the forehead, chest, or foot, even if it's not slender.

4.9.6 Power Supply



FIG 4.7. Power Supply

A power supply breadboard is a device used in electronics prototyping to provide a stable source of electrical power to circuits built on a breadboard. It typically consists of a compact module that plugs into the breadboard and supplies regulated DC voltage and current to power electronic components.

- **Voltage Regulation:** It provides adjustable or fixed DC output voltages, typically ranging from a few volts to tens of volts, depending on the model.
- **Current Limiting:** Many power supply breadboards include current-limiting capabilities to protect circuits from overcurrent conditions.
- **Input Power Source:** Power supply breadboards can be powered from various sources, such as AC mains (via a wall adapter), batteries, USB ports, or external DC power supplies.
- **Display and Controls:** Some power supply breadboards feature built-in displays (e.g., LCD or LED) to indicate output voltage and current values.

Connecting wires, also known as jumper wires or hookup wires, are essential components used to establish electrical connections between components on a breadboard or between a breadboard and external devices. They are typically made of flexible insulated wire with connectors (e.g., pins, sockets, or alligator clips) at each end.

4.9.7 LCD DISPLAY

Flat panel LCDs can be of various types, so depending on your project needs, you will have to go with the right screen. The most basic version uses “seven-segment displays” commonly seen in calculators, digital alarms and gas station pump displays. These simply consist of vanes which can be lit in various combinations to produce a numerical reading. On the other hand, there are “thin-film transistor (TFT) LCDs” used in television sets, laptops, smartphones and complex electronic devices. They utilize pixel algorithms to provide fast response times, wide viewing angles, high contrast and accurate color schemes. “Dot-matrix LCD” lies somewhere in the middle of the basic and the most advanced LCD technologies. They are useful in displaying the alphabet, numbers and upper and lower cases of letters. One of the most common dot matrix LCD displays is the 2×16 module which refers to two rows and sixteen columns of LCD display pins. This is what we will be using in our

connections with the Arduino board. The Arduino website offers a detailed example of an assembly. It is compatible with the built-in library example available for Arduino IDE. While the circuit may look complex at first glance, here is a simple step-by-step explanation of the various stages.

First, all sixteen pins of the LCD should be connected to the bottom positive rail of the breadboard. The first and last pins of LCD are then connected to the negative rail on the top. Arduino's GND and 5 V pins on the power-source side are connected to the positive rail contrasting with the LCD connections.

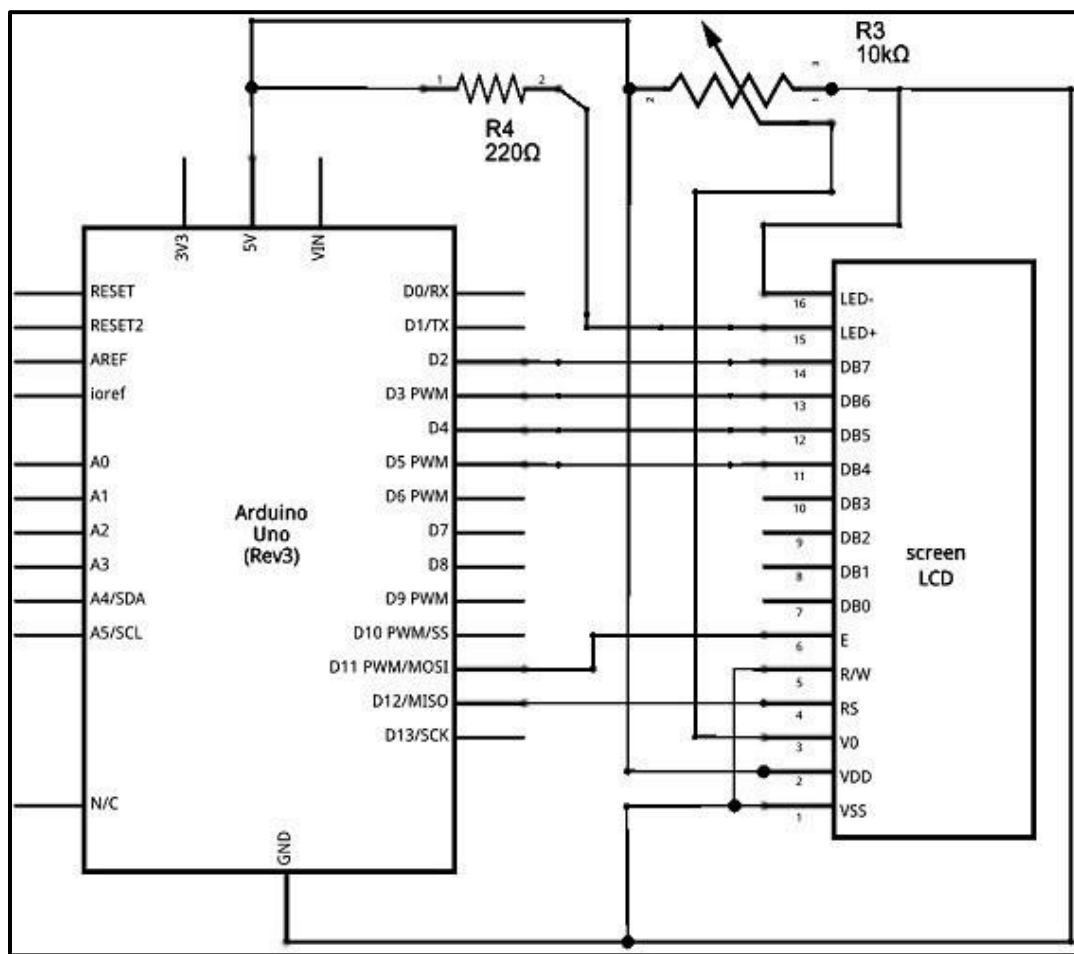


FIG.4.8 Pin Diagram Of Lcd Display

LCD screens are one of the most useful applications of Arduino smart device projects. As shown in this tutorial, it is possible to interface an LCD screen using a standard example from Arduino library. IOT 16×2 LCD can be used for the remote

datamonitoring using Nodemcu Esp8266 Wi-Fi Module and Blynk Application. I have been using 16×2 LCD for displaying the sensors data. 16×2 LCD Physical interfacing with Arduino or Mega or Nodemcu esp8266 Wi-Fi module is really a hectic job, as it needs alot of soldering and needs many IO pins to control a 16×2 LCD.

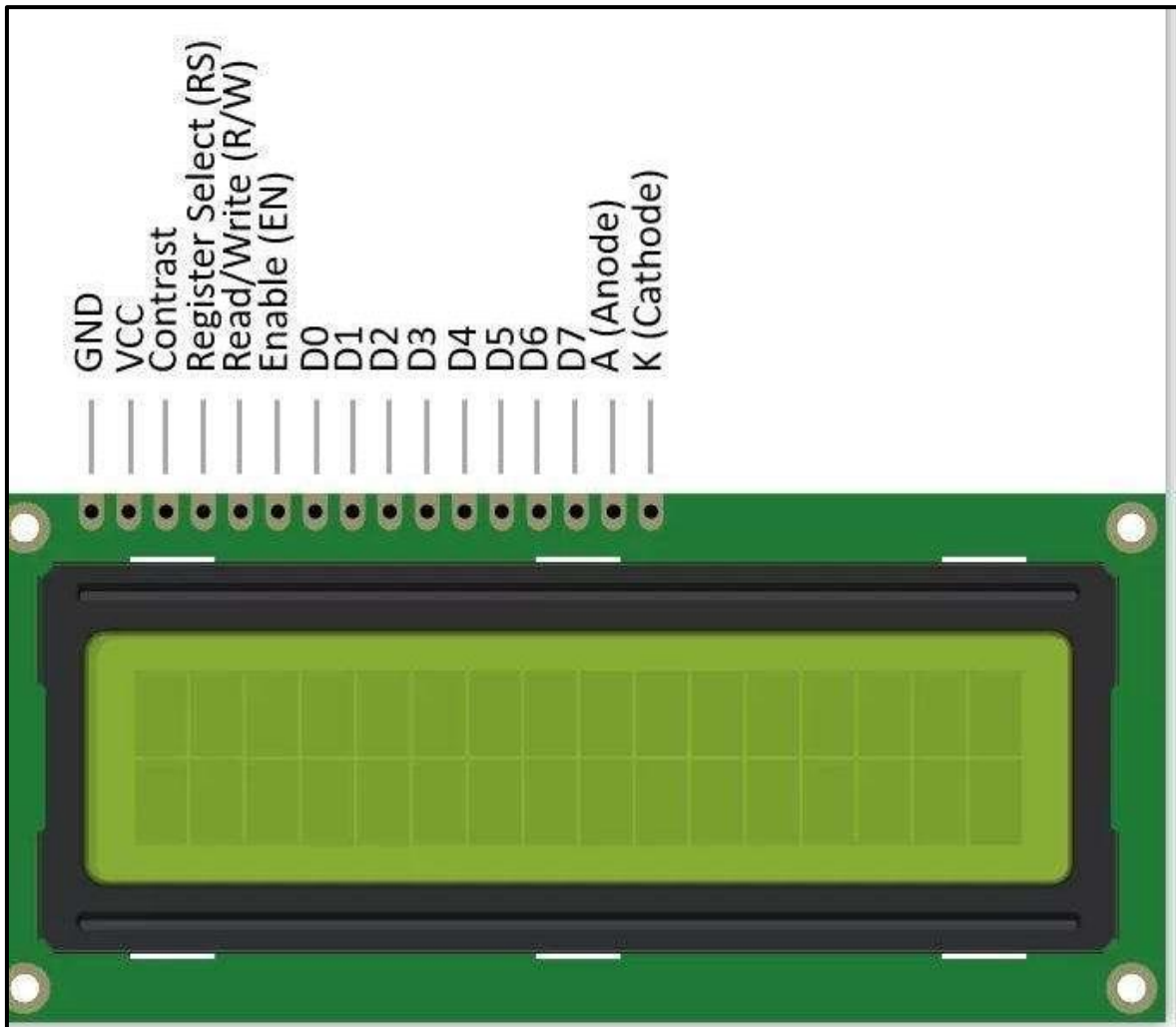


FIG.4.9- LCD DISPLAY

4.9.8 ECG Sensor

Electrocardiography (ECG) is the process of producing an electrocardiogram (i.e. electrical signals from the heart). It is a graph of voltage versus time of the electrical activity of the heart using electrodes placed on the skin and is displayed in the monitor. These electrodes detect the small electrical changes that are a consequence of cardiac muscle depolarization followed by repolarization during each cardiac cycle (heartbeat). Changes in the normal ECG pattern occur in

numerous cardiac abnormalities, including cardiac rhythm disturbances, inadequate coronary artery blood flow, and electrolyte disturbances. The full ECG setup comprises at least four electrodes which are placed on the chest or at the four extremities according to standard nomenclature. ECG electrodes are typically wet sensors, requiring the use of a conductive gel to increase conductivity between skin and electrodes.



Fig 4.10. ECG Sensor

Specifications

- Model: MAX86150
- Supply voltage: 1.8V for the chip and 3.3V for the LED drivers.
- One I2C interface for both ECG as well as PPG data.
- ECG can be measured using the onboard metal pads as well as standard ECG electrodes.
- Stereo-connector to ECG snaps cable included.
- Electrocardiogram sensor can detect the electrical activity of the heart.
- Length of sensor cable:24" long

4.10 SOFTWARE REQUIREMENTS

- Arduino IDE
- Thingspeak (IOT Cloud Server)

4.10.1 Arduino IDE

Arduino is an open-source electronics platform based on easy-to-use hardware and software. Arduino boards can read inputs - light on a sensor, a finger on a button, or a Twitter message - and turn it into an output - activating a motor, turning on an LED, publishing something online. You can tell your board what to do by sending a set of instructions to the microcontroller on the board. To do so you use the Arduino programming language (based on Wiring), and the Arduino Software (IDE), based on Processing. Arduino boards are equipped with microcontrollers, which act as the brain of the system. The Arduino Software (IDE) provides an integrated development environment for writing and uploading code to the Arduino board. Arduino programming involves writing code, known as sketches, using the Arduino IDE. One of the key features of Arduino is its versatility and expandability. Users can easily connect various electronic components, such as sensors, actuators, displays, and communication modules, to Arduino boards using standard connectors (e.g., digital and analog pins, serial interfaces).

4.10.2 Thing Speak

ThingSpeak is an open-source Internet of Things (IoT) application and API to store and retrieve data from things using the HTTP and MQTT protocol over the Internet or via a Local Area Network. ThingSpeak enables the creation of sensor logging applications, location tracking applications, and a social network of things with status updates". ThingSpeak was originally launched by IoT Bridge in 2010 as a service in support of IoT applications. ThingSpeak has integrated support from the numerical computing software MATLAB from MathWorks, allowing ThingSpeak users to analyze and visualize uploaded data using MATLAB without requiring the purchase of a MATLAB license from MathWorks. ThingSpeak has a close relationship with MathWorks, Inc. In fact, all of the ThingSpeak documentation is incorporated into the MathWorks' MATLAB documentation site and even enabling registered MathWorks user accounts as valid login credentials on the ThingSpeak website.



FIG.4.11. Architecture Of Thingspeak

Thingspeak enables sensors, instruments, and websites to send data to the cloud where it is stored in either a private or a public channel. ... Once data is in a **Thingspeak** channel, you can analyze and visualize it, calculate new data, or interact with social media, web services, and other devices. Thingspeak™ is an IoT analytics platform service from MathWorks®, the makers of MATLAB® and Simulink®. Thingspeak allows you to aggregate, visualize, and analyze live data streams in the cloud. Thingspeak provides instant visualizations of data posted by your devices or equipment. Execute MATLAB code in Thingspeak, and perform online analysis and processing of the data as it comes in. Thingspeak accelerates the development of proof-of-concept IoT systems, especially those that require analytics. You can build IoT systems without setting up servers or developing web software. For small- to medium-sized IoT systems, Thingspeak provides a hosted solution that can be used in production.

4.11. ENCRYPTION PROCESS

Data encryption is a method of protecting data by encoding it so that it can only be decrypted or accessed by people who have the correct encryption key. Once a person or organization gains access to encrypted data, the data may appear unreadable or unreadable.

Data encryption is the process of converting data from readable text to encrypted data. This is done to prevent nosy people from reading confidential information

during transmission. Encryption can be used for files, documents, messages or other online communications.

How does data encryption work?

The information that needs to be encrypted is called plain text. The plaintext must be sent through some encryption algorithm, which are the passwords of the original data. There are many encryption algorithms, and each algorithm is different depending on the application and security measures.

In addition to the algorithm, there must also be an encryption key. Using the key and the appropriate encryption algorithm, the text is converted into encrypted data, also known as ciphertext. Instead of sending plain text to the recipient, encrypted text is sent over unsecured communication.

Once the ciphertext reaches the recipient, he can use the decryption key to convert the ciphertext back to its original readable form, i.e. plaintext. This decryption key must be kept secret and may not be the same as the key used to encrypt the message.

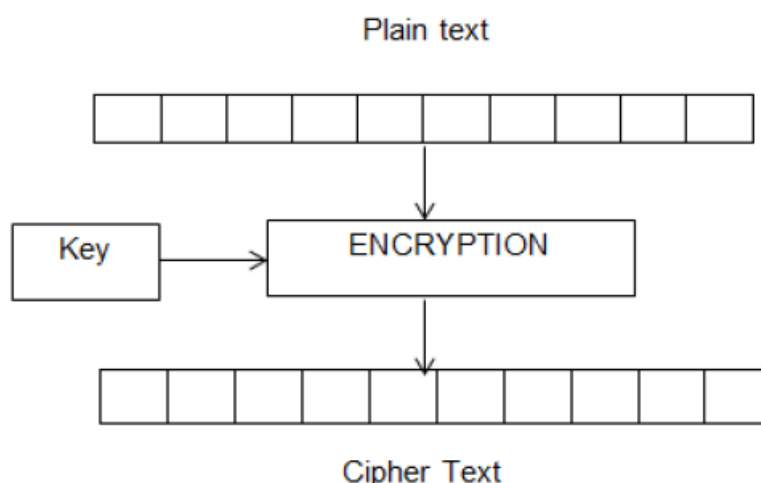


FIG. 4.12. Encryption Process

Why is encryption important?

Confidentiality: Encryption ensures that communications or data at rest cannot be read by anyone other than the recipient or the legal owner of the data. This protects

the user's privacy by preventing attackers, media, ISPs, and sometimes the government from intercepting and reading sensitive information.

Security: Encryption helps prevent data leakage, whether data is in transit or at rest. If the company's device is lost or stolen, the data on the device will still be safe if its hard drive is properly encrypted. Similarly, encrypted communication allows communicators to exchange sensitive information without revealing it.

Data Integrity: Encryption also helps prevent malicious behavior such as attacks. When data is transferred over the Internet, encryption ensures that the recipient cannot view or tamper with the path.

Policy: For all these reasons, many business and government regulations require data processing companies to retain this information. Examples of regulatory and compliance standards that require encryption include HIPAA, PCI-DSS, and GDPR.

Purpose

- After the world wars, encryption techniques were widely used by the military and government agencies to protect sensitive and classified information.
- According to the survey, 71% of publicly traded companies use encryption for some data in transit and 53% use encryption for data storage.
- It is recommended to use encryption techniques for information transmitted via...Internet, mobile phones, wireless radios, Bluetooth, etc.
- **Data protection:** Can protect long-term data storage. Even if the storage is hacked or leaked, the data will not be readable without the corresponding encryption key.
- **Data Transport:** Transfer data over the network to ensure that no one on the network can read the data.
- **Access data across multiple devices:** Cloud storage providers encrypt data storage so it can be accessed securely from any supported device.
- **Ensure compliance:** Many organizations, governments and companies consider access to protect their data and protect the privacy of individuals or customer information. This also prevents employees from illegally

accessing user information.

Encryption Algorithm

The process or the key used for encrypting the patient data is shown below in Table:

ACTUAL DATA	ENCRYPTED DATA
A	=
B	-
C	+
D	—
E	)
F	(
G	*
H	&
I	^
J	%
K	\$
L	#
M	@
N	!
O	`
P	~
Q	/

R	?
S	.
T	>
U	<
V	{
W	}
X	[
Y	]
Z	\
0	a
1	b
2	c
3	d
4	e
5	f
6	g
7	h
8	i
9	j

4.12. DECRYPTION PROCESS

Decryption is the process of returning encrypted and unreadable data to its unencrypted state. When decrypting, the system will extract the corrupted data and convert it into easy text and images that the reader and the system can understand.

Decryption can be done manually or automatically. It can also be done using keys or passwords.

Advantages

The reasons for using decryption vary, but adequate security is one of the advantages. This method is especially important in terms of ensuring control of the organization. It's easy to see how this system would benefit security experts because it prevents filtering of duplicates that use encryption to hide sensitive information.

Disadvantages

These disadvantages are twofold. The first of these concerns privacy, and if the company chooses to decrypt, it risks isolating key employees. If employees have time to check their email or bank information, it will be difficult for them to cause firewall problems every time due to inappropriate gossip. Therefore, the use of eliminates the special hope for the privacy of end users, since unknown persons do not need to worry about information being disclosed, although alarm in the organization may cause them to be unable to disclose their own information. It works to see the Network Firewall.

Decryption Algorithm

The process or the key used for decrypting the patient data is shown below in Table:

ENCRYPTED DATA	DENCRYPTED DATA
=	A
-	B
+	C
—	D
)	E

(	F
*	G
&	H
^	I
%	J
\$	K
#	L
@	M
!	N
`	O
~	P
/	Q
?	R
.	S
>	T
<	U
{	V
}	W
[	X
]	Y
\	Z
a	0

b	1
c	2
d	3
e	4
f	5
g	6
h	7
i	8
j	9

4.11.1 DIFFERENCE BETWEEN ENCRYPTION AND DECRYPTION

ENCRYPTION	DECRYPTION
Encryption is the process of converting normal message into meaningless message.	While decryption is the process of converting meaningless message into its original form.
Encryption is the process which takes place at sender's end.	While decryption is the process which take place at receiver's end.
Its major task is to convert the plain text into cipher text.	While its main task is to convert the cipher text into plain text.
Any message can be encrypted with either secret key or public key.	Whereas the encrypted message can be decrypted with either secret key or private key.
In encryption process, sender sends the data to receiver after encrypted it.	Whereas in decryption process, receiver receives the information (Cipher text) and convert into plain text.

CHAPTER 5

RESULT

Our goal is to implement a Enhanced Medical Data Encryption Method For Iot Based Health Care Management System that can monitor the heartbeat and body temperature. The smart patient health care monitoring system developed by us has numerous applications. These types of healthcare systems can be implemented in hospitals as well as at home places where a person needs to have immediate medical attention whenever his/her health goes unstable. As we are using the Thing Speak IoT platform with the help of Thing Speak we can easily capture sensor data. The data that is collected by the sensors are encrypted and then stored in the cloud using Thingspeak. This allows to keep a track of patients' heartbeat and body temperature value with change in time. This would give the doctor a more wide perspective of treating the patient in a much effective way within less time. The system developed patient monitoring based on Internet of things, is an alternative that can be used to help patients with chronic diseases. Likewise with this set of solutions the aim is to improve the quality of life of patients, not just monitoring them, but also to enable direct them to improve their eating habits and workout routines. The context model developed for the system proved to be efficient when making inferences related to the context, such as recommendations for taking measures through sensors, as well as recommendations and workout routines tips to improve the eating habits of patients.

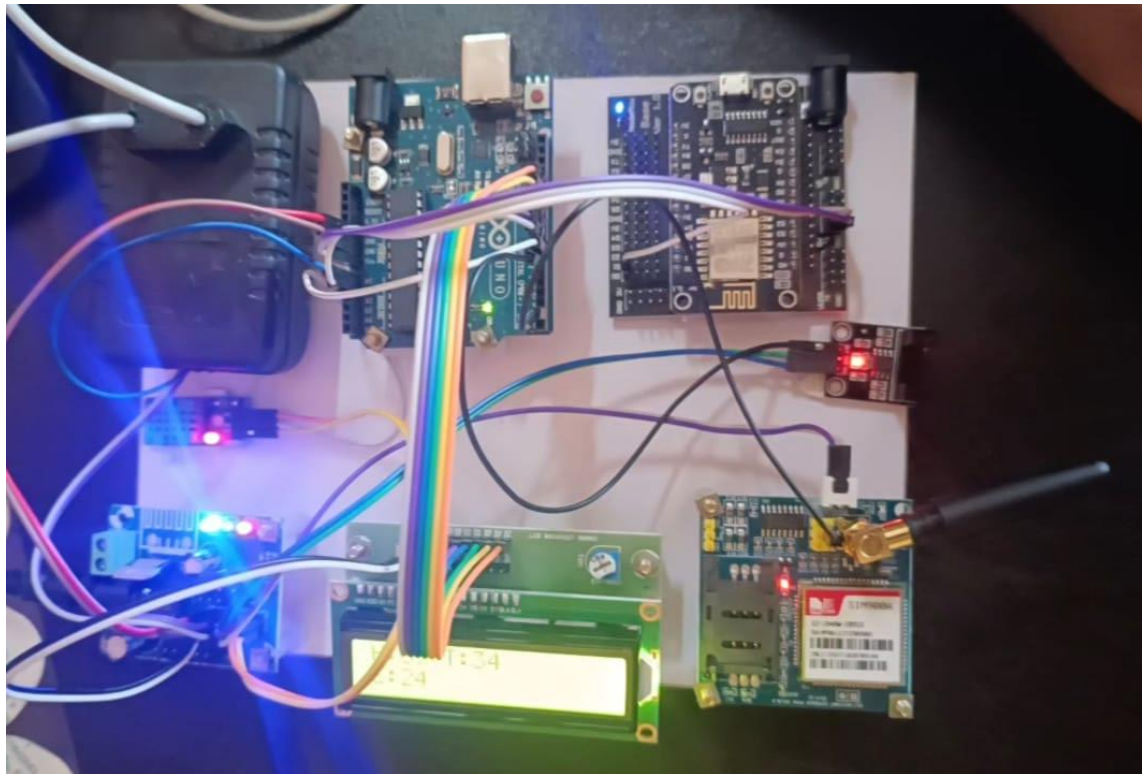


FIG. 5.1 Structure Of Project



FIG 5.2. Thing Speak Platform

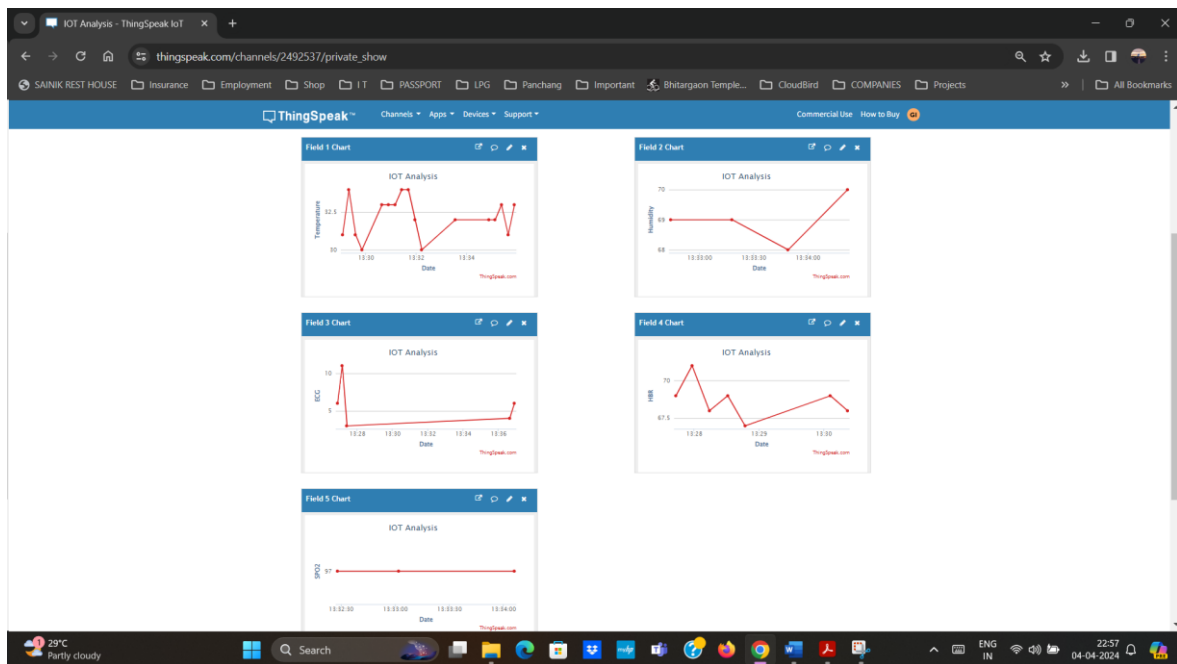


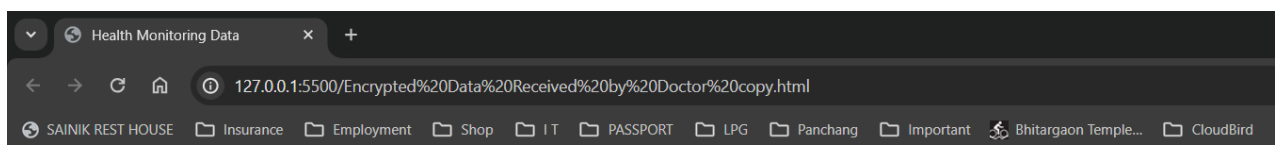
FIG.5.3 Output Console

6.2. RESULT OF ENCRYPTION

Encrypted Data Received by Patient Attendee

Name	Age	Gender	Temperature
=-+-	cd	@=#)	de

FIG.5.4. Encrypted Message For Patient Attendee



Encrypted Data Received by Doctor

Name	Age	Gender	Blood Group	Medical History	BP	Temperature
=-+	cc	@=#)	,	!'	bbg/ja	ja

FIG.5.5. Encrypted Message For Doctor

6.2. RESULT OF DECRYPTION

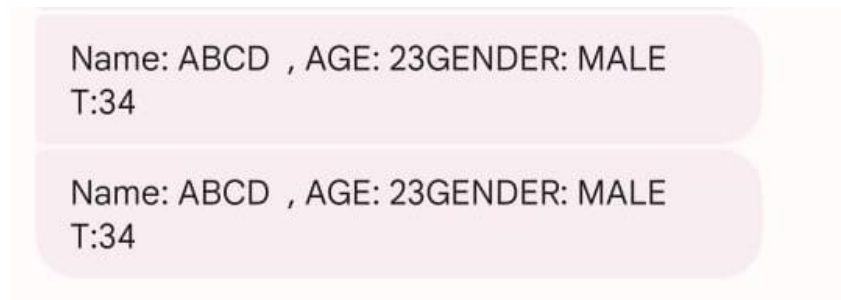


FIG 5.6. SMS Data Sent To Patient Attendee



FIG 5.7. SMS Sent To Doctor

CONCLUSION

The numbers of patients are nearly doubled in every four decades, and it is difficult for hospital to taking care of all these patients. This healthcare system works in real time and if any abnormality occurs, then it immediately put an alarm and simultaneously sends a message to doctor within a minute. Hence, we can avoid a critical situation and be able to provide treatment at time. The main purpose of developing such a system is to diminish health care overheads and also offers a system which detects abnormalities in seconds. The major advantage of this system, compared to earlier system is to reduce the electricity consumptions, a long lifetime, Increase the speed and enhance the communication coverage area. This healthcare monitoring system can be easily introduced in hospitals, clinics, and houses. With the help of IoT huge data can be stored in cloud database. This system is decreasing the patients visit to hospital for consistent routine check-ups. Accordingly, this system provides a quality of life to patients.

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