DESIGN AND IMPLEMENTATION OF AN IOT-BASED HEALTH MONITORING AND WIRELESS VOICE COMMAND SYSTEM

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CERTIFICATE OF APPROVAL

This project entitled as **"Design and Implementation of an IoT-Based Health Monitoring and Wireless Voice Command System**" Submitted by **Syed Md. Sajjad Bin Alam** bearing Matric ID. **ET171011** and **Md. Hasan Murad** bearing Matric ID. **ET163020** of session **Spring 2021**, to the Department of Electrical and Electronic Engineering, International Islamic University Chittagong, has been accepted as satisfactory in partial fulfilment of the requirements for the degree of Bachelor of Science in Engineering and approved for the examination held on **24^{th} December, 2021.**

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DECLARATION

It is hereby declared that this work has been done by us and no portion of the work contained in this thesis/project has been submitted elsewhere for the award of any degree or diploma.

Syed Md. Sajjad Bin Alam

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ABSTRACT

Bangladesh faces a large burden of diseases. Several lives are lost every day in Bangladesh as a consequence of patients who are not treated quickly and effectively. The world's population is increasing at an exponential rate. As a consequence, more health alternatives are necessary. Elderly people need greater medical treatment than the general public. As a consequence, monitoring and recording physiological markers of patients outside of the hospital setting is becoming more important in order to care for elderly citizens. To overcome such kind of problem in this project, we implemented an IoT based health monitoring and wireless voice command system. Using IoT we can obtain outcome which is more precise, quick and exact. Our project gives us the development of a microcontroller based system for wireless patient temperature, patient occurrence by gyro sensor, pulse condition and oxygen level monitoring using Wi-Fi module. By this we can easily provide real time information available for many users and can send them alert in critical conditions over internet. Our system, among other things, is designed to monitor a patient's health in terms of temperature, oxygen and pulse levels, heartbeat, and fall detection. People will benefit from our proposal in terms of keeping track of their health. Our software allows users to keep track of their health in real time. Patients may also use this service to get drug and saline nil level notifications.

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CHAPTER 1
INTRODUCTION

1.1 Introduction

The number of senior people is rising all the time, and it is becoming common place in industrialized countries for elderly individuals to be self-sufficient in their own homes. In today's world, when both spouses work, it's tough to keep track on the health of older people who are alone at home. The elderly is hospitalized in this city culture owing to their health conditions, and there is no one to look after them. When they were at home, one person was responsible for directly caring for them. Our idea is really beneficial to such individuals since it allows them to track their health and tell their caregivers. A patient may be tracked utilizing a collection of small powered and lightweight wireless sensor nodes using the body sensor network (BSN) technology, which is one of the most recent IoT breakthroughs in the Health Monitoring system. Heart disease is one of the most significant illnesses that might risk human life in current age. As a result, we will demonstrate a system with many wireless sensors that will collect health-related data such as body temperature, oxygen and pulse sickness, fall location, and broadcast it over the internet to be viewed by other users at a distant place. This device also sends out three medication alerts and a saline nil-level alarm. [1]

1.2 Background

Various IoT solutions for health monitoring systems have recently been created. Wanget al created an IoT system for medical equipment that was interoperable with numerous communication standards. Xu et al. presented a resource-based data retrieval approach (UDA-IoT). For health-related applications that need a lot of data. Peer-to-peer (P2P) and Internet of Things (IoT) technologies were combined in a medical gadget known as a smart box to keep patients in control. Kolici et al. devised a strategy for comparing experimental results in different environments. Web Real-Time Communication (WebRTC) was introduced by Sundholm et al., and it focused on the safe and efficient transmission of data from several concurrent streams. [1]

A distributed flow scenario was utilized to demonstrate a real-time IoT healthcare application. If the person under surveillance wanders out of range, data will be saved on the local server and delivered later. A Galileo board is an Internet-of-things device with an integrated medical platform that analyzes ECGs and uses algorithms to monitor heart function. A few IoT Portable Medical Devices have been introduced to the market, allowing patients to move about more freely. However, there were certain security concerns and drawbacks of using Portable Medical Devices. When we started thinking about benign IoT devices based on accessible data, we expected infections. However, there were issues with database storage and analysis when such predictions were made. With the implementation of a new cloud-based fine-grained healthcare information access control framework, the security concerns and cloud compatibility issues were resolved. The world's population is increasing at an exponential rate. As a consequence, more health alternatives are necessary. To improve medical technologies and infrastructure. The proportion of senior people in Western society is increasing. These elderly people need greater medical treatment than the general public. As a consequence, monitoring and recording physiological markers of patients outside of the hospital setting is becoming more important in order to care for elderly citizens. People will benefit from our proposal in terms of keeping track of their health. Our software allows users to keep track of their health in real time. Patients may also use this service to get drug and saline nil level notifications.

1.3 Motivation

Several lives are lost every day in Bangladesh as a consequence of patients who are not treated quickly and effectively. True model parameters are not yet measured with the same efficiency in clinics as they are in hospitals. In times like this, our method comes in helpful. Our system, among other things, is designed to monitor a patient's health in terms of temperature, oxygen and pulse levels, heartbeat, and fall detection. Our technology also serves as a drug administration reminder.

1.4 Objectives

The details objective of this project are given below:

- To build a wireless communication by using nRF technology.
- To developed the wireless voice command system.
- To monitor the oxygen level, body temperature, pulse condition, patients fall and get reminder for medicine taking by matrix Key Pad.

1.5 Overview

Our approach will benefit individuals of all ages, but mainly the elderly and ICU patients. It will monitor the patient's status and detect any falls. It sends out a warning when it's time to take medication. Its upload result is visible on the web server and on a mobile device. As a result, we created a website as well as a mobile version so that anyone can access and examine the results. Furthermore, in the event of an emergency, a nurse or a family of the patient inspects the patient's status. Our objective was to create a system that was high in accuracy yet low in cost, so that everybody could use and afford it.

1.6 Report Outline

Six chapters have been covered in the design and construction of this project. The chapters and their material are as follows:

- **Chapter 1** (Introduction): This chapter providing the outline, motivation and purpose of the project.
- **Chapter 2** (Literature Review): This chapter explored previous work or study related to this project.
- **Chapter 3** (System Design): The components of this project has been addressed in detail in this chapter.
- **Chapter 4** (Design Methodology): This section covers experimental setup of this project.
- **Chapter 5** (Implementation and Results): Discuss the execution of the project and the performance of the project.
- **Chapter 6** (Conclusion): The overview of this project is explored in more depth in this Chapter. The advantage of the project, the benefit and the possible future work of the project are addressed.

CHAPTER 02
LITERATURE REVIEW

2.1 Introduction

With the advancement of technology, health professionals are taking full use of these electronic devices. In the medical field, IoT (Internet of Things) devices are widely utilized. The project in this article is a health monitoring system. Particularly for cardiac patients in rural areas, since the number of physicians in rural areas is lower than in metropolitan areas. Medical equipment is not accessible in rural areas, with the exception of the government hospital. As a result, the number of patients at the private hospital is greater than at the government hospital. In many situations, the equipment is also out of date. So, in the event of an emergency, this hardware gadget will transmit the information to the physicians or intern doctors right away. The remainder of the job will be done by the doctors based on their reports.

Hypertension has expanded across the world and is the major cause of cardiac and stroke mortality. However, for hypertension patients in rural regions, there are presently no remote HRV (Heart Rate Variability) analysis methods available to aid doctors in following the progression of the patient's condition or critical events. The Internet of Things (IoT) is a cutting-edge information and communication technology idea (Information Communication Technology). The Arduino component is more costly than the Raspberry Pi component. The on-line or web-based system has substantially advanced technology. Data collection in real time is essential these days. When a patient is released from the hospital with a severe illness, he or she must return to the hospital often. As a consequence, for rural regions, IoT-based health monitoring devices are the best option. [2] The Internet of Things includes sensors, devices, machines, gateways, and the network. It allows people and things to communicate in real time. In a typical IoT network, the variety, velocity, and overall quantity of data may fast grow, resulting in an experimental growth in the variety, velocity, and overall volume of data. This knowledge sets the door for significant revenue and value growth. However, in IoT scenarios, the actual challenge is evaluating large volumes of data from several sources and acting in real time.

2.2 Iot-Based Patient Monitoring

According to the World Health Organization, 17.9 million individuals died as a result of cardiovascular illnesses. Patients who need frequent monitoring by physicians in order to discuss their health status would benefit from an IoT-based patient monitoring system. The primary premise of the Internet of Things is characterized as the connection of technological equipment to physicians or health-monitoring personnel. Kevin Ashtor coined the phrase "internet of things" in 1998. IoT can be classified in three sections:

1. Internet Oriented Middle ware.
2. Things Sensors Oriented.
3. Knowledge Oriented Semantics.

Sensors and other contemporary devices are included into the system as the initial physical layer, making connections feasible. Sensors can monitor a variety of things, including heart rate, ECG, and temperature. An ontology-based system for monitoring a person's health is the major objective of this Internet of Things project.

2.2.1 Description of Iot

IoT is a network of physical devices that may share data and connect to each other over the Internet utilizing sensors, software, and other technologies. [2] Multiple technologies, such as real-time analytics and machine learning, commodity sensors, embedded systems, and sensors, have revolutionized the landscape. Embedded systems, wireless sensor networks, control systems, automation (including home and building automation), and other existing fields allow the Internet of Things. Smartphones and other mobile devices may be used to operate a wide range of consumer electrical items, such as smart lighting, cameras, and speakers. In the near future, we may be able to use the Internet of Things to improve healthcare delivery. Businesses and governments across the globe are scrambling to develop global standards in response to growing privacy and security concerns raised by the Internet of Things (IoT).

2.2.2 Application of Iot

For medical research and monitoring, the Internet of Medical Things (IoMT) application depends largely on data collection and processing. IoMT is the technology used to establish a digital health care system that integrates readily available medical resources and healthcare services. Healthcare that is efficient and effective. Improved remote monitoring of health and emergency alarm systems are possible with the Internet of Things (IoT). It is possible to monitor vital signs using simple wristbands like Fitbits or hearing aids, as well as more complicated devices like a pacemaker. Smart beds, which can detect whether a patient is in them or attempting to get out of them, are now being used in certain medical facilities. A patient's pressure and support needs may often be met without the involvement of a nurse. Healthcare Health care costs might be reduced by $300 billion a year by using IoT devices, according to a 2015 Goldman Sachs study. As a consequence of "m-health," which is the use of mobile devices to improve medical follow-up, the word "m-health" was created. [3] Elderly people's health and safety may be monitored using sensors installed in their living environments, and this information can be utilized to guide their treatment and aid in the recovery of lost mobility. Smart sensors may connect home monitoring systems to hospital-based systems, collecting, processing, transmitting, and analyzing data in any of these locations. Calorie counting scales and heart monitors may now be connected thanks to the Internet of Things. Every step of the way, your health is being monitored. For pregnant women and chronic patients, IoT devices may help them keep track of their vital signs and determine how frequently they need to take medication. Items intended to be used just once before being thrown away. It has become easier to manufacture IoMT sensors thanks to plastic and fabric electronics manufacturing advances. Sensors and RFID circuits for wirelessly powered sensors may be printed on paper or e-textiles. Portable medical diagnostic applications with minimal system requirements have been created. Some of the industries where IoMT has been used include healthcare and health insurance companies. Health care providers, patients, and others on a patient's medical team may all participate in an IoMT system that keeps patient information electronically in a database right now. IoT-based solutions may be tailored to each patient's specific requirements if they are approached from a patient-centered perspective. The insurance industry now has access to a wider range of high-quality dynamic data sources thanks to the IoMT. Among sensor-based solutions are biosensors, wearables, connected health devices, and mobile apps that measure consumer activity Thus, new pricing models and more accurate underwriting may be developed as a result of this. [3] IoT plays a significant role in healthcare, especially when it comes to the management of chronic diseases and the prevention and control of disease. Telemonitoring has become possible due to advancements in wireless technology. Thanks to the connection, medical professionals may now collect patient data and run complex algorithms on it for analysis.

2.2.3 Consumer Applications

There are a number of IoT devices being developed for consumer use, including connected automobiles, home automation, wearable technology, and networked health.

2.2.3.1. Smart Home

IoT is a subset of home automation, which also includes systems for lighting, cooling, media playback and security, as well as televisions and other visual components. Shutting off lights and other electronics while not in use may help save energy, as can making inhabitants aware of how much energy they are use. For a smart home or automated house, a platform or hubs that control smart gadgets and equipment may be its foundation. Apple's HomeKit framework may be used by manufacturers to combine their home appliances and accessories with iOS-based applications, such as the iPhone and the Apple Watch. Siri is an example of a native iOS app, although there are many more. That smart home devices may be controlled through Apple's Home app or Siri without the need of a Wi-Fi bridge is shown by Lenovo's Smart Home Essential line. The Amazon Echo, Google Home, Apple HomePod, and Samsung's SmartThings Hub are examples of smart home hubs that are touted as separate platforms for integrating various smart home gadgets. Non-proprietary, open source ecosystems like Home Assistant, OpenHAB, and Domoticz are available.

2.2.3.2 Elder Care

One of the most significant applications of smart home technology is to help the elderly and those with disabilities. In order to satisfy the specific needs of the owner, assistive technology is included into these home systems. With vision or mobility disabilities, voice control may be an advantage, while hearing-impaired persons may benefit from cochlear implant alarm systems. They may also be equipped with additional safety features. A few of these features are sensors that can detect medical emergencies like falls or seizures. It's possible that smart home technology may enhance people's quality of life when used in this way. The term "Enterprise IoT" refers to Internet of Things (IoT) devices used by businesses. There will be 9.1 billion gadgets connected to the Internet of Things by 2019, according to current estimates.

2.2.4 Privacy, Autonomy, And Control

Philip N. Howard, a professor and author, feels that the Internet of Things has enormous promise for empowering individuals, promoting transparency in government, and boosting openness in general. Philip N. Social and political manipulation, as Howard is keen to remind out, may have terrible consequences. Some argue that IoT and data mining conflict with people's demand for privacy. Professionals and lawmakers alike must address the pressing issues of data security and privacy in the water, transportation, and energy industries. [4] As an illustration of how the Internet of Things (IoT) is influencing public behavior, billboards fitted with concealed cameras have been seen. Individuals that pause to view the advertising have their demographic data collected by these cameras. The Internet of Things has been likened to Jeremy Bentham's imaginary 18th-century panopticon. Michel Foucault and Gilles Deleuze, two well-known French philosophers, supported the idea. Punishment and punishment-based discipline have a long history, and it is crucial to know this. As a result of the panopticon, Foucault believes, society became increasingly regulated throughout the Industrial Revolution. Using Bentham's panoptic governance paradigm, he contends that today's business and school punishment systems are built on this concept. "Postscripts on Societies of Control," Deleuze's 1992 publication, substituted discipline and control with computers while keeping the panopticon's features. As a professor of technical economics in the Netherlands, Peter-Paul Verbeek claims that technological innovation has already had an impact on human agency, privacy, and autonomy. As opposed to seeing technology as a means to an end, he suggests seeing it as a partner in the creative process. Justin Brookman of the Center for Democracy and Technology has expressed worries about customer privacy. "Large amounts of data are seen as a handy way to store everything and pay someone else to worry about security problems later on. It's up to us whether or not to put together a plan to prevent this from happening." When it comes to selling Internet of Things (IoT) products, Tim O'Reilly believes that the current approach is deceptive. IoT is supposed to improve productivity by connecting numerous devices online, but his idea is that this isn't what the IoT is all about, and he disputes this widely held view. "There is no Internet of Things without human progress. Many novel applications have emerged as a result of sensors and data-driven decision-making." "It's time to take action," WIRED said in an editorial post. "As a result, your privacy will be violated. It was far worse than I had expected. As you watched, a new definition of privacy was revealed to you, and you were forced to take note of it." It is possible that the Internet of Things may restrict people's capacity to regulate their own lives, according to the ACLU. The American Civil Liberties Union claims that "Now that these massive resources are concentrated in the hands of enterprises and governments, it's difficult to predict what will be done with them." Our lives will grow more difficult to manage as we are more exposed to big corporations and political organizations that are increasingly opaque to us." [4] In response to growing privacy concerns, the British government announced in 2007 that it will execute its smart metering plan in accordance with specific Privacy by Design principles. When compared to currently used bulky meters, a smart meter would provide better information on energy use. Even if these theories were put into practice, members of the British Computer Society would remain skeptical. In 2009, the Dutch Parliament rejected a similar smart metering scheme on privacy concerns. The Dutch scheme was given final approval in 2011 following more review.

2.2.4.1 Data Storage

IoT app developers have to clean, analyze, and understand massive volumes of data generated by sensors. Wireless sensor networks have been proposed as a technique of assessing data. Sensor nodes provide data to a distributed sensory data processing system over these networks. There is also the question of how to store so much data. A large quantity of data collecting and storage may be necessary, depending on the application. Even while the Internet now consumes just 5% of the world's energy, there is still a "daunting issue to power" IoT devices that collect and store data.

2.2.4.2 Security

Some believe that the fast proliferation of the Internet of Things (IoT) without appropriate consideration of the enormous security concerns involved and the potential legislative changes is taking place. Traditional servers, personal computers, and mobile phones account for the vast majority of security breaches. Security flaws include insufficient authentication, outdated default credentials, and unencrypted communications between devices. When it comes to IoT devices, the computational power available is extremely constrained. For one thing, this is because many products are so inexpensive that it's impossible for manufacturers to include proper security patching procedures. [4] Physical products may be used to "spy on people inside their own residences" in 2014 if new types of data and the frequency of their manipulation by internet-connected gadgets enable it. The brakes, engine, locks, hood and trunk releases, horn, heat, and dashboard computers have all been compromised via on-board network access. Remote access to automotive computers is possible if they are regularly linked to the Internet. By 2008, security researchers have shown the ability to remotely regulate pacemakers without the patient's permission. Hackers believe that in the future, insulin pumps and implanted cardioverter defibrillators will be remotely controlled by hackers. IoT devices that are not effectively protected might be used to harm others. Several high-traffic websites and a DNS provider were affected by cyberattacks using Mirai-infected Internet of Things devices last year. IoT devices were compromised in under twenty hours by the Mirai Botnet. At the height of the epidemic, between 200,000 and 300,000 persons were afflicted annually. 41.5% of the illnesses were found in Brazil, Colombia, and Vietnam. IP cameras, routers and printer are among of the IoT devices that Mirai targeted. As a result of the vulnerabilities found in the Dahua and Huawei devices as well as the Cisco and Zyxel products, these companies were the most affected by the flaws. Cloudflare's Junade Ali discovered the issue, but the Publish–Subscribe system had already been tainted at that point. Security experts are more worried than ever about the hazards of the Internet of Things in light of recent hacks like this one. As a result of an unclassified assessment by the US National Intelligence Council (NIC), however, "Enemies, criminals and miscreants in the United States have access to sophisticated sensor networks as well as remote-control devices. In the event of a free market for sensor data, spies and fraudsters may profit. Community cohesiveness may be at risk even if this technology is found to be in full compliance with the Fourth Amendment's restrictions against arbitrary searches." Intelligence agencies throughout the world see the Internet of Things as a vital source of data. [5] IoT doorbells and cameras may have security and ethical implications, according to a Washington Post article published on January 31. "Analysis of selected user videos by Ring's Ukrainian team was confirmed. In a statement, Ring claims that it only looks at recordings that have been made accessible to the public or authorized by Ring owners. Hackers were able to access a California family's Nest camera and send out false warnings about a missile assault due to the family's poor password choice "Security worries have prompted a variety of responses. This foundation was created on September 23rd, 2015, with the goal of disseminating knowledge on the best ways to secure the Internet of Things (IoT). The executive committee of a corporation is made up of representatives from various technological and telecommunications firms. Large IT businesses are always inventing new methods to protect IoT devices. To route IoT devices safely, Mozilla's Project Things was launched in 2017. Global IoT security sales are expected to grow at a CAGR of 27.9% between 2016 and 2022 to keep pace with this growth, according to KBV Research. Some say that government regulation is vital to safeguard IoT devices and the Internet. Because of their architecture, most IoT development boards generate predictable and weak keys, which makes them ideal targets for MiTM attacks. Weak keys in SSH are still a problem, even though researchers have come up with a number of solutions. [6]

2.2.4.3 Safety

It is typical for event-driven smart applications to govern IoT systems, which receive as input sensed data or human inputs, or other external triggers (through the Internet), and run one or more actuators to offer different types of automation. An example of a sensor is a device that detects smoke, heat, motion, or touch. Examples of actuators include smart locks, smart power outlets, and door controls. Third-party developers may leverage popular control platforms like Samsung SmartThings, Apple HomeKit, and Amazon Alexa to construct smart apps that connect wirelessly with these sensors and actuators.. Failures in IoT systems, such as "opening the front door while no one is home" or "turning off the heating when the temperature is below 0 Celsius and people are sleeping at night," may occur.. These difficulties include, but are not limited to, malfunctioning programs, unwanted app interactions that were not anticipated, and more. All installed programs, as well as the individual devices and their settings, must be well understood, as must the way in which they work together. Researchers at the University of California Riverside have developed a new practical approach called IotSan that uses model checking as a building block to discover "interaction-level" flaws by identifying events that might drive the system into dangerous situations. SmartThings from Samsung was the platform of choice when it came time to put IotSan to the test. Vulnerabilities are discovered in IotSan's 76 manually configured systems (i.e., violations of safe physical states and attributes).

2.2.4.4 Design

The Internet of Things (IoT) necessitates "anarchic scalability" because of its dynamic design and administration. In the case of physical systems, anarchic scalability may be implemented since they are constructed to tolerate future management scenarios. In order to achieve the promise of Internet-of-things solutions, physical systems may be limited such that they can be used in any number of management regimes without danger of physical collapse. According to Brown University computer scientist Michael Littman, an efficient Internet of Things implementation requires a careful examination of the interface's use as well as its technological capabilities. It is hard to argue that customers' lives have been made any easier if they are forced to learn different layouts for their vacuums, locks and sprinklers, lights and coffee makers.

2.2.5 Environmental Sustainability Impact

A difficulty with IoT technology is the environmental effect of all these semiconductor-rich gadgets, whether they're created, used, or disposed of. Today's electronics include substantial quantities of heavy metals, rare earth metals, and synthetic chemicals. As a result, it's tough to recycle effectively. Discarded and damaged electronic parts are common. Mined rare-earth metals, which are crucial for modern electronic components, have risen in price and environmental impact. Concerns concerning the long-term environmental impact of IoT devices have been raised by this study, which is a worry for the general population. [6] In spite of the fact that IoT devices may reduce energy use in certain scenarios, the cumulative effect from billions of devices networked and pulling power from batteries and the grid will have a major impact on greenhouse gas emissions.

2.2.6 Intentional Obsolescence of Devices

As a result of the Electronic Frontier Foundation's concerns that connected device support technologies may be used to deliberately disable or "brick" their customers' devices, the EFF has taken action. "Lifetime Subscription" devices were rendered ineffective after Nest Labs purchased and shut down the central servers that the Revolv devices used to operate. A "poor precedent" has been set by Google's parent business for firms that want to sell self-driving vehicles, medical equipment, and other high end products crucial to a person's livelihood or physical safety, according to the Electronic Frontier Foundation (EFF). It should be up to the users to decide if they want to utilize a separate server or collaborate in improving the system. Even if "local use" exemptions are permitted under Section 1201 of the DMCA in the United States, this sort of action is prohibited under the law. Access to one's own tools necessitates navigating a complicated legal terrain. Customers are advised by the Electronic Frontier Foundation (EFF) to avoid items and software that place the interests of the manufacturer above those of the end user. On the PlayStation 3, Sony disabled Linux and enforced an EULA on the Wii U after purchase, all in the name of protecting users' privacy.

2.2.7 Confusing Terminology

"Termology zoo" is the word Kevin Lonergan, a business technology journalist at Information Age, used to describe the jargon around the Internet of Things. The absence of precise terminology is "practically useless" and a "source of end-user confusion." For an IoT firm, sensor technologies, networking, embedded systems, and analytics are just some of the possibilities. Several terms with varying degrees of overlap and convergence in technology have been coined by Lonergan, including Internet of Things (IoT), Internet Of Everything (IoE), Internet Of Goods (Supply Chain), Industrial Internet, Smart Objects (IoT), pervasive sensors, ubiquitous computing, Cyber-Physical Systems (CPS), and Wireless Sensor Networks (WSNs). Vocabulary for IIoT, an industrial sub-field of IoT, has been developed by the Industrial Internet Consortium's Vocabulary Task Group in order to guarantee "uniform language" throughout all publications of the Industrial Internet Consortium. New terms are automatically added to the database when a New Word Alert is activated in IoT One's IoT Terms Database. With 807 IoT-related phrases as of March 2020, this database is "clean and complete." [6]

2.3 Heart Beat

Heart rate, also known as pulse rate, is the number of times a person's heart beats each minute. The typical heart rate varies by each, although 60 to 100 beats per minute is considered normal for adults. The age, body size, cardiac condition, whether they are sitting or moving, medication they are taking, and even the ambient temperature all influence a person's average heart rate. Heart rate may be affected by emotions; for example, being delighted or afraid might increase it. According to the American Heart Association, one well individual's heart rate should be between 40 and 60 beats per minute (AHA).

There are four steps to measure the heart rate:

1. Writs
2. Inside of an elbow
3. Side of the neck
4. Top of the foot

To determine your precise heart rate, place your fingers on one of these spots and time how many beats you hear in 60 seconds. This is the easier of the two phases since all you have to do is time yourself for 20 seconds and then multiply the result by three. Monitoring a person's heart rate is easier when they are laying down or resting comfortably down. Adults and the elderly should have heart rates of 60-100 beats per minute, according to the American Heart Association (bpm). A heart rate of less than 60 beats per minute normally does not signal any health issues (bpm). As a result, active people have lower heart rates since their muscles don't have to work so hard to keep their heartbeats regular.

As a general rule, people should aim for a heart rate between 50% and 85% of their maximum heart rate. A 30-year-maximal old's heart rate is between 50% and 85%, according to the American Heart Association. Data on maximal heart rates is provided in **Table 2.1.**

Age	Target HR zone 50-85%	Average Maximum Heart Rate, 100%
20 years	100-170 beats per minute	200 beats per minute
30 years	95-162 beats per minute	190 beats per minute
35 years	93-157 beats per minute	185 beats per minute
40 years	90-153 beats per minute	180 beats per minute
45 years	88-149 beats per minute	175 beats per minute
50 years	85-145 beats per minute	170 beats per minute
55 years	83-140 beats per minute	165 beats per minute
60 years	80-136 beats per minute	160 beats per minute
65 years	78-132 beats per minute	155 beats per minute
70 years	75-128 beats per minute	150 beats per minute

Table 2.1 Rate of heartbeat per minute

2.4 Communication Between Hardware And Software

In this project, serial data transfer is utilized to communicate between hardware and software. There are two techniques for serial data transfer.

1. Synchronous
2. Asynchronous

A single chunk of data is sent at a time using the synchronous method. A single byte is sent at a time using the asynchronous method. Any of these methods may be accomplished using software. Serial data transmission software may be time-consuming and difficult to use, hence several manufacturers have developed their own IC chips for this purpose. Universal Asynchronous Transmitter/Receiver Chips (UART) are the technical name for these chips (UART).

2.5 Advantages of Wireless Communication

There are several advantages to wireless communication, internet connections, and wireless systems over wired ones, including lower costs, greater mobility and installation ease.

2.5.1 Cost

Wireless communication reduces the cost of installing wires, cables, and other infrastructure compared to traditional communication techniques. This undertaking is time-consuming and costly since it needs excavating into the ground to install wires and connecting them across the street. There's no use in tampering with the integrity and historical value of an antique building by drilling holes for wires. In older buildings without dedicated communication lines, a wireless connection, such as Wi-Fi or Wireless LAN, is sometimes the only choice.

2.5.2 Mobility

Mobility The main advantage of a wireless communication system is its portability, as previously stated. In this way, you are free to move about while still having internet connection.

2.5.3 Ease of Installation

Wireless networks are easy to set up and deploy since there are no wires involved. In addition, a wireless system, such as an Area network, may be put up far more quickly than a cable one.

2.5.4 Reliability

Wires and cables are no longer a concern since wireless technology removes the need for them completely. Environmental variables like humidity and temperature variations may harm wires and cause them to short out. Immediately after a calamity, there is a period of recovery. The harm to a transceiver's communications network may be minimal if it is destroyed in a fire or flood.

CHAPTER 03
SYSTEM DESIGN

3.1 Introduction

In this chapter, we'll take a look at the hardware. All the project's theoretical information is included here. The functional components of this project are covered in great detail. The information in this article will help us quickly grasp the various device interface standards. Pulse oximeter and heart rate sensor on an Arduino Nano, accelerometer and a keypad are some of the components used in this project. Other components include an esp8266 wi-fi module, an atmega328p processor, a nrf24l01 module, and a relay In the next sections, we'll go through all of the specifications of the equipment.

3.2 Arduino Nano

Using open-source hardware and open-source software, Arduino manufactures and markets single-board microcontrollers and microcontroller kits. Arduino boards and software are licensed under the GNU Lesser General Public License (LGPL) or the GNU General Public License (GPL) (GPL). Commercially available Arduino boards come in both pre-assembled and DIY kit form. There are several microprocessors and controllers on Arduino boards. The boards may be linked to expansion boards, breadboards (shields), and other equipment through digital and analog I/O ports. The boards include serial ports that may be used to load software from a personal computer. Microcontrollers support the programming languages C and C++. The Arduino project has a Processing-based IDE in addition to the normal compiler toolchains. This initiative, which was started in 2005 by students at Italy's Interaction Develop Institute (IDI), provides sensors, actuators, and other components for people of all skill levels to develop interactive devices. Beginner-friendly technology includes things like robots, thermostats, and motion sensors.

3.2.1 Power

Using an unregulated 6-20V power source (pin 30), an external 5V power supply (regulated), or an Arduino Mini-B USB connection, you can power an Arduino Nano board (pin 27). When choosing a power source, the densest sources of voltage are taken into consideration.

3.2.2 Memory

The internal memory of the ATmega328 is 32 kilobytes (plus 2 KB for the bootloader). The EEPROM and SRAM of the ATmega328 each have a 1 kilobyte capacity (kb).

3.2.3 Input and Output

A digital input or output may be made available on each of the Nano's 14 pins by using pinMode(), digital Write(), and digital Read() functions. A 5 volt battery is used to power these gadgets, and that's all. Inbuilt pull-up resistors on each pin allow it to deliver or receive current of up to 40 mA. A wide range of pins with particular functionalities are also available, including:

- There is a 1 (TX) and a 0 (RX) for TX and RX (TX). TTL serial data may be sent and received with this device. The relevant pins on the FTDI USB-to-TTL Serial chip are linked to these.
- Two and three interruptions from external sources. These pins may be used to produce programmable interrupts by setting them to low or high values, or to rising or falling edges, depending on the pin value. For further information, see the attach Interrupt() method.
- There are a total of eleven PWM outputs. There are 11 PWM outputs in all. When you use the analogWrite() method, you may produce an 8-bit PWM output.
- MOSI (MOSI) is the first of the four SPIs (SS, MISO, and 13) that make up the SPI (SCK). There are two SPI pins on the Arduino that may be used for SPI communication, however the Arduino language does not currently support this feature.
- There are 13 LEDs in total in this design. A cable connects digital pin 13 to a built-in LED. The LED is turned on when the pin is HIGH; when it is LOW, the LED is turned off. [8]

The Nano has eight analog inputs, each with a ten-bit resolution (i.e., 1024 different values). The analog Reference () function may be altered to vary the measurement range from 0 volts to 5 volts. There is no method to utilize digital pins 6 and 7 as analog pins in any manner whatsoever

- Pins A4 and A5 are used to interact with SDA and I2C. (SCL). With the Wire library, a TWI connection may be made (documentation on the Wiring website).

Additional pins may be found on the circuit board in the following locations:

- The analog inputs utilize this voltage as a reference, and it is referred to as AREF. In relation to analog sources of information ().
- In other words, start again. In order to reset the microcontroller, this line must be set to LOW. Reset buttons are often tacked on to shields that block the reset button as an afterthought.

3.2.4 Communication

This board can connect an Arduino Nano to a computer or another microcontroller. Digital pins 0 (RX) and 1 (TX) may be used to connect the ATmega328 to a UART TTL (5V) serial connection (TX). FTDI drivers use an FTDI FT232RL to send USB serial communication to the PC in the Arduino application. In the Arduino software, there is a serial monitor that may be used to transmit and receive basic text data. When data is sent to the PC through the FTDI chip and USB connection, the board's RX and TX LEDs will light up (but not for serial communication on pins 0 and 1). It is possible to serially transmit all of the Nano's digital pins using a Software Serial library. I2C (TWI) and SPI communication are supported by the ATmega328. The I2C bus may be simply connected to the Arduino using the Wire library. Details on SPI are available in the ATmega328 datasheet.

3.2.5 Programming

The Arduino Nano may be programmed using the Arduino software (download). Select "Arduino Duemilanove or Nano with ATmega328" from the Tools > Board menu (according to the microcontroller on your board). The preburned bootloader on the Arduino Nano's ATmega328 allows new code to be uploaded without the need of a hardware programmer. To exchange information, the STK500 protocol is used.. If you don't want to use the loader, you may program the microcontroller directly via the ICSP connection (In-Circuit Serial Programming).

3.2.6 Automatic (Software) Reset

Prior to uploading, the Arduino Nano (shown in **Fig. 3.1**) may be reset using software running on a connected computer. The reset pin of the Atmega328 is connected to the hardware flow control line of the FT232RL via a 100 nanofarad capacitor (DTR). When the reset line is asserted, the reset line drops long enough to reset the chip (taken low). Uploading code is a feature of the Arduino platform that is used by the software. The bootloader's timeout may be decreased due to the fall in DTR occurring just before upload begins. [8] There are further implications to this set-up. Whenever a new software connection is attempted after the Nano has been linked to a Mac or Linux computer, it resets (via USB). As long as the Nano's bootloader is active, it will remain there. It intercepts data transmitted to the board as soon as a connection is established (i.e. anything other than a new code upload). Waiting a second before delivering data to a sketch on the board after it receives configuration or other data is critical. **Table 3.1** shows the Arduino Nano Specification, whereas **Fig. 3.1** depicts the board's components.

Fig. 3.1 Arduino Nano

Table 3.1 Arduino Specification

Microcontroller	ATmega328
Architecture	AVR
Operating Voltage	5 V
Flash Memory	32 KB of which 2 KB used by bootloader
SRAM	2 KB
Clock Speed	16 MHz
Analog IN Pins	8
EEPROM	1 KB
DC Current per I/O Pins	40 mA (I/O Pins)
Input Voltage	7-12 V
Digital I/O Pins	22 (6 of which are PWM)

3.3 Temperature Sensor

This is a resistor whose resistance varies as the temperature varies. These NTC MOSFETs are made up of a combination of oxide that already have received a sintering technique to give them a negative electrical resistance versus thermal (R/T) connection. The hardware overview of an NTC model of temperature sensor, such as this model 103, is depicted in **Fig. 3.2.**

Fig. 3.2 NTC [9]

In a similar way to an electrical resistor, transducer is a solid-state thermistor device. A transducer is a device that responds to changes in temperature by producing an analogous output voltage. As a result, the electrical properties of a substance are affected by external and physical changes in heat. [9] To make a thermistor, two metal oxides and a ceramic disc or bead are molded together to form the two-terminal solid-state temperature transducer. This allows the thermistor to adjust its resistance value in response to small changes in the ambient temperature. For the same reason that "thermistor" is an acronym for "THERM-ally sensitive res-ISTOR," a change in resistance occurs as a result of a change in temperature. As opposed to typical resistors, temperature sensing circuits may benefit from the change in resistance produced by heat in certain cases. Because they are non-linear varying devices that can detect the temperature of both liquids and the surrounding air, thermometers are often used as temperature sensors. Their molecular operation is molecular in nature, with the outside (valence) electrons becoming more or less active depending on the increase or fall of the thermistor's temperature. This results in either a negative or positive temperature coefficient for the thermistor. As a result, they can withstand temperatures of up to 200 degrees Celsius with ease. Thermistors are often employed as resistive temperature sensors, but they may also be utilized in series with another device to control an electrical current flowing through them. These devices may act as current limiters, but they are also temperature sensitive. Depending on the kind, material, and size, thermistors have varying response times and operating temperatures. It is also possible to eliminate moisture-induced resistance measurement errors by using hermetically sealed thermistors. Among the three most common types of thermistors are the bead, disk, and glass-encased versions.

3.3.1 Negative Temperature Coefficient Thermistor

In response to an increase in the ambient temperature, NTC thermistors, also known as negative temperature coefficient of resistance thermistors, reduce or eliminate their resistive value. As a result, NTC thermistors are the most common form of temperature sensor since they may be used in practically any type of temperature-sensitive equipment. NTC temperature thermistors have a negative electrical resistance to temperature (R/T) connection. The great negative sensitivity of an NTC thermistor means that even small temperature changes may result in large increases in electrical resistance. As a consequence, they're excellent for monitoring and adjusting the temperature. Due to the fact that its resistance is very temperature sensitive, we may determine the thermistor's resistance at any given temperature by passing a steady current through it and then measuring the voltage drop that occurs at its junction. Because of the wide variety of base resistances and temperature curves available in NTC thermistors, their resistance decreases with increasing heat. Because it provides a straightforward reference point, the base resistance of NTC thermistors at room temperature (or 77 degrees Fahrenheit) is often used to identify them. 2.2kΩ at 25^{o}C; 10kΩ at 25^{o}C; 47kΩ at 25^{o}C; and so on are examples of temperature ranges A thermistor's "B" value is also important. Depending on the ceramic material, the B value has a fixed value. When applied to a given temperature range, it indicates the slope of the resistive (R/T) curve. Each thermistor will have a distinct material constant, resulting in a varied resistance vs. temperature curve. The resistive value of the thermistors at a first temperature or base point, called T1, will be specified by the B value, and the resistive value of the thermistors at a second temperature point, called T2, such as 100^{o}C, will be specified by the B value. Consequently, the B value will decide the thermistors' material constant between T1 and T2 as a consequence. That is, BT1/T2 or B25/100, with typical NTC thermistor B values ranging from around 3000 to 5000. [9]

3.4 Max30100 Pulse Oximeter and Heart-Rate Sensor

Pulse oximetry and a heart rate monitor are also included in the MAX30100 sensor. It uses two LEDs, a choice, better optics, and low-noise analog - to - digital processing to detect pulse oximetry & breathing rate. **Fig. 3.3** shows a hardware overview of the MAX30100, which may be found here.

Fig. 3.3 MAX30100 [10]

An oximeter and heart rate monitor are combined in the MAX30100 sensor. After two LEDs produce two different wavelengths of light - red and infrared - this optical sensor detects the absorbance of pulsing blood through photodetector. To read data with the tip of your finger, this LED color combination is appropriate. The pulse oximetry subsystem of the MAX30100 includes ambient light cancellation (ALC), a 16-bit sigma delta ADC, and a unique discrete temporal filter. It is ideal for battery-powered gadgets because of its low power consumption. MAX30100 needs a 1.8-to-3.3-volt supply for proper operation. All kinds of wearable devices, from fitness trackers to medical monitors, may benefit from it. Software may reduce the standby current of the MAX30100's 1.8V and 3.3V power sources, so the power supply does not need to be unplugged when the device is not in use. As can be seen in **Fig. 3.4,** the MAX30100's hardware overview contains a schematic and pin diagram descriptions.

3.4.1 Pin Configuration of Max30100

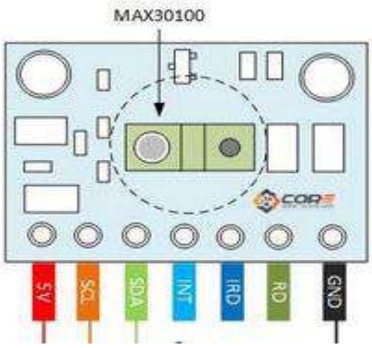


Fig. 3.4 Pin diagram of MAX30100 [10]

Sn	**Pins**	**Definition of Pins**
1	VIN	Input voltage (1.8V to 5.5V)
2	SCL	IIC-SCL
3	SDA	IIC-SDA
4	INT	MAX30100INT
5	IRD	MAX30100 IR_DRV
6	RD	MAX30100 R_DRV
7	GND	Ground

3.4.2 Specifications and Features Of Max30100

- LEDs, photosensors, and an analog front end are all incorporated right into this pul se oximetry and heart rate monitoring sensor.
- With a complete pulse oximeter and heart rate sensor, it is simple to create.
- Absorption of pulsating blood is measured.
- INT pin and I2C interface
- Optically enhanced System-in-Package of 5.6mm x 2.8 mm by 1.2 mm
- Battery Life of Wearable Devices is Improved by Ultra-Low Power Operation.
- Reduction in power consumption due to LED current and customizable sample rate
- Extraordinary Low Shutdown Current (typically 0.7A)
- Better measurement outcomes due to the inclusion of new functionality
- A high SNR ensures motion artifact resistance (signal-to-noise ratio).
- Reduction of glare from outside sources
- Capacity for High Sample Rates
- Assists in the Quick Creation of Data

3.5 Accelerometer

Acceleration forces may be measured with electromechanical accelerometers. Acceleration may be detected here only because of the gravitational pull of g. The g unit is used to quantify acceleration.

3.5.1 Adxl335 Module

- In terms of measuring axes, the ADXL335 is an accelerometer.
- This gadget monitors x, y, and z accelerations within a 3g range.
- The output voltage of this module fluctuates in response to variations in acceleration.
- Surfacemicro machining is used to fabricate polysilicon sensors and signal conditioning circuits.
- An accelerometer hardware overview is shown in **Fig. 3.5,** which illustrates the various axis of module instructions (x, y, and z).

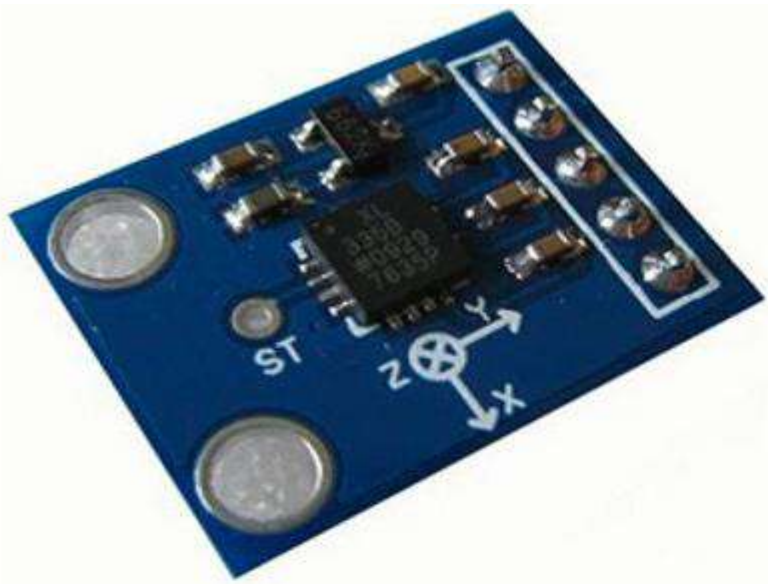


Fig. 3.5 Accelerometer [11]

3.5.2 Features

VCC	:	This is where you'd plug in your power supply's 5 volts.
X OUT	:	Analog output for the X axis.
Y OUT	:	Output of the Y axis in analog form.
Z OUT	:	Analog output for the Z axis.
GND	:	This is the ground pin, therefore attach it here.

It is necessary to provide an analog voltage to each of the ADXL335 accelerometer's output pins to measure acceleration in X, Y, and Z. The hardware overview of the accelerometer pin design is shown in **Fig 3.6.**

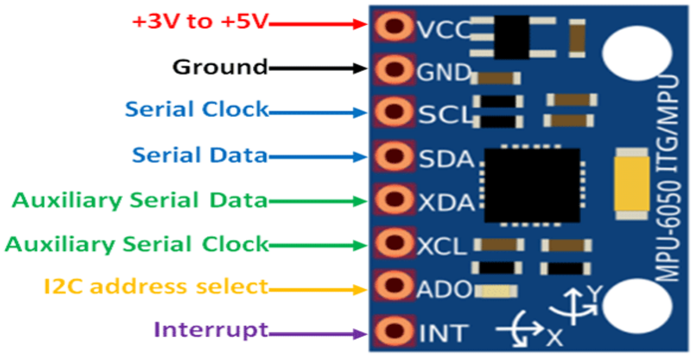


Fig. 3.6 Pin Diagram [11]

3.5.3 Use Mpu6050

Both the accelerometer and gyroscope on the MPU6050 are three-axis. An object's acceleration, velocity, and direction may all be calculated using this method in conjunction with other motion-related characteristics. Another feature of this module is the Digital Motion Processor (DMP), which enables it to do complex computations while saving CPU resources. To connect external IIC modules, such as a magnetometer, two auxiliary pins may be utilized, however this is unnecessary. Since the IIC address of the MPU6050 sensor module may be altered, the AD0 pin can be utilized to connect many sensors to the microcontroller. Using this module in your project couldn't be easier thanks to the included libraries for major platforms like Arduino. For RC cars, drones, and self-balancing robots, as well as humans and bipeds, this motion sensor is the finest. [11]

3.6 Keypad

Devices that are integrated into the system There wouldn't be a game without a keypad. With a keypad as an input device, equipment such as calculators and computers may be communicated with. During this course, you'll discover how a keypad may be connected to an Arduino. It's possible to hack just about anything with an Arduino. Let's see how an Arduino and a 4x4 matrix keypad interface works together. **Fig. 3.7** depicts a 4*4 dot matrix keypad's hardware.

Fig. 3.7 Keypad [12]

The term "keypad" refers to a block or "pad" containing numbers, symbols, or alphabetical letters. As its name suggests, a numeric keypad has just numbers on it. Numeric keypads are seen on calculators, push-button phones, vending machines, ATMs, Point of Sale systems, combination locks, and digital door locks. The E.161 standard is used by a slew of electronic devices. **Fig. 3.8** depicts the 4*4 dot matrix keypad's hardware overview, internal diagram, and pin connection schematic.

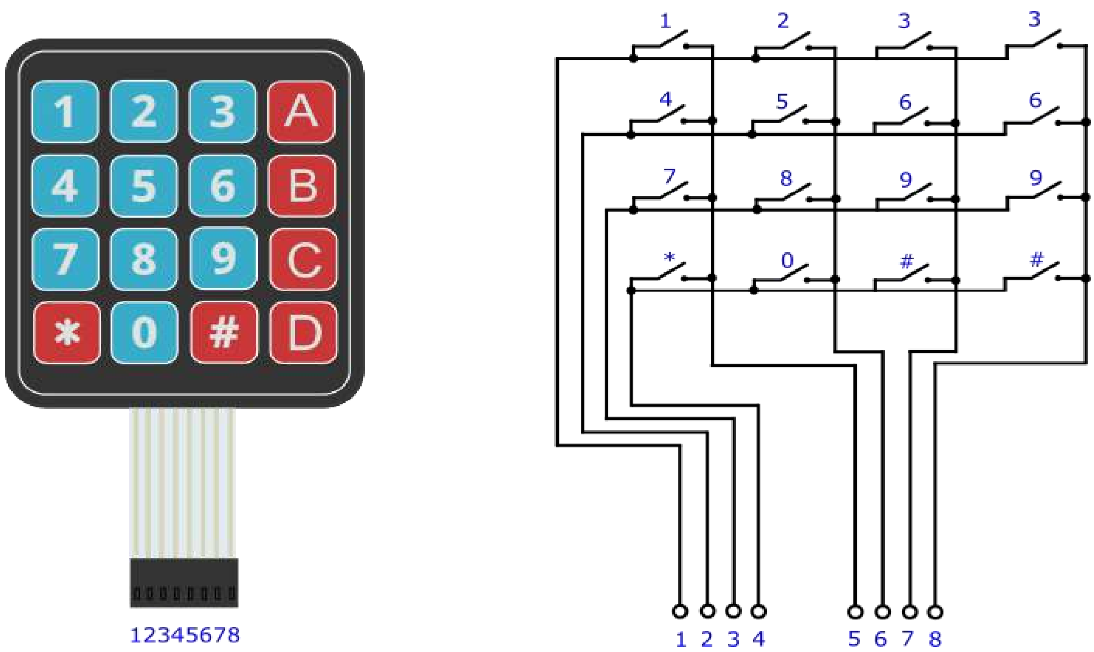


Fig. 3.8 Key Pad diagram [12]

3.6.1 Uses and Functions

The numeric keypad on the side of a computer keyboard makes it simpler to input numbers since it has a layout similar to a calculator. Since most individuals use their right hands to type, the number pad is usually placed on the right side of a keyboard. [12] As an alternative to having a separate number keypad integrated into a laptop, several computers utilise particular function buttons to transform a portion of the keyboard into one. The purchasing of external keypads is possible. Keypads are seen on ATMs, vending machines, payment terminals, time clocks, combination locks, and smart door locks, among other devices.

3.6.2 Origin of The Order Difference

John Karlin, the chief of a Human Factors group at the Bell Laboratories, led a series of studies that resulted in the top-to-bottom configuration for telephone keypads. In addition to the Facit-style two-row arrangement, they tried a circle layout, arc layouts, and three-button rows. This field's leading researcher, R. L. Deininger, released his seminal work, "Human Factor Engineering Studies of the Design and Use of Pushbutton Telephone Sets," in 1960. In this study, the researchers determined that the arrangement they selected to use was the most effective. Folklore and popular belief have a variety of theories as to why phone and calculator keypads have reversed numbers. In the late 1950s and early 1960s, slow switches were suggested as a reason for the unique ordering of keyboard keys, which is similar to the reasoning given for the QWERTY layout.

3.7 Wi-Fi Module (Esp8266)

It is possible to host the ESP8266's Wi-Fi networking operations on an application processor or offload them. If the ESP8266 is the sole processor in the device, it may be booted from flash memory. The self-contained ESP8266 Wi-Fi Module, which has an integrated TCP/IP protocol stack, may be used to connect any microcontroller to a Wi-Fi network. Any processing unit other than the ESP8266 may take over control of all Wi-Fi networking capabilities. A Wi-Fi Shield and an ESP8266 module preloaded with the AT command set have almost identical capabilities. One of the most popular low-cost boards with a rapidly expanding ecosystem is the ESP8266. The development and stress on the module may be decreased by utilizing sensors or other application-specific devices with the GPIOs of this module. In order to reduce the amount of external circuitry required, on-chip integration of the front-end module is used. **Fig. 3.9** shows the ESP8266 Wi-Fi module from above.

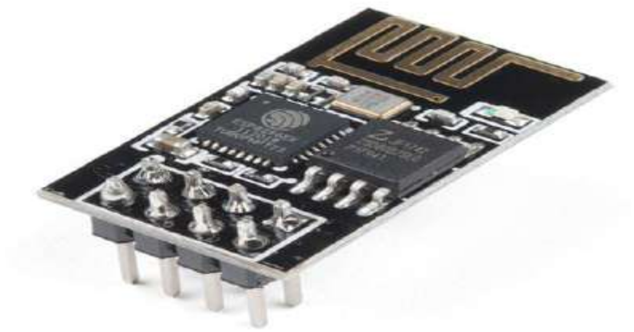


Fig. 3.9 Wi-Fi Module (ESP8266) [13]

3.7.1 Wi-Fi Module (Esp8266) Pin Configuration

The ESP-8266 Wi-Fi Module Pin configuration and pin diagram operating method are presented in **Table 3.2,** as well as the alternative function of pin configuration.

Table 3.2: Wi-Fi Module (ESP 8266) Pin Configuration

Pin Number	Pin Name	Normally used for	Alternate purpose
1	Ground	Connected to the ground of the circuit.	
2	TX	Connected to Rx pin of programmer to upload program.	Can act as a General-purpose Input/output pin when not used as TX.
3	GPIO-2	General purpose Input/output pin.	
4	CH_EN	Chip Enable – Active high	
5	GPIO-0	General purpose Input/output pin.	Takes module into serial programming when held low during start up
6	Reset	Resets the module.	
7	RX	General purpose Input/output pin.	Can act as a General-purpose Input/output pin when not used as RX [13]
8	VCC	Connect to +3.3V only	

3.7.2 Wi-Fi Module (Esp8266) Features

Wi-Fi Module that is low-cost, small, and powerful

- Input/Output Voltage: 3.6V (max)
- Input/Output Voltage: 3.6V (max)
- Input/Output Source Current: 12mA
- Power Supply: - (+3.3V)
- Input/Output Voltage: 3.6V (max)
- Aids in deep sleep (10uA)

3.8 Power Adapter

We'll need two power adapters to operate our project: a 12v 1A power adapter and a 5V 2A power adapter. We use a 5V 2A power adapter to connect with the Arduino and a 12V 1A power adapter to connect with the GSM module. The hardware overview of the power supply is given in **Fig. 3.10,** which has a 220 volt AC input and a 05 volt DC 02 amp output voltage.

Fig. 3.10 Power adapter [14]

An electrical device that provides a load with power is known as a power supply. It is the primary function of a power supply to convert incoming electrical current into the voltage, current, and frequency needed to drive a load. This is the reason for the existence of electricity generators and electric motors/power converters. In some cases, power supplies are connected directly to the load appliances they are meant to power, while in others, the power supply is integrated within the appliance itself. " Consumer electronics like desktop computers and other laptops often use this kind of power supply. For example, power supplies may limit the current load resistance to normal limits; they may also shut off the current if there is a power fault; they may exercise to prevent electronic noise from reaching the load; and they may store energy so that even if the source power fails (an uninterruptible power supply) they can still keep the load powered (uninterruptible power supply). [14] An output connection sends electricity to the load from the power supply, whereas a source receives energy. If you're looking for a power source, you may use anything from batteries to fuel cells to generators to alternators to solar power converters. Hardwired circuit connections aren't necessary for every power supply, although the majority of them do. For example, some power supplies provide additional inputs and outputs that may be used for external monitoring and control reasons.

3.9 Liquid-Crystal Display

Flat-panel displays and other electronically modified optical devices, such as LCDs, employ liquid crystals and polarizers to control the light they output. A reflector or backlight is necessary for the generation of color or monochrome images using liquid crystals. [1] Random visuals or preprogrammed text, numbers, and seven-segment displays (such as a digital clock) may be shown or hidden by LCDs (such as a general-purpose computer display). When it comes to screens, some utilize bigger components while others utilise a grid of small pixels to produce random pictures. LCDs may be switched on or off based on the polarizer setup (negative). Instead of showing white text against a black background, character negative LCDs display white text against a black background that matches the backlight color. Hardware specifications for a 16x2 LCD are shown in **Fig. 3.11**. A total of 32 digits may be shown at a time on this LCD.

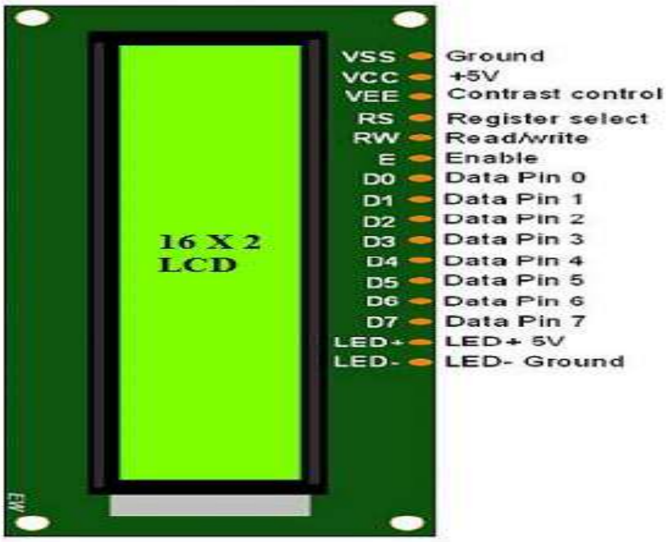


Fig. 3.11 LCD Display **[**15]

These electronic gadgets include LCD displays that can be found in LCD displays in LCD displays that can be found both inside and outdoors. Digital cameras, calculators, and mobile phones, for example, all feature tiny LCD screens. LCD screens may be found in video gaming consoles, DVD players, and alarm clocks. Displays using liquid crystal displays (LCDs) have mostly replaced monitors using cathode ray tubes (CRTs). CRT and plasma displays may be found in various sizes, from tiny digital watches to large television sets. For a given display size, OLEDs have a lower load and thinner profile than LCDs, and probably lower power consumption, thanks to the use of a single glass or plastic panel instead of two separate glass panels, which rises in thickness with screen size and is more evident on LCDs (as the display is only "on" where needed and there is no backlight). OLEDs are more expensive due of the necessity for phosphors, which are high-priced EL materials for a particular display size. Recycling technology for OLED displays isn't readily accessible now, although LCDs can be recycled. Phosphors, which are used in OLEDs and other optoelectronic devices, have the potential to induce screen burn-in. LCDs' lifespans have been extended with the development of quantum dot displays.

Specifications

- Achieving a result Since the bulk of each pixel is made up of red, green, and blue subpixels, we may use a pixel count of 1024768 to estimate LCD resolution. Few things stayed consistent among LCD screens. To increase the apparent resolution of a display without increasing the actual resolution, Quattron employs sub-pixel sharing between pixels.
- At close range, the resolution of a computer monitor or other display may be described using terms such as "dot pitch" or "pixels per inch." The display density is modest for long-distance viewing on TVs, but excellent for close-range detail on mobile devices. LCD viewing angles may be critical depending on the display and intended use, however certain display technologies only work effectively at specified viewing angles.
- Displaying data at a rate of several times per second is an important consideration when evaluating an LCD display's capacity to properly and swiftly transmit visual changes. Because LCD pixels do not flash between frames, there is no refresh-induced flicker with LCD screens. When the refresh rate is reduced, fast-moving pictures may seem smeared or ghosted. A fast-changing projected image may cause visual abnormalities on any display because of the inherent latency that displays

have while delivering an image. The reaction time of each individual pixel is of considerable concern.

- It is possible to characterize the display's color performance in a variety of various ways. It's unfortunate that marketing brochures don't feature color gamut unless they're used by specialists, since it's a measure of how finely the spectrum may be split. Color depth, on the other hand, refers to the available range of hues. Displays are only designed to work within or below a predetermined standard since having a color range that surpasses the information on the screen has no value. White point correction and gamma correction are two of these extra qualities that help define what color white is and how it compares to other colors. [15]
- It's the difference between a on pixel's brightness and the brightness of an off-pixel's brightness that determines a photo's contrast ratio. To provide lighting, the LCD uses a light valve; the backlight, which may be fluorescent or LEDs, does not. There are several factors that affect how bright an LCD screen may be, including the LCD's transparency and the brightness of its backlight. A longer battery life comes at the cost of increased brightness.

3.10 Atmega328p

It's an AVR-based high-performance microcontroller with a plethora of pins and capabilities. As a result, it is more powerful and consumes less power than a typical 8-bit CMOS processor. Temperature sensors and an auto-sleep mode are also included. A number of programming methodologies and built-in safeguards make it possible for engineers to prioritize the ATmega328P IC as a controller in a variety of circumstances. As a result of its broad variety of modern-era communication protocols, the ATmega328P microcontroller is becoming more popular.

3.10.1 Pinout Diagram Atmega328p

This microcontroller has 28 pins, and we'll go through the functions of each one and the pin diagram in this part. The ATmega328P's pinout is shown in **Fig. 3.12:**

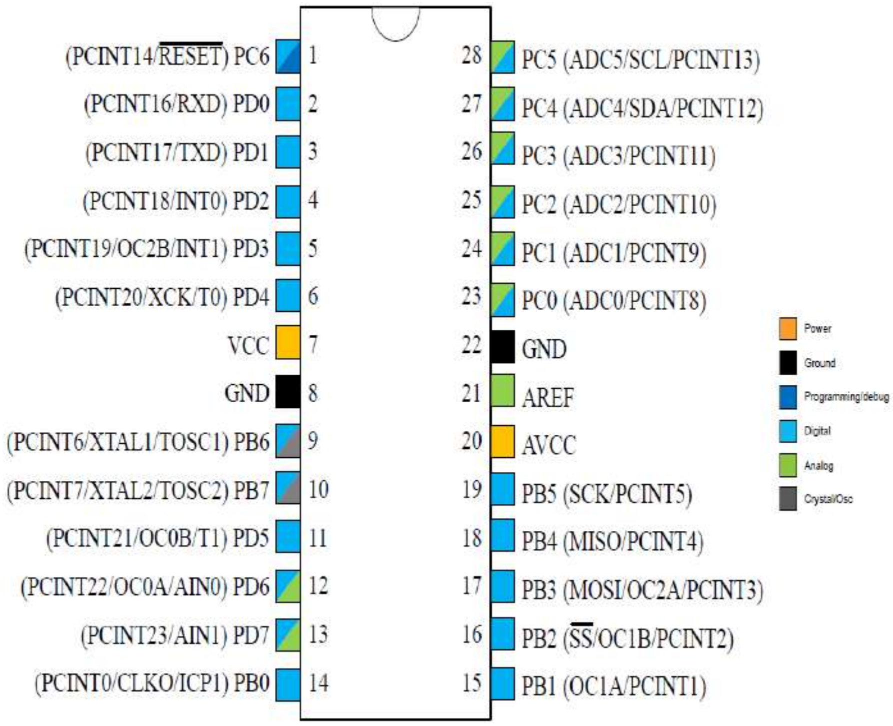


Fig. 3.12 Pin Diagram of ATmega328P [16]

3.10.2 Pin Configuration Details

Pins for digital input and output The three digital ports (B, C, and D) on this microcontroller are labeled PORTB, PORTC, and PORTD. They may all be used as digital inputs and output pins, as well. Aside from the fact that each link may be used for a wide range of purposes, All I/O pins must have a default function before they may be used as output/input or for any other reason. These are the controller's digital input and output pins.PB0 – GPIO14

- PB1 – GPIO15
- PB2 – GPIO16
- PB3 – GPIO17
- PB4 – GPIO18
- PB5 – GPIO19
- PB6 – GPIO9
- PB7 – GPIO10
- PC0 – GPIO23
- PC1 – GPIO24
- PC2 – GPIO25
- PC3 – GPIO26
- PC4 – GPIO27

- PC5 – GPIO28
- PC6 – GPIO1
- PD0 – GPIO2
- PD1 – GPIO3
- PD2 – GPIO4
- PD3 – GPIO5
- PD4 – GPIO6
- PD5 – GPIO11
- PD6 – GPIO12
- PD7 – GPIO13

3.10.2.1 Interrupt pins

The usage of an interrupt system is required for most electrical jobs, such as the use of AC dimmers. There are two interrupts in the ATmega328P controller that may be used to get the CPU's attention at any given moment. The interrupt pins of the ATmega328P are as follows:

- IN0 – GPIO4
- IN1 – GPIO5

Microcontroller ATmega328P with UART Interface USART is the most widely used communication technology inside devices and modules. It is one of the easiest and most basic approaches to create and understand for most developers and systems. Data is sent and received using two wires in this way.

- RX – GPIO2
- TX – GPIO3

Both internal and external clock pin options are available to maintain the data in sync with each other.

- XCK – GPIO6

The microcontroller may be programmed via the USART/UART communication mechanism.

3.10.2.2 SPI Communication ATmega328P

It is one of the best serial communication methods in the case of a large number of peripherals. The SPI protocol allows several devices to interact on the same network. In addition to the two data bus and the clocking line, there is a choose slave that may be used to pick peripherals. Additional peripherals will result in an increase in the number of select slave pins. The SPI ports on the microcontroller are:

- MOSI – GPIO17
- MISO – GPIO18
- SS – GPIO16
- SCK – GPIO19

The below **Fig. 3.13** show the hardware overview of ATmega328P. This is a microcontroller IC.

Fig. 3.13 ATmega328P [16]

3.10.3 I^{2}c Communication Module

The vast majority of peripherals communicate in one direction at a predetermined time using the I2C protocol. When using the I2C protocol, all that's required is one data cable and one clock cable. Clock pulses are sent and received on the clock wire in order to maintain the data in sync with what the data line is sending and receiving. The ATtiny328P module has two built-in timers. In order to produce counters and pulses, you may make use of these timers. Every single one of these timers has an oscillator inside of it. Both the internal and external clocks can control the timers; however, an internal pin may be utilized to count external pulses. The following is a list of the ATmega328P's pins:

- T0 – GPIO6
- T1 – GPIO11
- TOSC1 – GPIO9
- TOSC2 – GPIO10
- ICP1 – GPIO

At a preset time, interval, an external pulse may be collected via ICP1. It is possible to utilize this pin's timestamp to identify when the outer signal was received.

3.10.3.1 System clock

The internal and external clock pulses may be split by the Prescaler and their value can be received through an external port. The following will serve as the external pin for split clock pulses:

- CLKO – GPIO14

3.10.3.2 Comparator Module

Comparator modules incorporated within the microcontroller handle analog signals. An inverting/non-inverting input signal may be converted to an inverting/non-inverting output signal either internal use or output signal generation.

3.10.4 Atmega328p Capture/Compare/Pwm Channels

There are six capture/compare/PWM pins are used to generate the desired time pulse-based signal. It uses a Prescaler to divide the time pulse. All of these pins in ATmega328P are:

- OC0B – GPIO11
- OC0A – GPIO12
- OC1A – GPIO15
- OC1B – GPIO16
- OC2A – GPIO17
- OC2B – GPIO5

3.10.4.1 Analog to digital converter channels

In ATmega328P there are 6 ADC channels that can be used to convert the analog signal to digital. The power pin of the analog converter must be connected to GND before it can be used (AVCC). The analog input levels are differentiated by the ADC channels using the power supply voltage as a reference. The following are the controller's analog nodes:

- ADC0 – GPIO23
- ADC1 – GPIO24
- ADC2 – GPIO25
- ADC3 – GPIO26
- ADC4 – GPIO27
- ADC5 – GPIO28
- AVCC – Pin20

3.10.4.2 Aref pins

However, despite these fluctuations, the controller's power input is used to detect the voltage of the analog signals. A voltage reference AREF will also be used to measure the voltage from any other power source or from a device that generates analog signals. The analog signal's greatest value will be detected by this pin, and the appropriate output will be provided.

3.10.4.3 Reset

Resetting the ATmega328 microcontroller is possible under certain circumstances. To perform all of these restarts, an external signal is needed to reset the device:

- RESET – GPIO1

3.10.4.4 Power

Every controller has a power input pin, since it is a must for it to work. There are three power pins on the ATmega328P. The remaining two pins are used for common ground and one is used to provide power. ' Since they are both connected internally, it doesn't matter which of these ground pins is used. In order to provide power to the microcontroller, the following pins are used:

- VCC – Pin7
- GND – Pin8, Pin22

3.10.4.5 Oscillator

- The 8MHz oscillator of the controller may be altered. Nevertheless, an external oscillator of up to 40 MHz may be used. When employing an external oscillator, oscillation pins are required for signal input and output. The pins are as follows:
- XTAL1 – GPIO9
- XTAL2 – GPIO10

3.10.5 Applications

Most embedded systems, such as IoT-based systems, utilize the ATmega328 to perform a range of tasks because of the quantity of examples and instructional material accessible online. Since Arduino uses it, it is the most popular controller.

3.11 nRF24L01 Module

These two RF Modules operate at different frequencies, which is the main distinction between them. In prior modules, a 434MHz radio frequency was utilized. The 2.4GHz frequency is used in this model. nRF24L01 Both the transmitter and receiver on the 434 MHz RF Modules are self-contained units (Receiver). There are two integrated circuits in a single all-in-one transceiver (AIC).

3.11.1 A Brief Note on nRF24L01 Transceiver Ic

The nRF24L01 transceiver from Nordic Semiconductor is a single-chip transceiver. Rates of up to 2Mbps are feasible for ISM devices running in an unlicensed band. A megahertz of channel capacity is required for data transmission at 250kbps and 1Mbps. 126 channels at 250kbps or 1Mbps data speeds are possible at the lowest and maximum working frequencies of 2400MHz and 2525MHz. Channel capacity must be 2MHz or above in order to operate at two megabits per second (Mbps). **Fig. 3.14** shows the circuits for the nRF module.

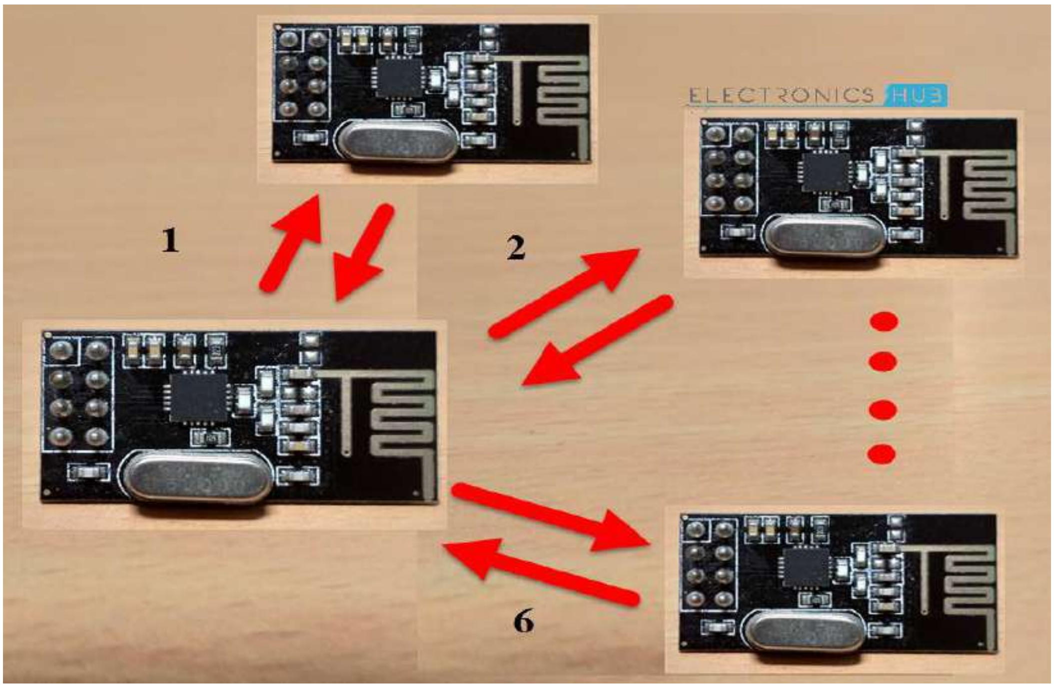


Fig. 3.14 nRF24L01 Module [17]

One unique feature of the nRF24L01 is called MultiCeiver. In order to link to as many as six additional modules on the same RF Channel, each module has six unique data streams. With the NRF24L01 IC, you'll need an antenna and associated circuitry. A microcontroller with a serial peripheral interface is all that's required to utilize the nRF24L01 Module in a wireless communication system (SPI).

3.11.2 Important Features of nRF24l01 Ic

- Using a minimal amount of electricity (900nA power down mode, Standby-I at 26A)
- A Microcontroller having an SPI Interface.
- RF transmitter, receiver and synthesizer in a single unit.
- For functioning, a voltage range of between 1.9V and 3.6V is utilized.
- At least five voltage levels will not damage the input pins.

3.11.3 nRF24l01 Transceiver Module

The nRF24L0 Transceiver Module boards, which comprise all of the necessary components and pins for building a radio system, have been developed by a number of businesses. The nRF24L01 Transceiver Module just requires an antenna trace (on the printed circuit board), communication and power connections, and a few passive components to function. The nRF24L01 transceiver module PCB may be seen in the image below. **Fig. 3.15** shows the nRF24L01 transceiver module in action.

Fig. 3.15 nRF24L01 Transceiver Module [17]

Important Note: Most recent nRF24L01 Transceiver Modules utilize the nRF24L01+ IC. Everything we've said thus far has been predicated on the nRF24L01+ chip, which has now been enhanced.

- VCC is the pin that connects to the power supply.
- Only 3.3 volts may be delivered.

- The GND pin on the power supply is used here.
- During the SPI protocol, the SCK pin is utilized as a clock source.
- MOSI is the input pin for an SPI slave.
- MISO is the data output pin.
- Active Low Interrupt Pin (IRQ)
- You must connect the CE pin to the chip to activate it.
- Chip Select Pin (CSN) of the SPI

3.11.4 nRF24l01 Transceiver Module Adapter

There are no breadboard pins on the nRF24L01 Transceiver Module, thus connecting wires directly isn't a good idea. There are two ways to get around this. Make a perf board for the nRF24L01 Transceiver Module, with breadboard-friendly pins at the bottom, to place the module on top of. The second alternative is to purchase the nRF24L01 Transceiver Module adaptor, as indicated in the accompanying illustration. The nRF24L01 transceiver module is shown in the **Fig. 3.16.**

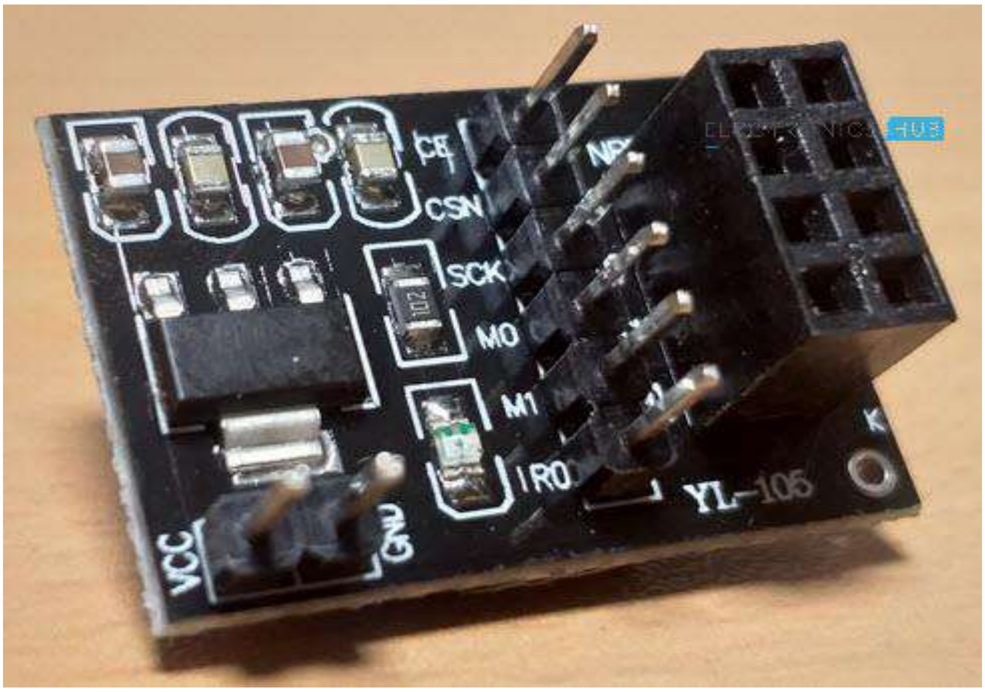


Fig. 3.16 nRF24L01 Transceiver Module [17]

Female headers are used to connect the nRF24L01 Transceiver Module to the adapter, while male headers are used to attach it to other boards like the Arduino. For those who need to provide 5V to their nRF24L01 Transceiver Module adaptor, there is a regulator IC that provides 3.3V.

3.11.5 Components Required

- Arduino UNO x 2
- nRF24L01 Transceiver Modules x 2
- Joystick
- TowerPro SG90 Servo Motor
- LED

3.12 Relay

You can use electricity to control a relay, which is a switch of a different sort. There are solid-state relays and other operating principles that can be employed to activate switches in numerous relays, but electromagnetism is the most common. To regulate low-power circuits, relays may be utilized, provided that both systems are electrically separated. A single signal may be used to operate many circuits. Long-distance telegraph networks used early relays as amplifiers, retransmitting signals between them. Early computers and telephone exchanges relied heavily on relays for logic operations for many years. You'll need a contactor or relay capable of handling high power in order to directly operate an electric motor or other load. Instead of using mechanical components, solid-state relays handle power using semiconductor chips. Even if digital devices like "protection relays" are still widely utilized in the modern world, more complex devices like "relays with calibrated operating characteristics and numerous operational coils" are becoming more commonplace. A diagram of the 05-pin relay is shown in **Fig. 3.17.**

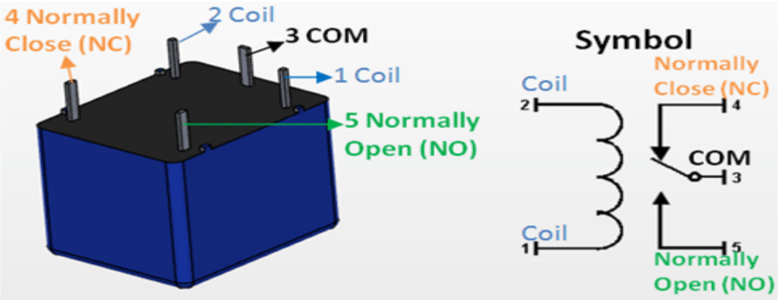


Fig. 3.17 Relay [18]

3.12.1 Relay Switch Circuit

Electromechanical devices are those in which an electromagnet affects the condition of two moving contacts. Examples include providing high-power AC circuits or heating elements while using just a small amount of electrical energy to operate the relay coil.

Electromechanical relays are output devices (actuators) in electrical circuits that may perform a wide range of tasks. To pick from a variety of shapes and sizes. This circuit may be used in low-power electrical and computer devices to switch huge currents or voltages from ON to OFF. When working on tiny electrical projects, transistors and MOSFETs are often utilized as the principal switching devices because of their ability to rapidly switch DC (ON-OFF) control of the relay coil. You may switch relays in a variety of methods.

3.12.2 NPN Relay Switch Circuit

In the illustration, an NPN transistor switch, TR1, is used as a standard relay switch. When a transistor's base voltage is 0, an open switch may be generated (or negative). If the Base does not have any current flowing through it, no current can move via a relay coil. [18] If the NPN transistor is saturated by a large enough positive current, the flow of current from Base to Emitter (B to E) governs the larger relay coil current. Saturation is accomplished in most bipolar switching transistors by feeding a relay coil current into the collector that is 50-800 times greater than the base current required. The BC109's beta value () is now approximately 290 at 2mA. (Datasheet). **Fig. 3.18** shows the relay-based NPN transistor switching circuit.

NPN Relay Switch Circuit

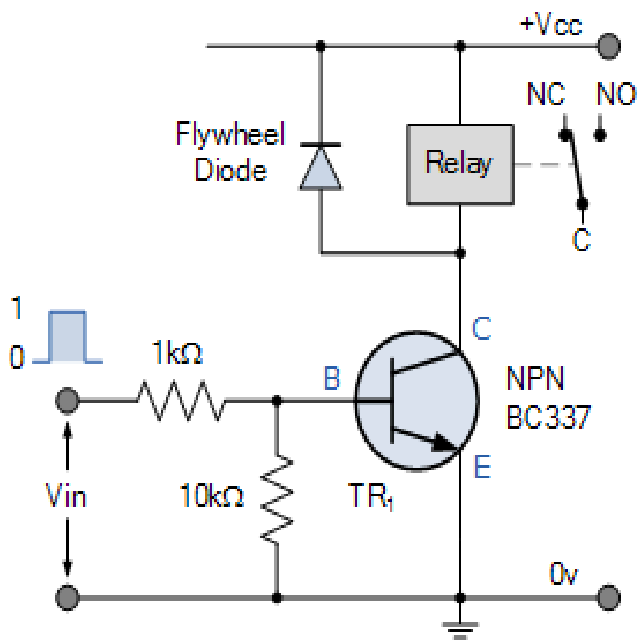


Fig. 3.18 NPN Relay Switching Circuit [17]

The relay coil is both an electromagnet and an inductor, so it's important to keep that in mind. When the transistor switches power to the coil, the coil's DC resistance causes the largest amount of current to flow, as indicated by Ohms Law (I = V/R). The relay coil's magnetic field preserves some of this energy. The relay coil's current is lowered and the magnetic field is lessened as a consequence of shutting off the transistor. In order to keep the relay coil current flowing, the magnetic field's stored energy must be released, therefore a reverse voltage rises across the coil. For example, a long amount of time allowing the voltage to build up might destroy the switching NPN transistor as a result. [18]

CHAPTER 04
DESIGN METHODOLOGY

4.1 Introduction

This chapter contains our project's approach. Here we used several types of figure, which depict the project block diagram and flow chart, also we have added a full descriptions of that block diagram and flow chart. The block diagram and flow chart depict the step-by-step working procedure of our project. Also we illustrate the project circuit diagram in details. The circuit diagram depicts how the project's components are linked to the circuit diagram.

4.2 Block Diagram

The below **Fig. 4.1** is our system block diagram. In this block diagram, we have mentioned the parts of our system. We have used some sensors in our system, which are temperature sensor, gyro sensor, MAX30100, which are respectively measuring patient temperature, bpm, oxygen saturation and fall detection. That's are work as a input in our system. We will do the work of medicine reminder through keypad. We can see the values provided by the keypad and the sensor on the server and display. Also our system has 24 push button. By which information can be sent away, so that the team as well as the nurse can come and work for the treatment. The patient's information will go to the server through the internet and we will get the information by entering with the user id and password, which is also showing on the lcd display.

That is why, we are sending the information of our system to the server through IoT. For doing this task, we use sd card. The sd card reader will contain the sd card. The data that we have saved in the sd card will be checked by Arduino to see if it matches. If it matches, then we will be able to hear the voice through the amplifier and the speaker. We will be able to hear the voice loudly through the amplifier and the speaker.

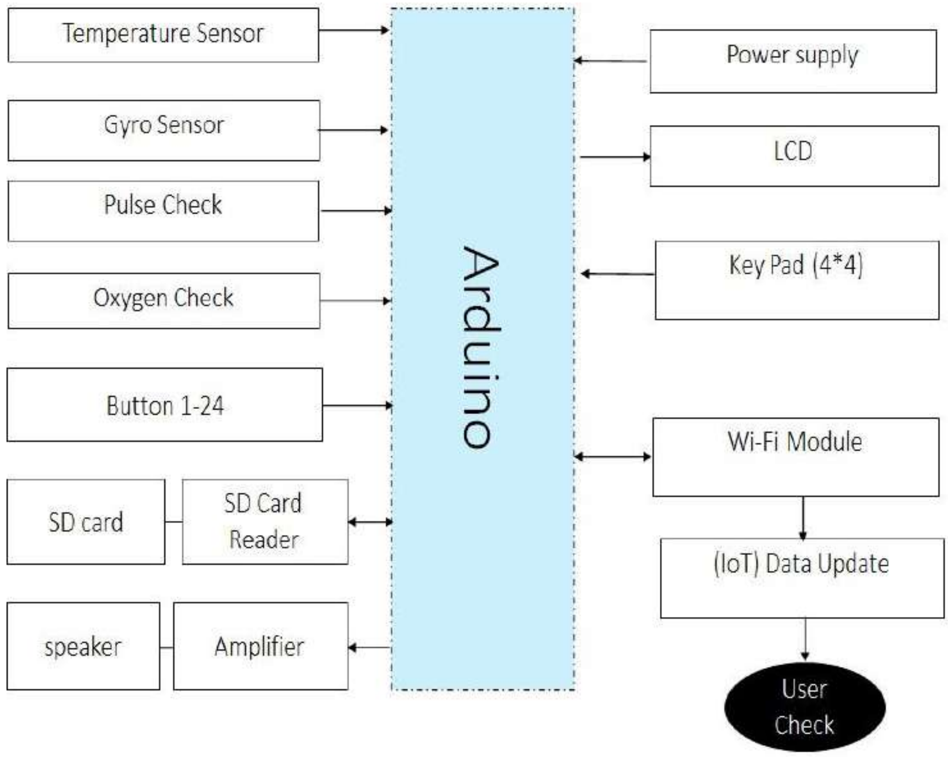


Fig. 4.1 System Block Diagram

4.3 Flow Chart

Fig. 4.2 depicts the whole system flow chart, which includes the entire system's working process, work completed step by step, and sensor condition checks, among other things. Here we can see that, after pressing the switch button, it will send a signal to the device and will be connected to the device and get input from human body. But if it can't be connected to the device, it will re-start again. After getting input from human body, sensor check the data and gives the result that means we heard the voice in receiver section. But if sensor don't match the data, it will be return to getting input from human body.

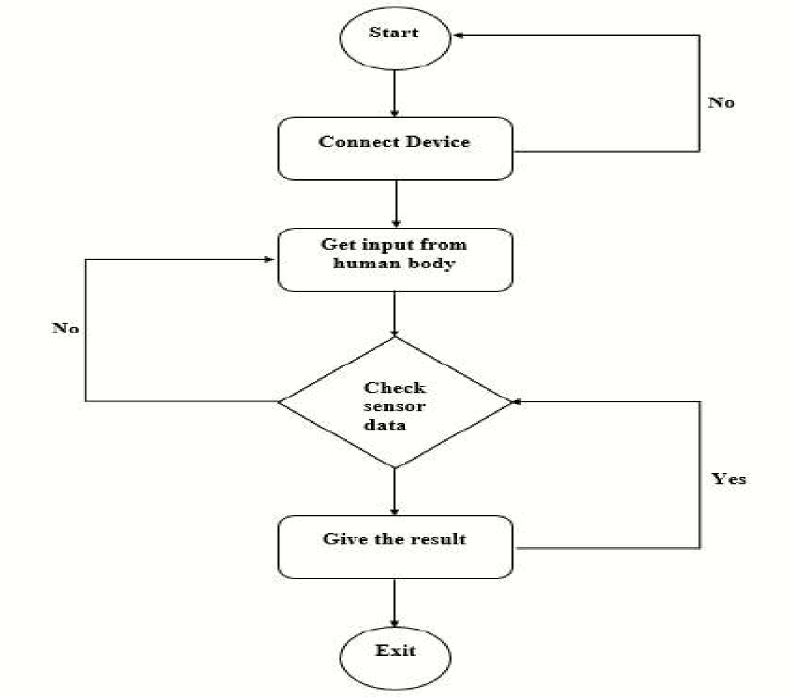


Fig. 4.2 System Flow Chart

4.4 Circuit Diagram

The circuit design for the whole system is shown in **Fig. 4.3,** which includes the controlling device as well as additional parameters such as the LCD, keypad, Wi-Fi module, and sensors.

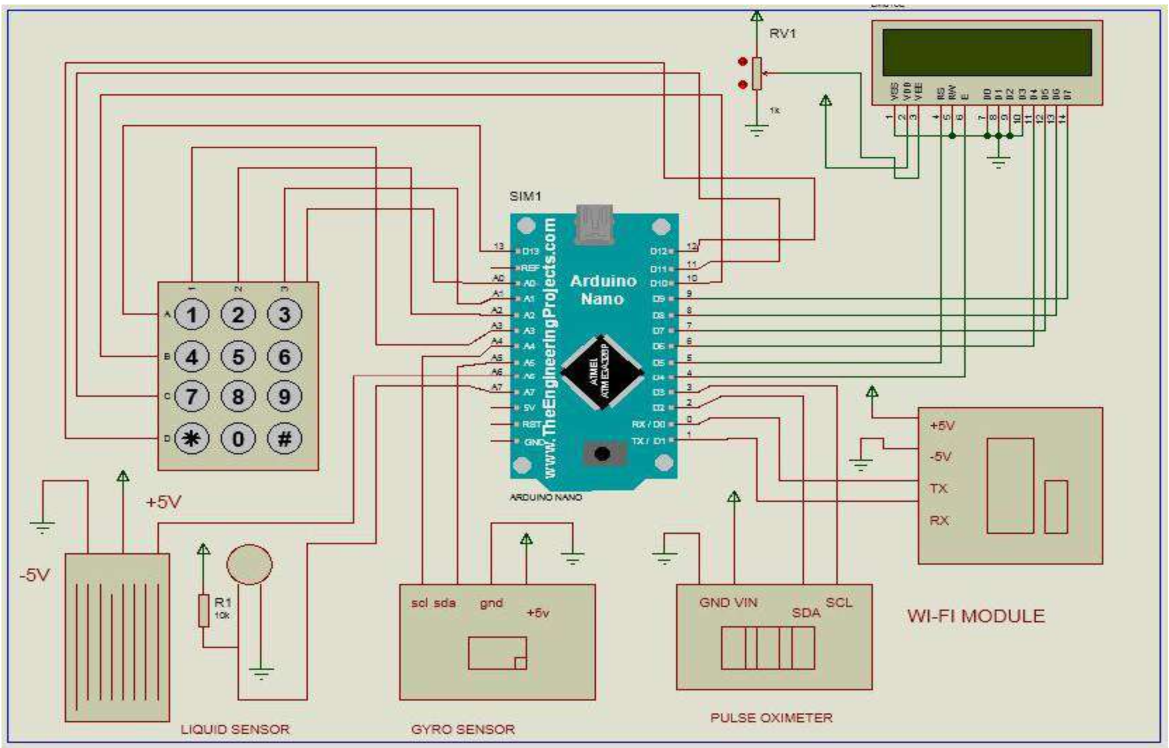


Fig. 4.3 Circuit Diagram of interfacing sensor

The circuit diagram of the voice command reception unit is shown in **Fig. 4.4**. This circuit receives the signal from the transmitter and raises this sound individual transmission signal.

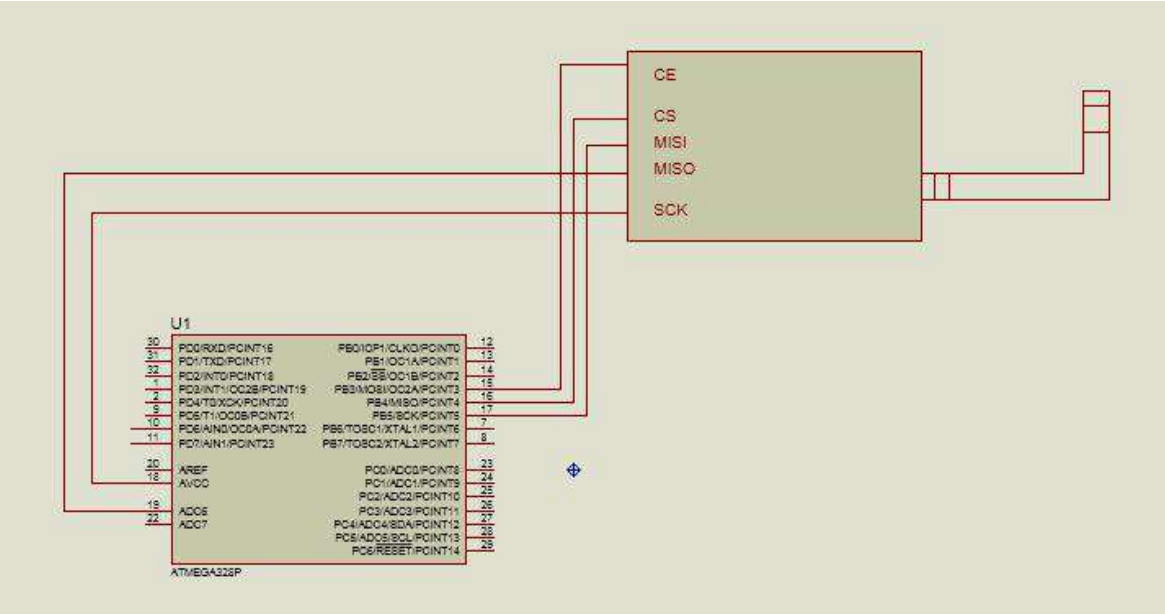


Fig. 4.4 Circuit Diagram of voice command receiver unit

The circuit design of the voice command Transmitter unit is shown in **Fig. 4.5,** which uses nRF technology to convey the signal to the reception section.

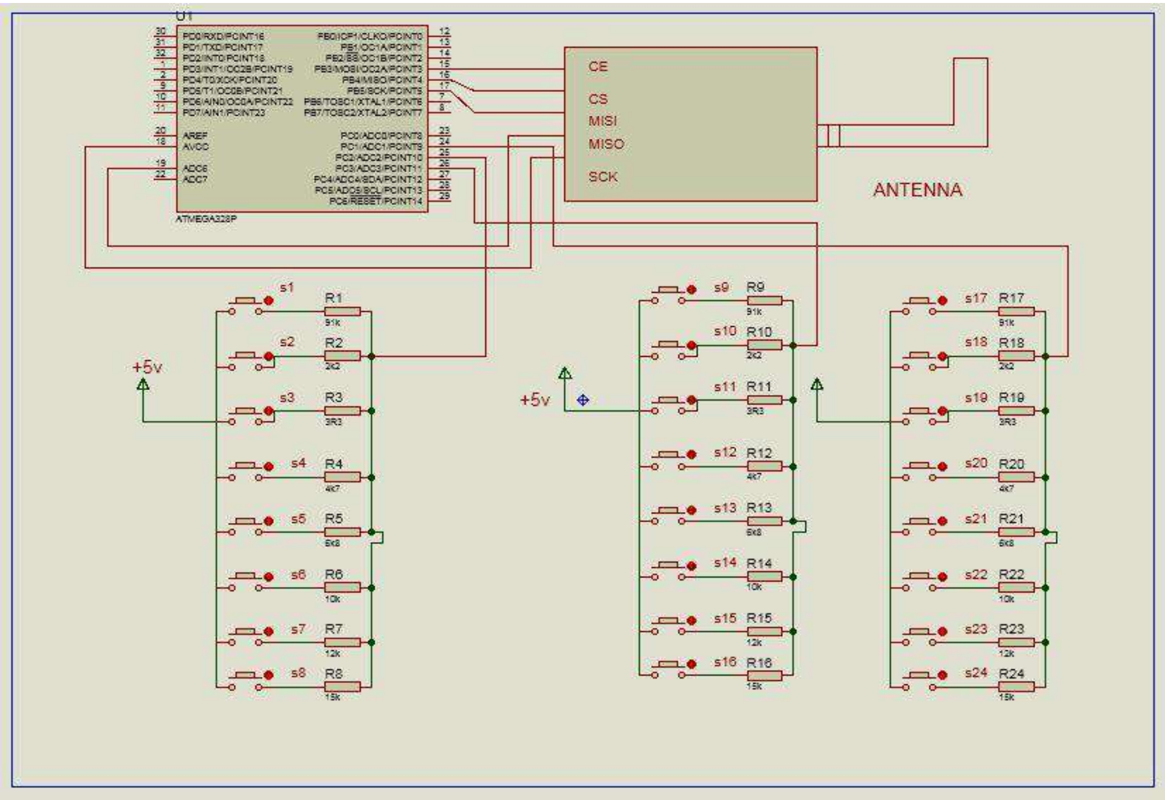


Fig. 4.5 Circuit Diagram of voice command Transmitter unit

4.4.1 Circuit Description

The circuit schematic for this system is given below. This figure clearly shows all of the connections between the modules utilized in this system and the Arduino board and microcontroller board. The GND and VCC connections of the Arduino and microcontroller have been connected with the VCC and GND connections of the temperature, Gyro sensor, Wifi module, Keypad, nRF, and LCD. The Arduino-nano is switched on at the same time as the Wi-Fi module, and a link is formed between the Wi-Fi module and the access point, allowing the sensor value to be uploaded and accessed via the internet. The user's control is supplied via Arduino nano and uploaded to the cloud server; the controller then gets the data from the cloud server through a Wi-Fi module and executes the needed action, based on the control signal given by the user. The program for the health monitoring portion, the transmitter section, and the receiver section is detailed in the appendix.

CHAPTER 05

IMPLEMENTATION AND RESULT

5.1 Introduction

This chapter contains the total system result, hardware picture, controlling method of the project. Our project operate by two method likes one method is controlling by website (Automatically) and another method is controlling by manually.

Website Result:

Website is two parts:

1. Controlling.
2. Monitoring the whole System.

5.2 IoT Monitoring

The below **Fig. 5.1** and **Fig. 5.2** show the patient heart rate, temperature, fall status, medicine reminder, saline level of individual patient. It's totally patient condition show at server, the patient authority monitoring in any place through the internet. It is real time patient status submit at server.

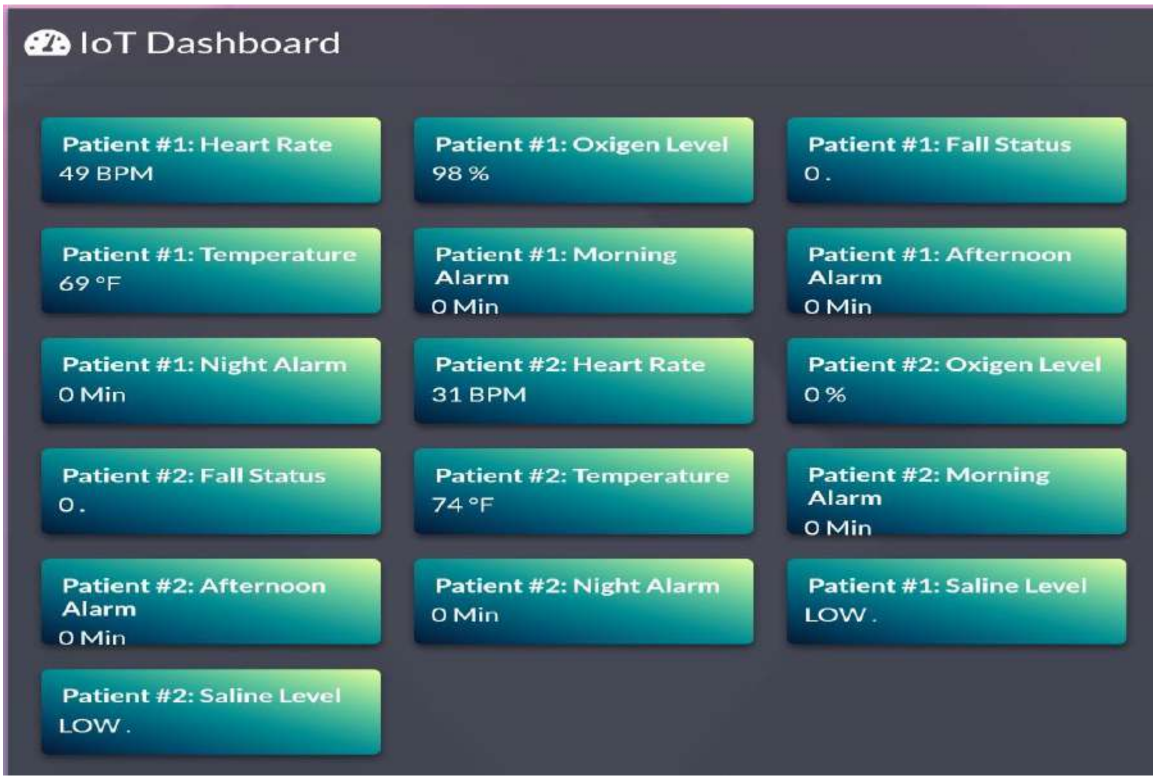


Fig. 5.1 Server Data for attempt 01

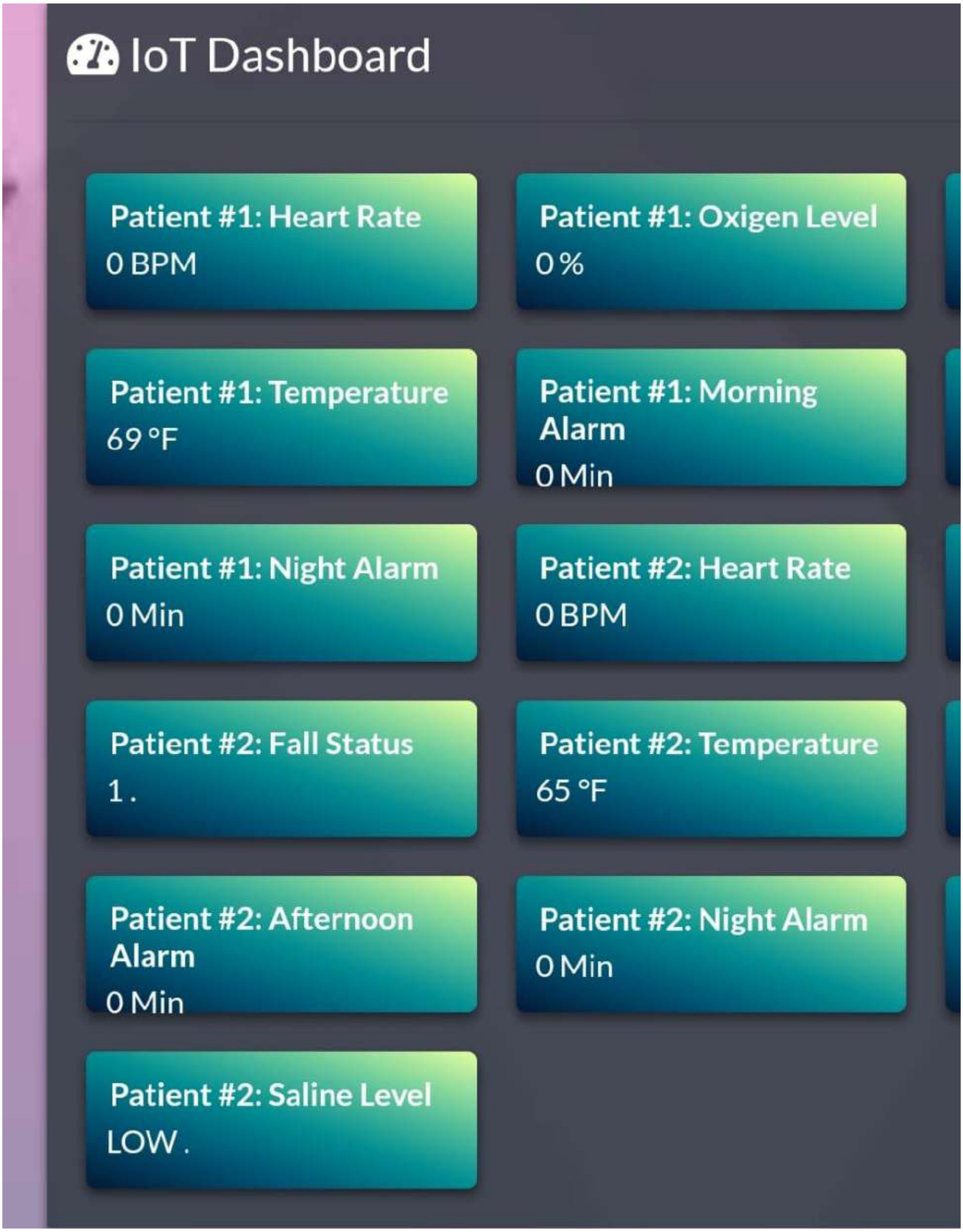
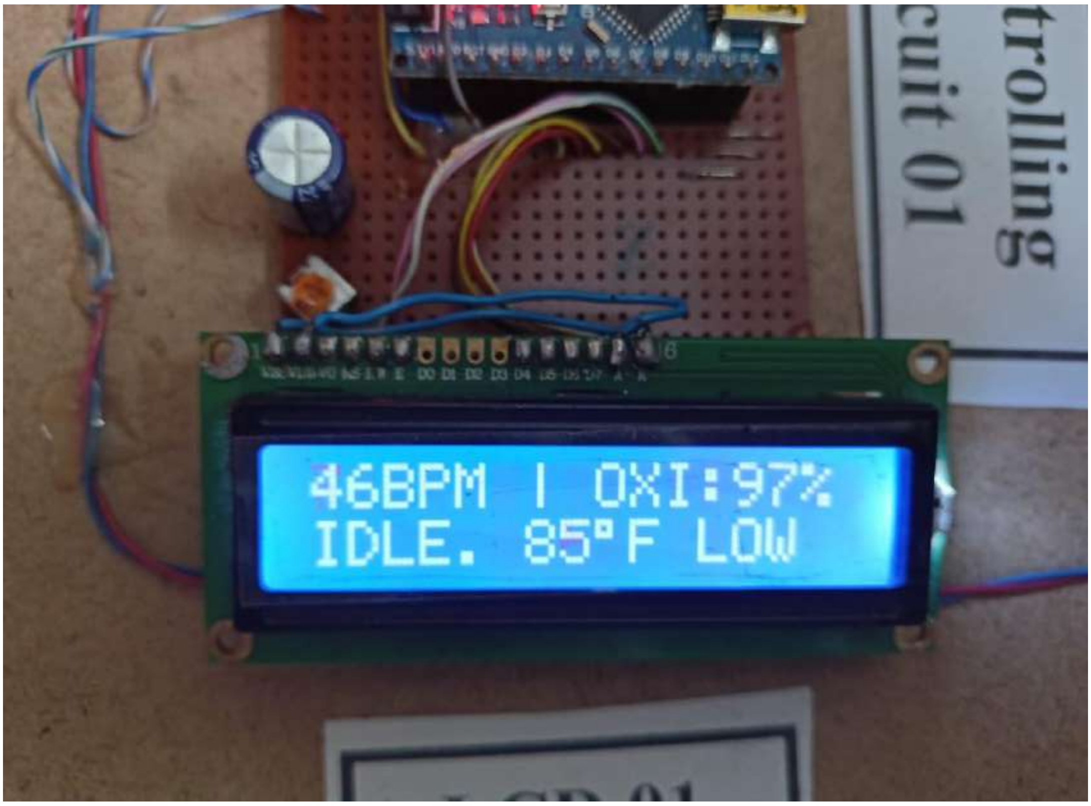
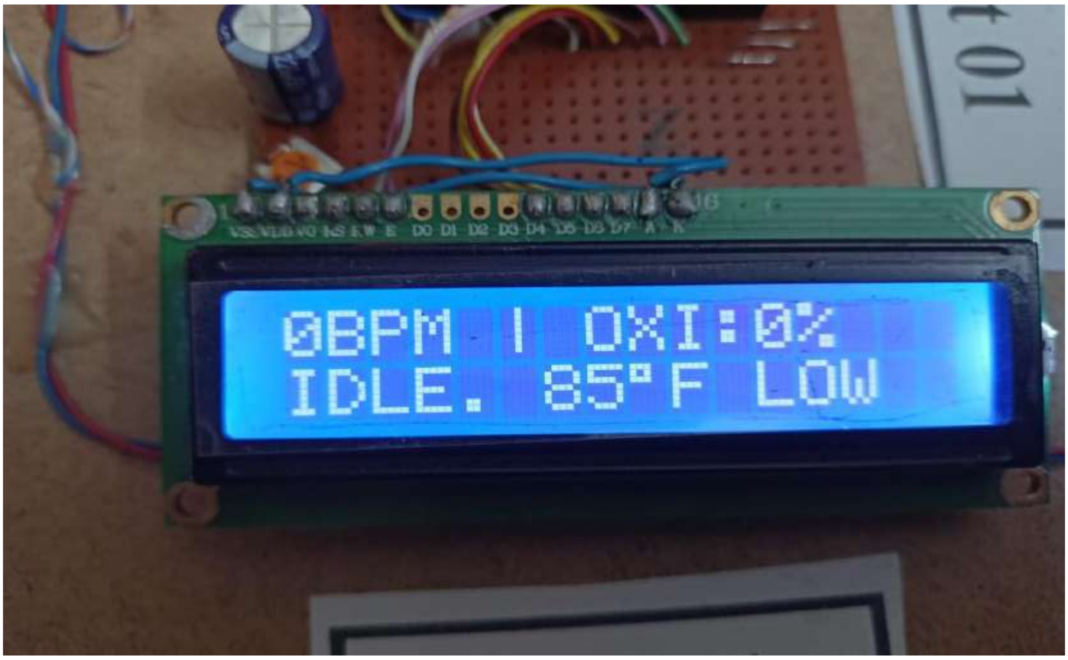


Fig 5.2 Server Data for attempt 02

The below **Fig. 5.3** is showing the patient body temperature, oxygen level, Saline level show the LCD.



(A)



(B)

Fig. 5.3 Temperature sensor data (A, B)

5.3 Hardware Implementation

The below **Fig. 5.4** is showing the voice massage sender part, we see some push switch, the individual push switch sent the individual voice at receiver section.

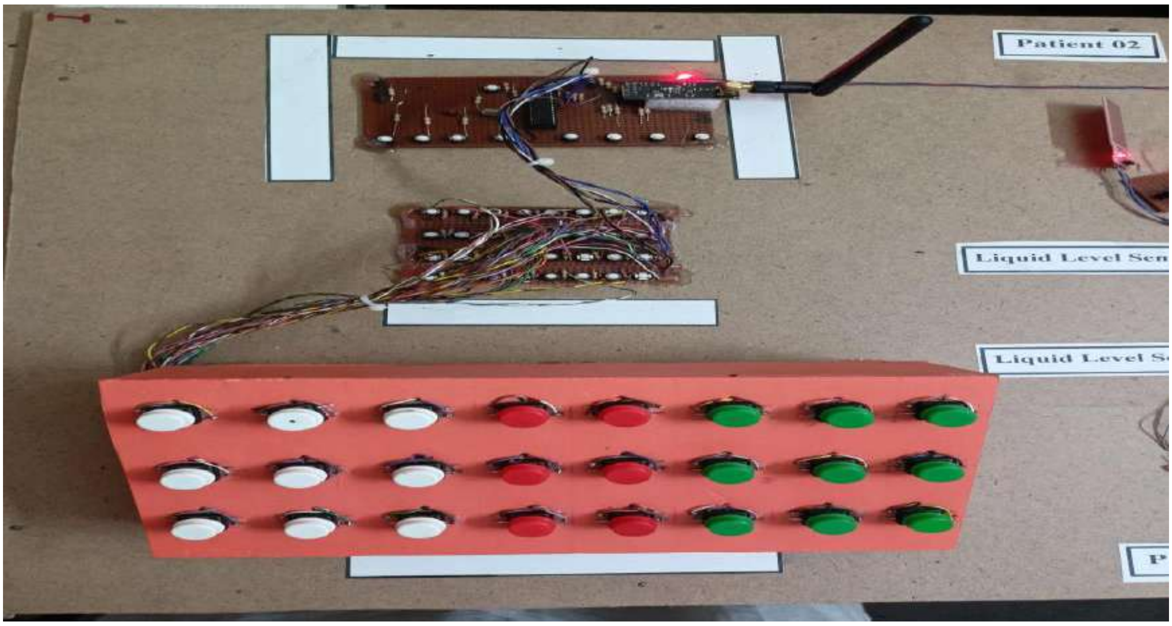


Fig. 5.4 We used push switch for mention of voice.

The below **Fig. 5.5** show the 05-pin relay based NPN transistor switching circuit of voice massage controlling circuit.

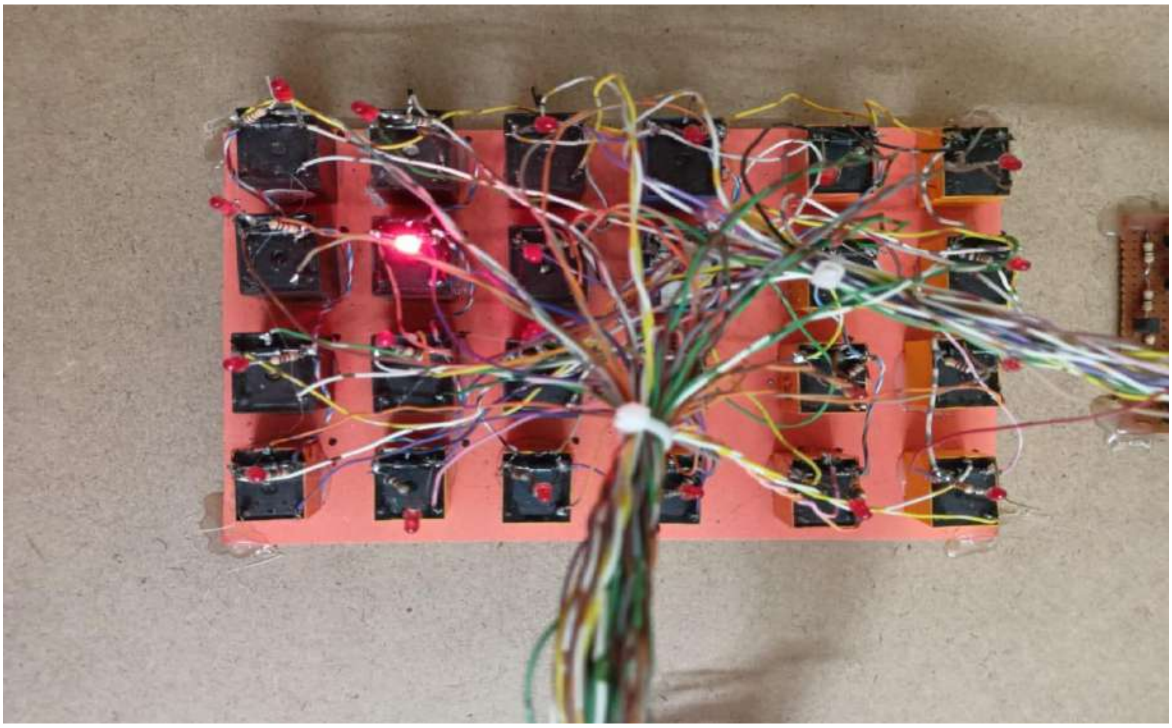


Fig. 5.5 Relay Switching Circuit

The below **Fig. 5.6** is showing the whole system overview of receiver section, which is included the voice massage receiver section, wireless nRF module, power supply etc.

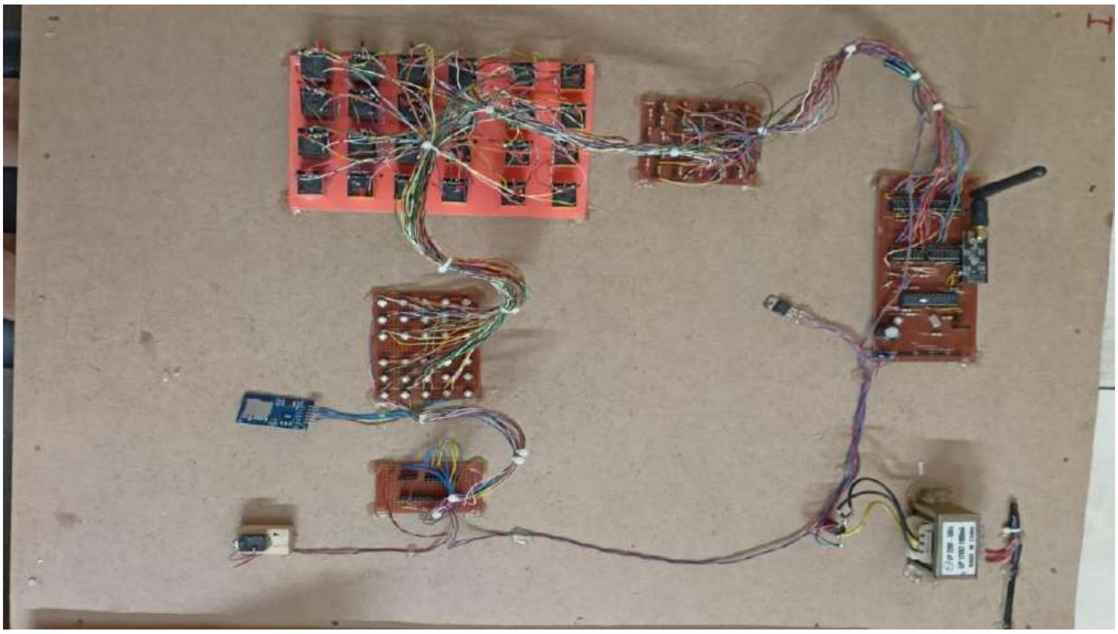


Fig. 5.6 Receiver Section

The below **Fig. 5.7** is showing the whole system overview of transmitter section, which is included the voice massage sender section, medicine reminder, patient condition etc.

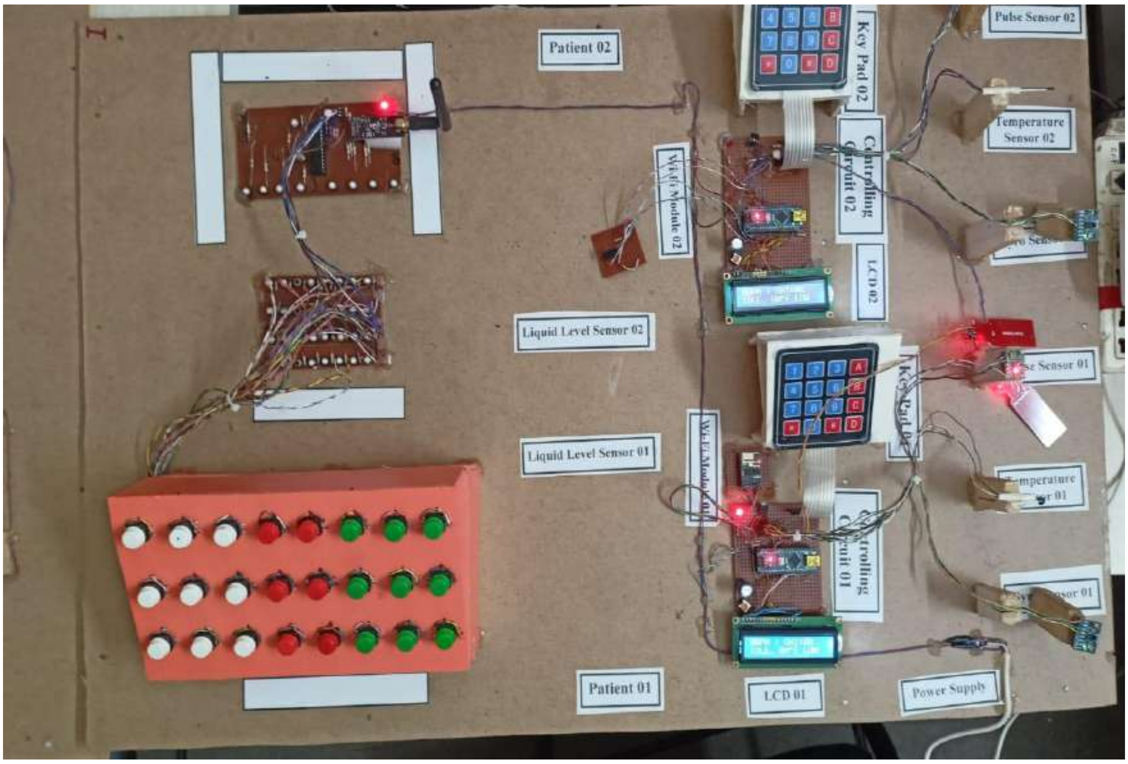


Fig. 5.7 Sender Section

The below **Fig. 5.8** is showing the medicine reminder section, which is included the keypad, arduino nano, LCD etc.

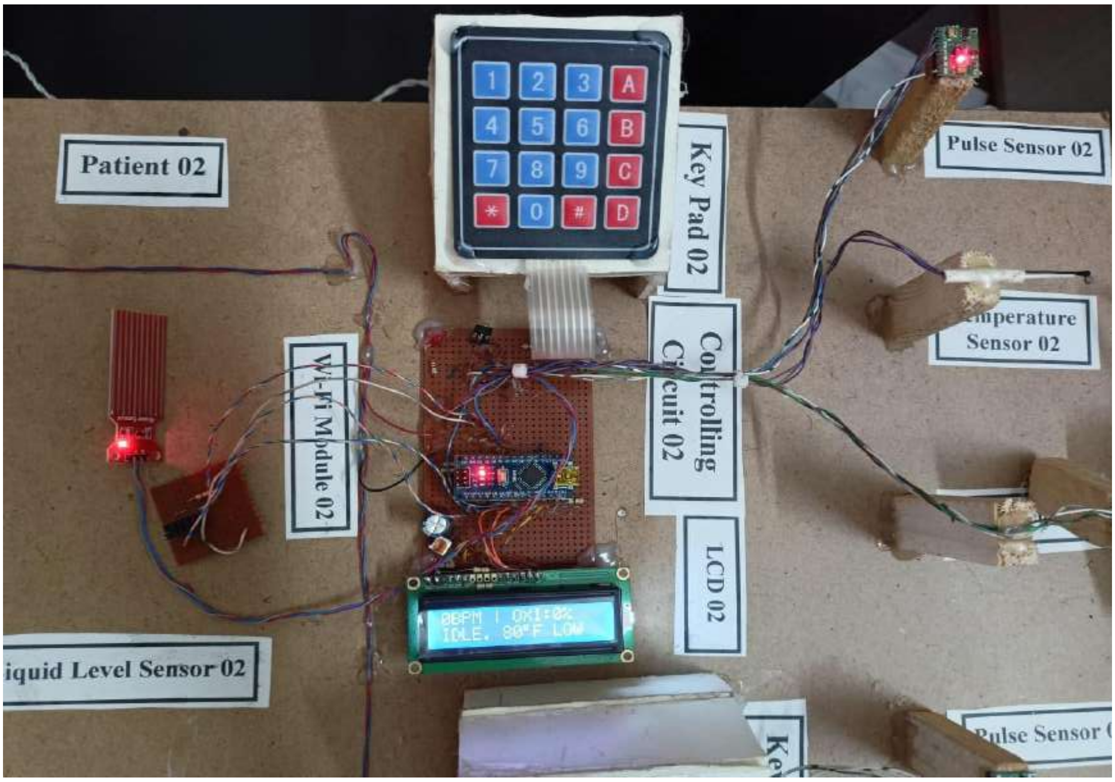


Fig. 5.8 Medicine Reminder Section

The below **Fig 5.9** is showing the voice command section, which is included the Relay Switching circuit, memory card module, microcontroller, push switch etc.

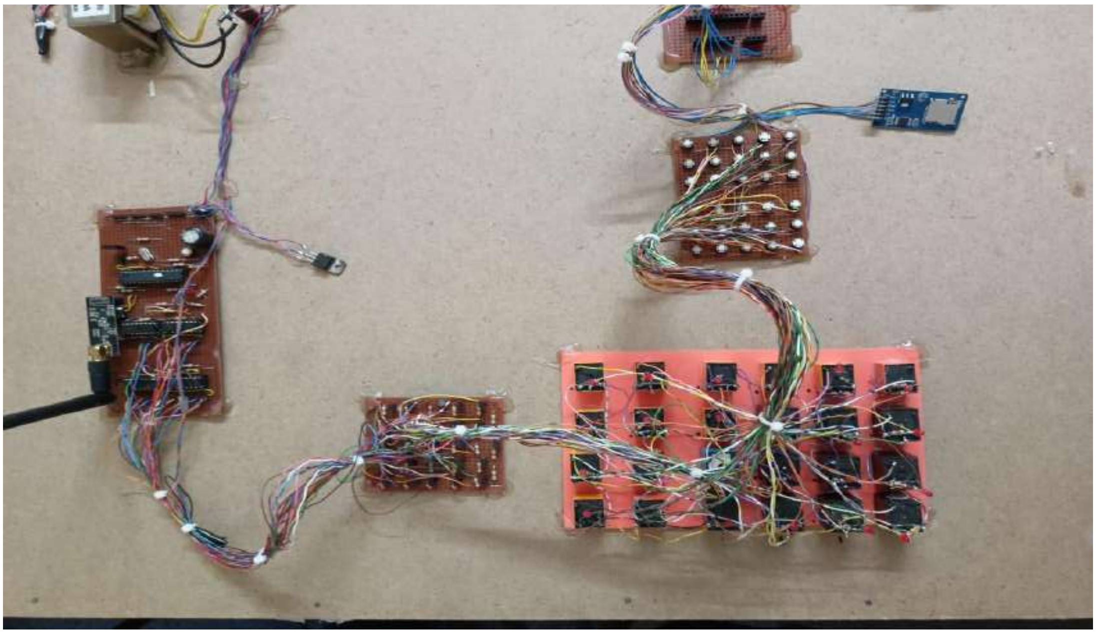


Fig. 5.9 Voice Command Control Circuit

5.4 Implementation Tools

We have implemented my hardware device & web server using some tools are given below,

5.4.1 Hardware

- Processor core i5
- 4GB RAM
- And other necessary hardware
- Arduino mega
- Necessary sensors

5.4.2 Software

- Operating system
  - Windows 10
- Programming Language
  - C/C++
  - HTML, CSS & Javascript
- IDE
  - Arduino IDE
  - Brackets (text editor)

5.5 Hardware Implementation

A hardware implementation is when a task is completed using a physical device or electrical circuit rather than a computer program. A hardware implementation takes longer to develop, which might increase the cost. It is typically quicker to operate and has the virtue of not being readily tampered with or reprogrammed once created. Embedded Internet of Things Hardware Design Challenges (IoT) The Inability to Run Applications on Embedded Systems Due to a Lack of Necessary Flexibility the Embedded System Design Security Crisis Embedded System Design with High Power Dissipation. Testing an Embedded System Design Issues.

5.6 Cost Analysis

Here, we look at our cost table, we see that, we focused at the main equipment price here. It is not so high. We were always careful to keep our costs within limits. The most expensive device in our project is nRF 24L01, and that's it 600 tk. And the least expensive device is temperature sensor, and it's price is 140 tk. The total cost of our project is 6190 tk. The below **Table 5.1** shows the Cost of these project equipment's.

Table 5.1 Cost Analysis

SL. No	Components Name	Price (BDT)
1	Arduino Nano	350/-
2	Wi-Fi module esp8266	600/-
3	Atmega328	260/-
4	Temperature Sensor	140/-
5	Gyro Sensor	480/-
6	nRF 24L01	1200/-
7	Max30100	600/-
8	Accelerometer	600/-
9	SD Card Module	260/-
10	Key Pad	150/-
11	LCD Display	300/-
12	Power Supply	250/-
	Others	1000/-
	Total	6190/-

5.7 Comparative Study

We have compared some of the previous work with our system, the most notable of which is “Health Monitoring Using Wireless Sensors And Gsm” and another work is “Patient Monitoring in Mobile Health”. If we compare our proposed system with these work, we will see many more difference. The below **Table 5.2** of Comparative Study of our proposed system. We show here, the difference between of our proposed system and related project of our proposed system.

Table 5.2 Comparative Study

Comparison	**Related Project**	**Proposed System**
Management System	More Management System are manually.	Our proposed system is totally automatically.
Quantity of patient	01 patient	02 patient
Monitoring & Controlling Section	Physically monitoring & Controlling system.	Server based monitoring & controlling.
Purpose of user	User Friendly	So much user friendly
Extra Features	ECG , Temperature measure are available.	We used patients fall system, saline level detection, Heart rate measure, Oxygen level etc.
Home Treatment Support	Maximum body check-up support aren't available	Maximum body check-up support are available

CHAPTER 06
CONCLUSION

6.1 Introduction

This is the report's last chapter. In this chapter, we'll talk about the project's completion. We'll also talk about the project's limitations, potential developments, applicability, and benefits.

6.2 Conclusion

In general, IoT-based health care platform which connects with smart sensors attach with human body for health monitoring for daily checkup. In this paper we discussed about IoT based patient monitoring system. The system technologies being used by smart phones or gadgets in present time where we also mentioned about advantages, challenges and opportunities. Due to the importance of observing medical patient & home elderly people, continuous remote monitoring is necessary. Our project work is giving the opportunity to monitor medical patient & elderly people continuously by using the web and apps service. This paper also compared the early aged medical system between present time health monitoring. The present time represents the time reducing, reduce health care cost especially for rural area people.

6.3 Application

- It can be installed in any medical Center.
- It can be installed in a patient's home.
- We can use it for regular body checkups.
- We can use the voice command system to talk to dumb people.
- We can use the voice command system to send messages without wire to remote areas.

6.4 Advantages

If Our Project is implemented, both the patient and the doctor will benefit greatly. Our Project has many advantages which are mentioned below:

- Enables Early Detection of patient problem.
- Enhanced Diagnosis and Prescriptions.

- Saves Time.
- Improved Communications patients & Doctor.
- Reduces Strains on the Available Facilities.
- Reduced Healthcare Delivery Costs.
- Increases Health care Access.
- Patient easily conversation with the family person via voice command system.

6.5 Limitation

There are advantages to each project, but there are also some disadvantages. Our project is not beyond that. Our proposed system also has some limitations, which are mentioned below:

- Security and privacy Heck
- Risk of failure
- Integration Problem
- Costly
- Internet Support
- The Complexity of the installation.
- It is difficult to find a solution by identifying the error.

6.6 Future Improvement

We monitor patient condition in our suggested system, particularly for elderly people at home and ICU or cardiac patients, but we will enhance both hardware and software elements in the future. We will measure the patient's blood pressure in the hardware section, which will need the use of a blood pressure sensor. We will use a Wi-Fi module to monitor the whole ward or patient room from afar. We'll also utilize the GSM module to get SMS alerts. We will improve the Website as well as the Apps in the software section. We will provide a user-friendly function on the website that will automatically display the patient's name, date, and time description in the ECG section. Continuous remote patient monitoring is critical due to the need of assessing the medical status of patients suffering from acute disorders, particularly cardiovascular diseases. The Internet of Things may provide you the tools you need to create complete services.

REFERENCE

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APPENDIX

(A) Health Monitoring Coding

```
#include <LiquidCrystal.h>
#include <Wire.h>
#include <Keypad.h>
#include "MAX30100_PulseOximeter.h"

#define DEBUG 0 // 1 for serial monitor, 0 for wifi

#define REPORTING_MS      1000
#define SERVER_UPDATE_MS 15000

const String link = "WEB=http://kitsware.com/projects/HealthMonitor/update_machine.php?";

#define buzz 2

LiquidCrystal lcd(9, 8, 7, 6, 5, 4);
PulseOximeter pox;

char hexaKeys[4][4] = {
  {'1', '2', '3', 'A'},
  {'4', '5', '6', 'B'},
  {'7', '8', '9', 'C'},
  {'*', '0', '#', 'D'}
};
byte rowPins[4] = {A3, A2, A1, A0};
byte colPins[4] = {13, 10, 11, 12};
Keypad key = Keypad( makeKeymap(hexaKeys), rowPins, colPins, 4, 4);

const int MPU_addr = 0x68;
int16_t AcX, AcY, AcZ;
int16_t GyX, GyY, GyZ, Tmp;
bool fall;
uint32_t tsLastReport = 0;
int bpm, spo2, temp, level;
long ct;
String sLevel = "LOW";

int alarm1, alarm2, alarm3, timer, ss, count, mm;
bool isAlarm = false;

void setup() {
  delay(1000);
  Serial.begin(9600);
  lcd.begin(16, 2);

  Wire.begin();
  Wire.beginTransmission(MPU_addr);
  Wire.write(0x6B);
  Wire.write(0);
  Wire.endTransmission(true);
  pox.begin();
```

```
  pinMode(buzz, OUTPUT);

  Serial.println("CON=iot,12345678,");
  ct = millis();
}

void loop() {
  level = analogRead(A6);
  fallDetector();
  pox.update();

  if (level < 300) sLevel = "LOW";
  else if (level > 580) sLevel = "HIGH";
  else sLevel = "MEDIUM";

  char k = key.getKey();
  if (k == 'A') setAlarm();

#if DEBUG == 0
  if (millis() - ct > SERVER_UPDATE_MS) {
    Serial.println((String)link
                   + "bpm1=" + bpm
                   + "&oxi1=" + spo2
                   + "&temp1=" + temp
                   + "&fall1=" + fall
                   + "&p1a1=" + alarm1
                   + "&p1a2=" + alarm2
                   + "&p1a3=" + alarm3
                   + "&slvl1=" + sLevel + "$");
//    Serial.println((String)link
//                   + "bpm2=" + bpm
//                   + "&oxi2=" + spo2
//                   + "&temp2=" + temp
//                   + "&fall2=" + fall
//                   + "&p2a1=" + alarm1
//                   + "&p2a2=" + alarm2
//                   + "&p2a3=" + alarm3
//                   + "&slvl2=" + sLevel + "$");
    ct = millis();
  }
#endif

  if (millis() - tsLastReport > REPORTING_MS) {
    bpm = pox.getHeartRate();
    spo2 = pox.getSpO2();
    readTemp();

    lcd.setCursor(0, 0);
    lcd.print((String)bpm + "BPM | OXI:" + spo2 + "%   ");
    lcd.setCursor(0, 1);
    fall ? lcd.print("FALL!") : lcd.print("IDLE.");
    lcd.setCursor(6, 1);
    lcd.print((String)temp + (char)223 + "F " + sLevel + "   ");

#if DEBUG == 1
```

```
    Serial.println((String)bpm + " BPM | OXI_LEVEL: " + spo2);
    fall ? Serial.println("FALL DETECT!") : Serial.println("IDLE.");
    Serial.println((String)temp + "dF | Level: " + level + "\n");
#endif

    if (isAlarm == true) {
      count = 0;
      ss++;
      if (ss == 60) {
        ss = 0;
        mm++;
      }

      if (alarm1 != 0 && mm == alarm1) {
        lcd.clear();
        lcd.setCursor(0, 0);
        lcd.print(">> ALARM 01");
        lcd.setCursor(0, 1);
        lcd.print("MORNING");
        beep(5000);
        alarm1 = 0;
      }
      if (alarm2 != 0 && mm == alarm2) {
        lcd.clear();
        lcd.setCursor(0, 0);
        lcd.print(">> ALARM 02");
        lcd.setCursor(0, 1);
        lcd.print("AFTERNOON");
        beep(5000);
        alarm2 = 0;
      }
      if (alarm3 != 0 && mm == alarm3) {
        lcd.clear();
        lcd.setCursor(0, 0);
        lcd.print(">> ALARM 03");
        lcd.setCursor(0, 1);
        lcd.print("NIGHT");
        beep(5000);
        alarm3 = 0;
      }
    }

    tsLastReport = millis();
  }
}

void setAlarm() {
  lcd.clear();
  lcd.setCursor(0, 0);
  lcd.print("A=Morning B=Noon");
  lcd.setCursor(0, 1);
  lcd.print("C=Night D=Exit");

  while (true) {
    char k = key.waitForKey();
```

```
String value = "";

if (k == 'D') break;
if (k == 'A') {
  lcd.clear();
  lcd.setCursor(0, 0);
  lcd.print("Enter [Min]:");

  value = "";
  while (k != '#') {
    k = key.waitForKey();
    if (k >= '0' && k <= '9') {
      value += k;
      lcd.setCursor(0, 1);
      lcd.print(value);
    }
  }
  alarm1 = value.toInt();
  lcd.setCursor(0, 1);
  lcd.print("D. Exit");
}
else if (k == 'B') {
  lcd.clear();
  lcd.setCursor(0, 0);
  lcd.print("Enter [Min]:");

  value = "";
  while (k != '#') {
    k = key.waitForKey();
    if (k >= '0' && k <= '9') {
      value += k;
      lcd.setCursor(0, 1);
      lcd.print(value);
    }
  }
  alarm2 = value.toInt();
  lcd.setCursor(0, 30);
  lcd.print("D. Exit");
}
else if (k == 'C') {
  lcd.clear();
  lcd.setCursor(0, 0);
  lcd.print("Enter [Min]:");

  value = "";
  while (k != '#') {
    k = key.waitForKey();
    if (k >= '0' && k <= '9') {
      value += k;
      lcd.setCursor(0, 1);
      lcd.print(value);
      lcd.display();
    }
  }
  alarm3 = value.toInt();
```

```
    lcd.setCursor(0, 1);
    lcd.print("D. Exit");
   }
  }
  if (alarm1 == 0 && alarm2 == 0 && alarm3 == 0) isAlarm = false;
  else isAlarm = true;
  lcd.clear();
}

void readTemp() {
  float c1 = 1.009249522e-03, c2 = 2.378405444e-04, c3 = 2.019202697e-07;
  int Vo = analogRead(A7);
  float R2 = 10000 * (1023.0 / (float)Vo - 1.0);
  float logR2 = log(R2);
  float T = (1.0 / (c1 + c2 * logR2 + c3 * logR2 * logR2 * logR2));
  T = T - 273.15;
  temp = ((T * 9.0) / 5.0 + 32.0) + 0; // change 0 if needed
}

void fallDetector() {
  Wire.beginTransmission(MPU_addr);
  Wire.write(0x3B);
  Wire.endTransmission(false);
  Wire.requestFrom(MPU_addr, 14, true);
  AcX = Wire.read() << 8 | Wire.read();
  AcY = Wire.read() << 8 | Wire.read();
  AcZ = Wire.read() << 8 | Wire.read();
  Tmp = Wire.read() << 8 | Wire.read();
  GyX = Wire.read() << 8 | Wire.read();
  GyY = Wire.read() << 8 | Wire.read();
  GyZ = Wire.read() << 8 | Wire.read();
  Wire.endTransmission(true);

  GyX = map(AcX, -32768, 32767, -90, 90);
  GyY = map(AcY, -32768, 32767, -90, 90);
  GyZ = map(AcZ, -32768, 32767, -90, 90);

  if (GyZ < -10) fall = 1;
  else fall = 0;
  //Serial.println((String)"X:" + GyX + "  Y:" + GyY + + "  Z:" + GyZ);
}

void beep(int d) {
  digitalWrite(buzz, 1);
  delay(d);
  digitalWrite(buzz, 0);
}
```

(B) Transmitter Section Coding

```
#include <SPI.h>
#include <nRF24L01.h>
#include <RF24.h>

#define butt1 2
#define butt2 3
#define butt3 4
#define butt4 5
#define butt5 6
#define butt6 7
#define butt7 8
#define butt8 A5

RF24 radio(9, 10);
const byte addresses [][6] = {"TRANS", "RECIV"};

char cmd[2];

void setup() {
  Serial.begin(9600);
  radio.begin();
  radio.openWritingPipe(addresses[1]);
  radio.openReadingPipe(1, addresses[0]);
  radio.setPALevel(RF24_PA_MIN);
  radio.stopListening();

  pinMode(butt1, INPUT_PULLUP);
  pinMode(butt2, INPUT_PULLUP);
  pinMode(butt3, INPUT_PULLUP);
  pinMode(butt4, INPUT_PULLUP);
  pinMode(butt5, INPUT_PULLUP);
  pinMode(butt6, INPUT_PULLUP);
  pinMode(butt7, INPUT_PULLUP);
  pinMode(butt8, INPUT_PULLUP);
}

void loop() {
  byte b1 = getButton();
  if (b1 != 0) {
    cmd[0] = (b1 / 10) + 48;
    cmd[1] = (b1 % 10) + 48;
    //Serial.println(cmd);
    radio.write(cmd, 2);
    delay(300);
  }

  if (!digitalRead(butt1)) {
    cmd[0] = 'C';
    cmd[1] = '1';
    radio.write(cmd, 2);
    delay(300);
  }
```

```
  if (!digitalRead(butt2)) {
    cmd[0] = 'C';
    cmd[1] = '2';
    radio.write(cmd, 2);
    delay(300);
  }

  if (!digitalRead(butt3)) {
    cmd[0] = 'C';
    cmd[1] = '3';
    radio.write(cmd, 2);
    delay(300);
  }

  if (!digitalRead(butt4)) {
    cmd[0] = 'C';
    cmd[1] = '4';
    radio.write(cmd, 2);
    delay(300);
  }

  if (!digitalRead(butt5)) {
    cmd[0] = 'C';
    cmd[1] = '5';
    radio.write(cmd, 2);
    delay(300);
  }

  if (!digitalRead(butt6)) {
    cmd[0] = 'C';
    cmd[1] = '6';
    radio.write(cmd, 2);
    delay(300);
  }

  if (!digitalRead(butt7)) {
    cmd[0] = 'C';
    cmd[1] = '7';
    radio.write(cmd, 2);
    delay(300);
  }

  if (!digitalRead(butt8)) {
    cmd[0] = 'C';
    cmd[1] = '8';
    radio.write(cmd, 2);
    delay(300);
  }
}

byte getButton() {
  byte key = 0;
  int adc = analogRead(A3);
  //Serial.println(adc);
  switch (adc) {
```

```
  case 220 ... 270:
    key = 1; break;
  case 390 ... 445:
    key = 2; break;
  case 500 ... 545:
    key = 3; break;
  case 590 ... 630:
    key = 4; break;
  case 680 ... 715:
    key = 5; break;
  case 720 ... 750:
    key = 6; break;
  case 790 ... 825:
    key = 7; break;
  case 830 ... 860:
    key = 8; break;
}

adc = analogRead(A2);
//Serial.println(adc);
switch (adc) {
  case 220 ... 270:
    key = 9; break;
  case 390 ... 445:
    key = 10; break;
  case 500 ... 545:
    key = 11; break;
  case 590 ... 630:
    key = 12; break;
  case 680 ... 715:
    key = 13; break;
  case 720 ... 750:
    key = 14; break;
  case 790 ... 825:
    key = 15; break;
  case 830 ... 860:
    key = 16; break;
}

adc = analogRead(A1);
//Serial.println(adc);
switch (adc) {
  case 220 ... 270:
    key = 17; break;
  case 390 ... 445:
    key = 18; break;
  case 500 ... 545:
    key = 19; break;
  case 590 ... 630:
    key = 20; break;
  case 680 ... 715:
    key = 21; break;
  case 720 ... 750:
    key = 22; break;
  case 790 ... 825:
```

```
    key = 23; break;
  case 830 ... 860:
    key = 24; break;
 }

 adc = analogRead(A0);
 //Serial.println(adc);
 switch (adc) {
  case 220 ... 270:
    key = 25; break;
  case 390 ... 445:
    key = 26; break;
  case 500 ... 545:
    key = 27; break;
  case 590 ... 630:
    key = 28; break;
  case 680 ... 715:
    key = 29; break;
  case 720 ... 750:
    key = 30; break;
  case 790 ... 825:
    key = 31; break;
  case 830 ... 860:
    key = 32; break;
 }
 return key;
}
```

(C) Receiver Section Coding:

```
#include <SPI.h>
#include <nRF24L01.h>
#include <RF24.h>

#define LED A0
#define ds 6
#define sh 8
#define st 7

RF24 radio(9, 10);
const byte addresses [][6] = {"TRANS", "RECIV"};
unsigned long led = 0;

void setup() {
 Serial.begin(9600);
 radio.begin();
 radio.openWritingPipe(addresses[0]);
 radio.openReadingPipe(1, addresses[1]);
 radio.setPALevel(RF24_PA_MIN);
 radio.startListening();

 pinMode(LED, OUTPUT);
 pinMode(ds, OUTPUT);
 pinMode(sh, OUTPUT);
```

```
  pinMode(st, OUTPUT);

  output(led);
}

void loop() {
  nRFCheck();
}

void nRFCheck() {
  if (radio.available()) {
    digitalWrite(LED, 1);
    while (radio.available()) {
      char b1[2];
      radio.read(&b1, 2);
      Serial.println(b1);


        byte tmp = ((b1[0] - 48) * 10) + (b1[1] - 48);
        bitRead(led, tmp - 1) == 0 ? bitWrite(led, tmp - 1, 1) : bitWrite(led, tmp - 1, 0);
        output(led);
      }
    }
    digitalWrite(LED, 0);
  }
}



void output(unsigned long val) {
  for (int i = 0; i < TOTAL_OUTPUT; i++) {
    digitalWrite(ds, bitRead(val, i));
    digitalWrite(sh, 1);
    digitalWrite(sh, 0);
  }
  digitalWrite(st, 1);
  digitalWrite(st, 0);
}

void output(int pin, bool state) {
  static long val;
  bitWrite(val, TOTAL_OUTPUT - (pin - 1), state);
  for (int i = 0; i < TOTAL_OUTPUT; i++) {
    digitalWrite(ds, bitRead(val, i));
    digitalWrite(sh, 1);
    digitalWrite(sh, 0);
  }
  digitalWrite(st, 1);
  digitalWrite(st, 0);
}
```