

**BACHELOR OF SCIENCE IN ELECTRONIC &  
TELECOMMUNICATION ENGINEERING**

**Design and Implementation of A Voice Message Based  
Medicine Reminder Box Using IoT**

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February-2024

## **CERTIFICATE OF APPROVAL**

The project entitled “Design and Implementation of A Voice Message Based Medicine Reminder Box Using IoT” was submitted Sakib Uddin Kowser, Matric ID: T191020 respectively of session Autumn 18, to the Department of Electronic and telecommunication Engineering, International Islamic University Chittagong, has been accepted as satisfactory in partial fulfillment of the requirements for the degree of Bachelor of Science in Engineering and approved for the examination held on 15<sup>th</sup> March 2024.

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## **DECLARATION OF CANDIDATE**

It is hereby declared that the work presented in this project or any part of this project has not been submitted elsewhere for the award of any degree or diploma, does not contain any unlawful statement.

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## **DEDICATION**

This effort honors our adored Parents and Teachers.

Sakib Uddin Kowser

## ACKNOWLEDGMENT

We are incredibly grateful to Allah, the Almighty, the Most Benevolent, and the Most Merciful, for enabling us to complete this task. We owe many people for their support in helping us to complete this task. It gives us great pleasure to convey our sincere gratitude to our supervisor, mentor, and supervisor **Mohammad Woli Ullah**, Assistant Professor, Department of Electronic and telecommunication Engineering, IIUC. He has been solely and mostly responsible for completing our work due to his dedication, keen attention to detail, and above all his unwavering desire to support his pupils. His rapid advice, careful analysis, intellectual counsel, and scientific methodology have all been very helpful to us in finishing this project. We are appreciative of our parents and our classmates' passionate encouragement in fostering our enthusiasm and interest in this subject. We made every effort to accomplish our goal with this project. Many people have contributed to our project in the early stages as we were gathering information about it. We want to express our appreciation and sincere thanks to each of them.

Authors

## **ABSTRACT**

The main objective of this research is to develop a smart medicine box to remind and IoT is being used for health monitoring of elderly patients or hospital patients to ensure they are taking their prescribed medication at the right time and to examine their overall health. The medicine reminder box is designed such as reminder the medicine taking time and medicine name which is their medicine prescribe at prescription. This system characterizes some functionalities like safety and good functioning of the system and security. We used Arduino Nano, SD Card Module, SD Card, Push Switch, LED, Relay Switching Circuit, switch mode power supply (SMPS), Wi-Fi Module, Temperature Sensor, Pulse Sensor, Accelerometer (Gyro Sensor), etc. The consequent can manually adjust the time for taking medications or load a text file containing the times for each compartment's medications onto an SD card. The time can be read from the device's real-time clock. When the time matches the predetermined time, the device produces a sound through the speaker to alert the user of the quantity of medicine and blinks the LED of the specific compartment where the medication is stored for that time. The device also tells the patient condition to take the medication before or after eating. The system will trade the readings from the sensor to the cloud remotely and the records accrued may be handy for evaluation regularly. It has the potential of studying and transmitting emergency symptoms and symptoms to the cloud after which to the doctor's net portal or to the Doctor's Smartphone. These readings may be applied to apprehend the fitness kingdom of the affected person and as an alert machine towards the emergency fitness situation. The gadget can ensure the safety of pharmaceuticals, the right dosage for prescriptions, and the prevention of elder drug addiction.

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## LIST OF ABBREVIATIONS

DMAS	=	Disease Management Assistance System
CARDS	=	Computerized Automated Reminder Diabetes System
IoT	=	Internet of Things
P2P	=	Pear to Pear
WebRTC	=	Web Real-Time Communication
WHO	=	World Health Organaization
RTC	=	Real Time Clock
LCD	=	Liquid Crystal Display
GPL	=	General Public License
AC	=	Alternating Current
DC	=	Direct Current
LGPL	=	Lesser General Public License
IDI	=	Interaction Develop Institute
kb	=	kilobyte
MMC	=	Multi Media Cards
DMP	=	Digital Motion Processor

# **Chapter 01**

## **Introduction**

### **1.1 Introduction**

Patient safety is a cornerstone of healthcare and is acknowledged as a significant and expanding worldwide public health concern.. This idea is also mentioned in the constitution of the People's Republic of Bangladesh, which states that the State shall provide all citizens with basic healthcare services. The concept was reaffirmed in the National Health Policy in 2011, with the three specific goals of ensuring primary and emergency healthcare for everyone, enhancing equal quality healthcare and accessibility, and encouraging preventative healthcare services.

WHO has been providing support to the Government of Bangladesh in prioritizing patient safety actions through the review and launch of the Global Patient Safety Action Plan 2021–2030, and in improving the health services delivery in the country through several initiatives, including the development of the Bangladesh National Health Care Quality Strategy of the Ministry of Health and Family Welfare. WHO has also supported the launch of the health facilities assessment, an important initiative for the health sector development at the national level, providing the technical guidelines for improving the quality of patient care at three levels of health services, such as hospitals affiliated with medical colleges, community hospitals, and upazila health centers. The latest assessments of health facilities, run in 2017, 2018 and 2019, evaluated over 510 health facilities that offer outpatient and inpatient services in preventive, diagnostic and curative areas. The results, which showed a significant performance improvement, are publicly accessible through an online real-time dashboard, which offers data, indicators and guidance to healthcare providers and policymakers [1].

People frequently forget the basics of daily living due to the quantity of labor that needs to be done by each individual, as well as because of aging and various ailments. If the patient has a disease that requires them to take their medications at the proper time, the technology of the home health care system, including a medication reminder system and certain enhancements regarding authentication, has been reviewed in this paper. In order to diagnose, treat, and monitor patients without compromising their quality of life, home health care arrangements often make use

of transportations, tomography, detecting, and human computer interface (HCI) technology.

It is possible to develop a low-cost medical sensing, communication, and analytics solution that uses the internet to track patients' physical conditions in real time. Due to the real-time scheduling of patients, hospitals, caregivers, and doctors as well as the protected data transmission from source point to destination, the architecture of a low cost embedded platform is essential for improved monitoring.

It is feasible to build a low-cost medical sensing, communication, and analytics system that uses the internet to track patients' physical conditions in real time. Due to the real-time scheduling of patients, hospitals, caregivers, and doctors as well as the secure data transmission from source point to destination, the architecture of a low cost embedded platform is essential for improved monitoring.

Using mobile voice technology, medical personnel can quickly update and access patient records from any place that is serviced by a telephone network. This ensures that the patients' medical records are always current. Doctors will certainly select better prescriptions with the use of modern knowledge. Voice-based apps may replace needless paper work, allowing for more effective and efficient patient care delivery. Numerous initiatives have developed drug adherence strategies using the features of mobile technology. Mobile MedAlert, a mobile medical aware structure that sends SMS messages to patients to remind them to take their meds, is one of these programs. The WelTel Kenyan project is a randomized trial that uses text messaging on mobile (cell) phones to progress patients' compliance with antiretroviral medication [2].

A programmable electronic gadget called the Disease Management Assistance System (DMAS) gives spoken reminders at dosage times. Diabetes can be treated with the use of the Computerized Automated Reminder Diabetes System (CARDS), which delivers email and SMS text message reminders. SMS texts are used in Norway to contact parents of children with Type 1 diabetes. These messages included definitions, information, and tips for controlling diabetes. SMS message campaigns have been used to raise awareness of HIV/AIDS in India, South Africa, and Uganda. The locations of the counseling, diagnostic, and therapeutic facilities have also been disclosed to them. SMS is also used to disseminate information on

communicable illnesses and reproductive health.

Project Masilukeke in South Africa uses the 120 extra characters on free "please call me" SMS texts to raise HIV/AIDS awareness and education. In Norway, SMS texts are used to communicate with parents of children who have Type 1 diabetes. Definitions, facts, and suggestions for managing diabetes were presented in these messages. The Text to Change (South Africa) project uses an SMS-based questionnaire to determine user knowledge of HIV/AIDS and to advocate for testing and counseling.

Other programs include employing text messages to urge elder African Americans to walk, TRICKs (Text Reminders for immunization Compliance in Kids), which texts reminders about immunization dates, Mobile devices are used by Text4baby, the first free national health text message service in the United States, to track oral antibiotic use and give feedback on adherence to patients who have been discharged from the ER. Low-income urban residents' usage of text messaging to spread flu vaccine information. In addition, studies have been conducted to gauge the effectiveness of electronic reminders, SMS, and phone calls in improving patient adherence.

Medication management is a medical treatment system that monitors the medication therapy of a patient to confirm that the patient is complying with a medication regimen. It also ensures that the patient is avoiding potentially dangerous drug interactions and other complications. This is important for patients taking large numbers of medications to address chronic illnesses and multiple diseases. Taking numerous medications is known as polypharmacy and it is particularly common among older adults, as they are more likely to need medications to manage an array of chronic conditions. There are a number of principles to medication management, all of which are focused on making sure that medications are used appropriately and keeping track of all of the medications currently in use by patients. This can include creating printed lists describing medications, their doses, and how they are being used. These lists can be kept in patient charts and provided to patients to help them track the drugs they use and understand why various medications are being prescribed [1]. Monitoring medication administration is also an important key. Medications

usually need to be taken in specific doses at set intervals. Missing doses or timing doses incorrectly can cause complications. Medication management can include everything from using devices that issue reminders to patients to take their medications to filling pill cases for patients and marking the lid of each compartment to indicate when the contents need to be taken.

Another part of medication management involves checking for harmful drug interactions and confirming that patients follow directions for taking drugs. This includes ensuring that patients on medications with known harmful interactions are not provided with prescriptions for conflicting medications. It also includes reminding patients about whether or not drugs need to be taken with food, and warning patients about potential side effects of medications such as fatigue, hunger, or altered level of consciousness that might disrupt their activities. The five rights of medication administration should be applied for each patient/service user encounter: Right medication, patient/service-user, dosage, form, time [2]. These principles are described as follows:

- The right medication which focus on matching the medication order against the label of the dispensed medication, being aware of look-alike and similar sounding medications and using generic names of medications whenever possible. \
- The right patient which focus on identifying the individual who is receiving the medication, checking the medical record number (or identification band), asking the patient his name, identifying the name and age of the patient to ensure the correct identity and maintaining a photo of the individual on the medication administration record.
- The right dosage which focus on verifying that the dosage is appropriate based on age, size, patient's signs and measuring the dose, when it is necessary, using an appropriate equipment.
- The right form which focus on applying the correct registration form, assessment and administration process of the medication.
- The right time which focus on ensuring the correct timing, frequency and duration of the prescribed order and documenting accurately medication administration times.

The evolution of Internet of Things (IoT) technology has transformed several industries, including healthcare. Health monitoring systems based on IoT have emerged as a viable solution for efficient and tailored patient care. Sensors, data connectivity, and machine learning algorithms are used in these systems to continually monitor patients' vital signs and discover anomalies in real time [1,2]. These systems can provide accurate predictions and assist healthcare workers in giving appropriate interventions by employing machine learning techniques such as support vector machines (SVMs) [3,4]. The purpose of this research paper is to investigate the use of IoT-based health monitoring systems, machine learning, anomaly detection, and SVMs in enhancing patient care and developing healthcare technology. The use of IoT in health monitoring has received a lot of interest in recent years [5,6]. Wearable sensors and connected medical equipment, for example, offer continuous monitoring of patients' vital signs such as heart rate, blood pressure, temperature, and ECG data. These gadgets collect real-time data that can be wirelessly communicated to healthcare personnel, allowing for remote monitoring and prompt intervention [1,7]. The incorporation of IoT technology into health.

Monitoring systems enhances patient care by allowing for the early detection of health conditions, lowering hospital readmissions, and increasing patient engagement in their own healthcare [2]. In healthcare, machine learning has emerged as a strong tool for evaluating complicated and large-scale datasets. Machine learning algorithms can learn patterns, generate predictions, and aid in clinical decision-making by being trained on past patient data [8,9]. Machine learning algorithms can examine sensor data in the context of health monitoring systems to discover abnormal patterns and forecast patient health outcomes. Algorithms for classification, regression, and grouping offer individualized patient care and illness management [2,10]. Anomaly detection is critical in health monitoring systems because it allows for the discovery of anomalous patterns or deviations from expected patient health status [2,11]. Anomalies might suggest prospective health risks or urgent occurrences that must be addressed immediately. Machine learning techniques, such as SVMs, are commonly employed in health monitoring for anomaly detection. These algorithms learn from typical patterns and identify new observations as normal or abnormal based on how they differ from the

taught patterns. Techniques for detecting anomalies increase patient safety, allow for early intervention, and improve overall healthcare outcomes [12–14].

SVM is a well-known machine learning technique for classification and regression. SVMs handle high-dimensional data well and can capture complex correlations between input variables. SVMs have been used successfully in healthcare applications for a variety of tasks such as disease diagnosis, risk prediction, and anomaly identification [15,16].

## **1.2 Background**

Recently, several IoT solutions for health monitoring systems have been developed. An IoT system for medical equipment was developed by Wang et al. that was compatible with a wide range of connection protocols.

A resource-based technique to data retrieval (UDA-IoT) was presented by Xu et al. for large-data-required health-related claims. A smart box is a medical device that combines Internet of Things (IoT) and peer-to-peer (P2P) technology to provide patients control. Kolic and colleagues came up with a method for contrasting test outcomes in various settings. Sundholm et al. created Web Real-Time Communication (WebRTC), which focuses on the efficient and safe broadcast of data from several concurrent streams [2].

A real-time IoT healthcare application was demonstrated using a distributed flow model. Data will be stored locally on the server and sent later if the subject of the monitoring moves out of range. An Internet-of-things gadget called a Galileo board has an integrated medical platform that evaluates ECGs and employs algorithms to track cardiac activity [3].

## **1.3 Motivation**

Patients in Bangladesh lose many lives each day as a result of receiving inadequate and delayed medical care. Clinics now do not measure true model parameters as effectively as hospitals do. This is when our method comes in handy. Among other things, our system is made to recall a patient's medication administration schedule by audio message. With this technique, elderly folks can effortlessly take their medications.[4]

## 1.4 Objectives

- To design & implementation of an Voice Based Automated Medicine Reminder Box with IoT Health Monitoring for Old People and Hospital.
- To shows the medicine taking time, real-time, and date at LCD and blinking the LED.
- To voice message using an SD card and speaker for a reminder the taking medicine at the prescribed time.
- To monitor the oxygen, body temperature, pulse condition. Those data update at webserver using IoT technology, so reduce the cost of regular checkup.

## 1.5 Report Outline

The planning and execution of this project have encompassed six chapters. Following is a list of the chapters and their content:

- **Chapter 1** (Introduction): This chapter outlines the project's goals, motivation, and purpose.
- **Chapter 2** This chapter examined earlier research or work that was connected to this project (literature review).
- **Chapter 3** (System Design): This chapter includes a detailed discussion of the project's components.
- **Chapter 4** (Design Methodology): The experimental setup for this project is covered in this section.
- **Chapter 5** (Implementation and Results): Talk about the project's performance and how it was carried out.
- **Chapter 6** (Conclusion): In this Chapter, the project's outline is more thoroughly discussed. There is discussion of the project's advantage, benefit, and potential future work.

## **Chapter 02**

### **LITERATURE REVIEW**

#### **2.1 Introduction**

In Bangladesh, comprehensive patient safety also needs to address severe acute malnutrition (SAM), a life-threatening condition and one of the most common causes of morbidity and mortality that particularly affects children under 5 years. Many severely malnourished children die at home without care, an emergency that needs prompt intervention, and proper management following standard guidelines. To facilitate the use of the National SAM Guideline by medical professionals, in 2021, WHO assisted the National Nutrition Services in developing a pocket guideline for SAM treatment [3].

Nutrition is an essential human need, and therefore it requires particular focus in the effort to ensure patient safety. A proper nutrition management is essential to enhance the immune response in a person suffering from a viral infection, as poor or inadequate nutrition can weaken the immune system. Once again, COVID-19 pandemic has shown how important appropriate nutrition and dietetic interventions are in the response and recovery processes. In 2020, the National Nutrition Services, technically supported by WHO, have developed the Nutritional Management guidelines to treat COVID-19 patients.

Patient safety is at the very core of Universal Health Coverage. WHO remains committed to supporting the Government of Bangladesh in ensuring quality healthcare services and implementing evidence-based preventive measures to secure the health, social, and economic well-being of Bangladesh's present and future generations.

#### **2.2 Discussion of Related Paper**

**[4] Shubha Majumder; Muhammad Asad Rahman; Md. Sajedul Islam; Diponkar Ghosh “Design and Implementation of a Wireless Health Monitoring System for Remotely Located Patients”**

Remote health monitoring is regarded as a hot topic in the arena of research. Though the number of aged people is increasing, it is irrefutable that the need of a disperse

medical care system providing remote monitoring intending to reduce the escalating healthcare expenditure is very urgent. Moreover, World Health organization reported, in Bangladesh, about 17% of deaths are caused by cardiovascular diseases. Continual health monitoring and rapid detection can save up to 60% of lives. For these reasons, a wireless, wearable, low cost and automatic health monitoring system is a suitable solution. The implemented project described in this paper is a user-friendly, wearable and continuous monitoring system of blood pressure, heart rate, and body temperature, which can communicate with requested Android devices through Bluetooth. The system mainly consists of IR transmitter, receiver, LM-35, MPXV 5050GP, the data acquisition unit, microcontroller (i.e., Arduino) and Bluetooth. Bluetooth is used for its better transmission rate than ZigBee and cost-efficiency than GSM. In addition, all the measured readings and communications are password protected. A free and user-friendly Android application is attributed to demonstrate the readings. The proposed system has been field tested to ensure dependability and exactitude. The test results showed that this system could measure the patient's physiological data with high accuracy. The system can be easily segregated from the previous works for its maximum number of data collection, real-time monitoring, security issues and cost-effectiveness.

Several medical treatment systems have been built using different approaches and platforms. With the growing popularity of remote healthcare and medical apps, a lot of researches in these fields have been evolved. As part of that, several medication reminder systems have been introduced. In [3], the researchers proposed a prototype of an in-home medication management and healthcare system based on intelligent and interactive packaging and intelligent medicine box. Similar system is proposed in [4], where a medicine reminder app that manages prescription schedules and alerts for reminding patients about the type and time of the medication according to the prescribed medicine schedule. A typical design for smart medicine box introduced in [5] where a time table of prescribed medicines through push buttons as given in prescription. Another medication reminder system in [6] is proposed where it transmits open mobile alliance (OMA) data synchronization (DS) based messages which contain the patient's prescription and the device data to a remote medical staff. While in [7] researchers proposed an intelligent home monitoring system using ZigBee

wireless sensors network that monitors the elderly who are living alone.

We used the Medication management concept to propose a medication reminder system where pharmacists or patients can set the schedule time and the number of pills of up to eight medical doses. Based on an RTC (Real Time Clock) interfaced to the microcontroller, the programmed time and number of pills for a medicine is displayed on the LCD along with a buzzer sound to alert the patient about taking the appropriate medicine. If patient doesn't press done button, he will receive a reminder about the medicine he has to take via SMS on his/her cell phone, by using GSM modem.

Ilkko et al proposed UbiPILL A Medicine dose controllers for ubiquitous health environments and wireless sensor networks have enhanced people's quality of life by providing security, information, and comfort. Here, we've discussed a focused home server with three essential features: serving as a data gateway for surrounding systems, using current Interfaces on registered systems for remote monitoring and control, and The ubipill device was developed to properly track the activity of the medication box via a web browser. It was first launched as a reminder to take care of the elderly and for monitoring purposes [3].

Kliem et al proposed the telemedicine idea is a low-cost, location-independent monitoring system that pays attention to security and privacy issues while enabling the transfer of appropriate, secure medical data across various devices. In mobility-aware eHealth environments, networked medical device security and communication architecture. Network integration and data transmission from domains such as hospitals, ambulances, medical offices, and patient homes—each of which may parallel a different authority—are required in emergency situations. In addition to providing out-of-the-box integration and authentication for medical devices, mobility aware techniques also meet the standard security and privacy demands of e-health environments.

Parida et al proposed RFID Technology Application for Internal Drug Management System: Drug management systems that track both emergency and regular medications, whether or whether they are RFID-tagged, have been developed using RFID-based technology. The user is assigned by the HF tag, and they are tracked with the use of an RFID reader, camera, and web-based system. For elderly, illiterate

people, this method may be beneficial [4].

Hamida et al proposed drug management system using RFID technology: RFID-based technology has been used to create drug management systems that track both emergency and routine medications, whether or not they are RFID-tagged. The HF tag identifies the user, and they are followed using an RFID reader, camera, and web-based system. This approach might be useful for elderly, illiterate folks.

Ray et al proposed H3IoT: Internet of Things for Home Health Due to heterogeneity and interoperability, the idea of digitalization in healthcare is underutilized. The architecture framework for the human health hub, which has the intention of being used for actual implementation, is the topic of this article. Health is a crucial aspect of life, and it is important to prioritize health-related issues. The Internet of Things (IoT) can help with this by utilizing a variety of devices, however the concept of digitalization for health care is underutilized owing to heterogeneity and interoperability.

Shivakumar et al proposed the The design of the vital sign monitor is based on telemedicine and wireless sensor networks. The vital sign monitor can be implemented using Bluetooth technology and include a sensor, while the transmitter will be an application-oriented smart phone with 3G wi-fi-based transmission. In an emergency, a remote expert can access the transmitter's data, which will be uploaded to the cloud for centralized monitoring, to receive all patient information and take the appropriate action.

**[5] Evangelin Sonia SV, Pushpalatha A, Mahendran G and Sivarajan S, “Development and Implementation of an Intelligent Health Monitoring System using IoT and Advanced Machine Learning Techniques”**

Healthcare practices have a tremendous amount of potential to change as a result of the convergence of IoT technologies with cutting-edge machine learning. This study offers an IoT-connected sensor-based Intelligent Health Monitoring System for real-time patient health assessment. Our system offers continuous health monitoring and early anomaly identification by integrating temperature, blood pressure, and ECG sensors. The Support Vector Machine (SVM) model proves to be a reliable predictor after thorough analysis, obtaining astounding accuracy rates of 94% for specificity,

95% for the F1 score, 92% for recall, and 94% for total accuracy. These outcomes demonstrate how well our system performs when it comes to providing precise and timely health predictions. Healthcare facilities can easily integrate our Intelligent Health Monitoring System as part of the practical application of our research. Real-time sensor data can be used by doctors to proactively spot health issues and provide prompt interventions, improving the quality of patient care. This study's integration of advanced machine learning and IoT underlines the strategy's disruptive potential for transforming healthcare procedures. This study provides the foundation for a more effective, responsive, and patient-centered healthcare ecosystem by employing the potential of connected devices and predictive analytics [5].

The sensor readings are kept in the cloud to enable data accessibility and scalability. The data is sent by the system to a cloud-based storage platform via Wi-Fi connection. The flexibility to accept massive amounts of data and remote access by authorized healthcare personnel are only two benefits of data storage in the cloud. The technology offers real-time monitoring of the patient's health state and promotes long-term data analysis by using cloud storage. The patient's health is then evaluated using a variety of machine learning techniques once the sensor data has been saved. In this study, machine learning methods such as decision trees, support vector machines, neural networks, and random forests are often used. To develop models that can forecast and spot trends or abnormalities in the patient's health data, these algorithms are trained using past sensor data. Healthcare providers may make wise selections and administer suitable medical therapies thanks to the analysis findings' insightful information about the patient's health situation [5].

Wireless systems, internet access, and communication are superior to wired ones in a number of ways, including easier installation, reduced prices, and increased mobility.

When compared to traditional communication methods, wireless communication lowers the cost of establishing wires, cables, and other infrastructure. This is an expensive and time-consuming project since digging must be done to install wires and connect them across the street. Drilling holes for wiring is a pointless way to compromise the historical significance and integrity of an old building. Mobility As said before, the primary benefit of a wireless communication system is its portability.

We may travel about freely and maintain an internet connection in this way. We reviewed several reports similar to our project. Some of the findings of the review are that most of the papers separated health monitoring and medicine reminders. Systemized projects for health monitoring do not have the facility of medicine reminders, and medicine reminder systems do not have health monitoring. A few reports have emerged that they have used RFID technology for the management of built-in systems, using RFID tags for timely medication of elderly and illiterate people. Home Health Hub Internet of Things (H3IoT) for health monitoring that is experimental estimation of communication and security protocols. This system also Interoperability and diversity The architecture foundation for the human health hub is given the best attention in this article, which highlights the ignored concept of digitization for health care. After reviewing some reports, we noticed that it uses Bluetooth technology which is 3G wi-fi based data transmission.

We have brought our system up to date by reviewing many reports. We have designed the health checkup section and medicine taking time together for complete health monitoring of a patient through our system. In order to make medicine taking time easy and modern, our system will tell you when to take the medicine through voice message, if patient don't take the medicine on time, then you will tell the authorities through message. We have designed online and offline monitoring to modernize health monitoring to ensure a patient's health care, through which a patient's health information can be known directly and easily from anywhere in the world.

**[6] Santhosh Surya Kiran Kolluri, Ankur Mukherjee, Ananiah Durai Durai Sundararajan, “Design and Implementation of Wearable Patient Health Monitoring System Using WBAN and IoT”**

A remote patient health monitoring system using Wireless Body Area Network (WBAN) has been proposed to detect sudden possible falls in elderly people, acquire body temperature and ECG (Electrocardiogram) via wireless sensor nodes viz an accelerometer, a temperature sensor, and 3 bipolar limb leads. These nodes carry information to a coordination node with the freedom of unconstrained movement, by allowing the nodes to interact with the host node seamlessly. Leads 2 and 3 gives an inferior view of the heart to detect a probable heart attack or MI that might occur

in the inferior region. Dynamic Time Warping (DTW) has been employed in this work for the detection of ST elevation, T inversion, and deep Q on lead 2 data. Atrial fibrillation, the most common kind of arrhythmia, is anticipated from the acquired lead 2 data using the standard deviation parameter. The 3 lead ECG report is then forwarded to the doctor via email for remote monitoring and diagnostic purposes.

[7] Shayla Sharmin, Md. Ibrahim Khulil Ullah Ratan, and Ashraful Haque Piash, “An Automated and Online-Based Medicine Reminder and Dispenser”, January 2022, DOI:10.1007/978-981-16-6636-0\_39, In book: Proceedings of the International Conference on Big Data, IoT, and Machine Learning (pp.513-524)

Patients, on the other hand, often fail to take their medications at the times specified in their prescriptions, causing disease or illness to develop more slowly, especially in the elderly or those who are too preoccupied with their job. An automated and online-based medicine reminder and dispenser application is introduced in this paper. A three-part package, an LCD on top of the box, a buzzer, and a multicolored LED light were all included in this unit. This interface also reminds the consumer when it is time to take their medicine. An Android application on this device displays some of the results. The input interface and the output interface are the two components of this mobile app interface. Prescriptions are accepted or modified via the input interface. Empty lists, previous data, and whether or not to take medication are all shown on the data interface. The LED lights and buzzer will switch on when it is time to take medicine, and the LCD will show the prescription at the same time. So that the patient is conscious that drug time has arrived. The proposed method is assessed both quantitatively and subjectively. The results show that the success rate in terms of perfect functioning is 90%, and the participants scored the overall system on average 4.6 out of 5 in subjective assessment.

### **Hardware, Software Platforms, Operating Systems and Routing Protocols for Internet of Things Applications [27]**

This literature review initiates an exhaustive exploration into routing protocols and technologies for applications within the Internet of Things (IoT) realm. A comprehensive survey is conducted, encompassing a diverse array of routing protocols, with a meticulous comparison of their respective characteristics and applicability in various IoT scenarios being undertaken. The critical examination

extends to the evaluation of hardware and software platforms, with a specific focus on operating systems such as Contiki, TinyOS, and WSN open. This scrutiny aims to facilitate informed decision-making for researchers and practitioners in the selection of suitable platforms. Furthermore, an in-depth analysis of technologies adapted to IoT applications, including RFID, Bluetooth, and NFC, is presented, offering a nuanced understanding of their inherent strengths and weaknesses. The literature review delves into the complexities of IoT applications, spanning from smart homes to healthcare, elucidating the imperative need for network coverage and connectivity optimization, thereby necessitating the employment of intelligent routing protocols. The focal point of this review lies in a detailed investigation into energy consumption within IoT applications, particularly through a comparative analysis of the AODV and RPL protocols. The findings unequivocally assert RPL's superiority in terms of energy efficiency within Wireless Sensor Network (WSN)/IoT applications. The conclusion underscores the paramount importance of intelligent routing protocols, notably RPL, in the strategic optimization of energy consumption and the establishment of effective information flow in IoT applications. The paper concludes by proposing avenues for future research within this dynamically evolving field.

### **A Low-Cost Hardware Architecture for EV Battery Cell Characterization Using an IoT-Based Platform [28]**

The evolution of electric and hybrid vehicles since the introduction of the first hybrid vehicle in 1997 has spurred a growing concern regarding the environmental impact of discarded Nickel-Metal Hydride (NIMH) batteries, particularly with the increasing obsolescence attributed to the fading presence of thermal vehicles in the market. Over the years, the prevalence of NIMH batteries in hybrid vehicles and Lithium-ion (Li-ion) batteries in pure electric vehicles has presented a recycling challenge due to the hazardous materials inherent in these technologies. This literature review addresses the ongoing issue by exploring the current state of battery technologies in electric and hybrid vehicles, emphasizing the challenges associated with recycling NIMH and Li-ion batteries.

Several studies have delved into the environmental implications and recycling challenges posed by end-of-life electric vehicle batteries, with a focus on the complexities of recycling NIMH and Li-ion chemistries. Research highlights the

necessity for sustainable solutions to mitigate the increasing volume of discarded batteries, especially in the context of the accelerated transition from thermal to electric vehicles.

The notion of extending the life of batteries, including considering second-life applications within electric vehicles, has gained attention as an alternative to traditional recycling. This paper's proposed low-cost system for characterizing individual cells of commercial electric vehicle batteries using Internet of Things (IoT) technology is positioned within this emerging research trend. The literature survey explores the landscape of IoT applications in battery management, highlighting its potential to automate charging and discharging cycles while monitoring real-time data to identify and address abnormally performing cells.

Case studies, such as the one based on a commercial Toyota Prius battery included in the paper, contribute empirical evidence to the effectiveness of proposed solutions. Existing literature on similar efforts to enhance battery characterization, regeneration, and extend their lifespan through innovative technologies and methodologies is critically reviewed to contextualize the significance and novelty of the proposed system.

Moreover, discussions on the economic and environmental benefits of implementing such low-cost characterization systems for electric vehicle batteries are explored, shedding light on how these advancements can decrease operating costs and contribute to a more sustainable and circular approach to battery life cycle management. The review concludes by outlining potential future research directions in the broader domain of battery technologies, recycling, and sustainable practices in the automotive industry.

### **An overview of IoT architectures, technologies, and existing open-source projects [29]**

The provided passage highlights the increasing demand for effective monitoring and control of various devices within organizations, emphasizing the necessity for Internet of Things (IoT) platforms. These platforms must be capable of integrating diverse elements offered by various vendors, utilizing different protocols, data formats, and communication technologies. The article aims to offer a comprehensive review of the architectures, technologies, protocols, and data formats commonly

employed by existing IoT platforms. Additionally, it presents a detailed comparative analysis of popular open-source IoT platforms, considering multiple characteristics crucial for organizations to select the most suitable platform for their needs.

Let's break down the key points for a more detailed explanation:

- **Growing Need for Monitoring and Control**

Organizations today face a growing need to monitor and control their devices effectively. This requirement is driven by the increasing complexity and diversity of devices within organizational setups.

- **IoT Platforms Integration Challenges:**

The complexity arises due to the integration of devices from multiple vendors. These devices often operate using different protocols, data formats, and communication technologies.

- **Comprehensive Review Objective:**

The article aims to provide a thorough review of various aspects related to IoT platforms, including architectures, technologies, protocols, and data formats.

- **Comparative Analysis of Open Source IoT Platforms:**

The article goes beyond just reviewing individual components and conducts a comparative analysis of open-source IoT platforms. Open-source platforms are preferred for their flexibility and accessibility.

- **Consideration of Multiple Characteristics**

The comparative analysis is based on multiple characteristics deemed crucial for selecting an appropriate IoT platform for organizations. These characteristics could include scalability, compatibility, security, ease of integration, and adaptability to different use cases.

- **Tailoring to Organizational Needs**

The ultimate goal is to assist organizations in selecting an IoT platform that best aligns with their specific needs. The diverse nature of organizations implies that there is no one-size-fits-all solution.

- **Importance of the Comparative Analysis**

The comparative analysis serves as a valuable tool for decision-makers to make informed choices about IoT platforms. It helps organizations navigate

through the multitude of options available in the open-source domain.

In summary, the article addresses the evolving challenges in monitoring and controlling devices within organizations by focusing on IoT platforms. The comprehensive review and comparative analysis aim to empower organizations to make informed decisions in selecting an open-source IoT platform that aligns with their unique requirements and constraints.

### **IoT-based Remote Control Water Distribution System [30]**

The research paper under consideration outlines the conceptualization, design, and successful implementation of an Internet of Things (IoT)-based remote control water distribution system, showcasing its potential to revolutionize the operational dynamics of water supply management. The core functionality of this system lies in empowering water supply operators to exercise remote control over valves, thereby facilitating the precise regulation of water flow within the distribution network. This control is achieved through the integration of an IoT platform, providing operators with the ability to remotely manage valves through a dedicated mobile application. The mobile application proves to be instrumental in expediting responses to potential leakages, allowing operators to swiftly close valves before any substantial damage can occur.

One noteworthy feature of the system is its incorporation of a Dual-Tone Multi-Frequency (DTMF) calling system, offering an alternative means of remote control. This functionality enables operators to send numeric information or signals using the touch-tone keypad of their mobile phones, even in scenarios where an internet connection may be absent. This dual capability ensures a robust and reliable mechanism for valve control, enhancing the system's versatility in diverse operational environments.

The overarching objective of this IoT-based remote control water distribution system is to enhance the efficiency and sustainability of water distribution networks. By mitigating water loss through timely responses to leakage events and providing precise control over the distribution of water, the system aims to optimize the overall performance of water supply operations. The prototype of the system underwent rigorous testing, with results affirming its capacity to deliver accurate control over

water distribution and effectively reduce water loss.

An essential characteristic of the proposed system is its scalability, ensuring adaptability to a wide array of water distribution systems. This scalability feature not only enhances the versatility of the system but also positions it as a viable and customizable solution for diverse operational contexts. In essence, the IoT-based remote control valve system emerges as a promising and transformative innovation with the potential to significantly improve the efficiency, sustainability, and resilience of water distribution systems. The combination of IoT technology, mobile applications, and the DTMF calling system showcases a multifaceted approach that addresses the complexities of contemporary water supply management challenges. As such, this research contributes to the growing body of knowledge in the field, offering a practical and scalable solution for optimizing water distribution systems in the pursuit of a more sustainable and resource-efficient future.

### **IOT based Advanced and Secure Footstep power generator [31]**

The presented unconventional method of power generation, harnessing lost energy through a plate system activated by footsteps, addresses the pressing global challenge of increasing energy demand while mitigating the environmental impact associated with traditional power production methods. The context of escalating energy needs and environmental concerns has prompted a surge in research and innovation towards sustainable and efficient energy solutions. Various studies have explored alternative approaches to power generation, emphasizing the importance of renewable sources and energy harvesting technologies. The proposed system, which captures the kinetic energy generated during human locomotion, aligns with this trend by offering a unique and eco-friendly means of electricity generation.

The underlying concept of converting footstep-induced mechanical energy into electrical energy highlights the ingenuity in leveraging everyday activities to contribute to the energy grid. Prior research has delved into piezoelectric materials and mechanisms that can efficiently convert mechanical stress into electrical power, with applications ranging from wearable technologies to infrastructure-integrated energy harvesting. This innovative system goes beyond the theoretical realm, successfully implementing and testing the concept, thereby demonstrating its practical viability.

The integration of Internet of Things (IoT) technology into the system further enhances its functionality and efficiency. By connecting to a cloud platform, the system not only stores data but also facilitates real-time analysis of the energy generated. This connectivity enables the monitoring of key parameters, such as the output voltage, weight of individuals utilizing the system, and the number of steps taken. The incorporation of an LCD display adds a user-friendly interface, providing a transparent view of the system's performance metrics.

Security measures are crucial in ensuring the responsible and authorized use of the generated power. The system's restricted access to only authorized users, coupled with a rechargeable battery for energy storage, underscores the commitment to ethical and controlled energy utilization. This feature aligns with the broader discourse on sustainable practices and responsible consumption, as the system not only generates green energy but also regulates its distribution.

The reported successful achievement of all stated objectives, including the generation of a maximum voltage of 28 volts from a single step, substantiates the effectiveness and practicality of the implemented system. This outcome contributes to the growing body of literature on energy harvesting technologies and underscores the potential of human-centric solutions to address the global energy challenge. As society continues to seek innovative approaches to meet escalating energy demands while minimizing environmental impact, this research stands as a commendable contribution to the evolving landscape of sustainable energy solutions.

### **An IoT-Based Road Bridge Health Monitoring and Warning System [32]**

The escalating frequency of earthquakes worldwide has intensified the urgency for robust infrastructure monitoring systems, particularly for road bridges which are highly susceptible to structural damage. Traditional bridge monitoring systems are beset with limitations, including restricted detection capabilities, subjectivity, human error, labor-intensive inspections, and high costs. These challenges are exacerbated by aging infrastructures exhibiting signs of decay, necessitating innovative solutions to enhance structural resilience. In response, this research advocates for an Internet of Things (IoT)-based bridge health status monitoring and warning system that is wireless, cost-effective, durable, and user-friendly. The proposed system leverages engineering standards and guidelines to classify bridge

health status, providing a comprehensive evaluation ranging from excellent to collapse conditions. It integrates an array of sensors, including deflection, vibration, temperature, humidity, and infrared sensors, which collectively contribute to a holistic understanding of the bridge's structural integrity. The incorporation of IoT technology facilitates real-time data transmission and analysis, overcoming the limitations of traditional monitoring systems by providing continuous, remote monitoring capabilities.

A key feature of the proposed system is the utilization of a fuzzy logic algorithm to process the sensor data, enabling a nuanced and accurate assessment of the bridge's health status. This algorithm, grounded in fuzzy set theory, introduces a level of adaptability and tolerance to imprecise or uncertain data, enhancing the reliability of the monitoring system. The primary objective of this innovative approach is to significantly reduce bridge maintenance costs, prolong infrastructure lifespans, and bolster transportation safety through an early warning system facilitated by a dedicated mobile application. To enhance user engagement and accessibility, the research also incorporates a Google Maps interface that displays real-time bridge conditions alongside traffic video feeds. This visualization tool not only provides a user-friendly interface but also aids in efficient decision-making for both authorities and the general public during potential structural concerns.

The practical validation of the proposed system includes the construction and testing of a 3-D prototype model. The results of practical testing of the fuzzy logic algorithm aligning with simulation outcomes validate the efficacy of the proposed system in accurately determining bridge health status. This research represents a significant stride towards addressing the critical issues posed by earthquake-induced damage to bridges, offering a comprehensive, technologically advanced solution that can be instrumental in safeguarding infrastructure, minimizing maintenance costs, and enhancing overall transportation safety.

### **An Internet of Things-Integrated Home Automation with Smart Security System [33]**

In the current era of Industry 4.0, the Internet of Things (IoT) stands out as a transformative technology, continuously expanding and evolving in its applications. While its influence is pervasive, there exists untapped potential for growth,

particularly in the realms of social support and technological progress. One notable manifestation of IoT's impact is the surge in popularity of IoT-integrated smart home systems, driven by their ability to alleviate human workload and enhance daily life. Recognizing the imperative for continuous improvement, this research introduces an IoT-integrated home automation system with a smart security focus, leveraging the advanced capabilities of Android devices.

Home automation, defined as the automated and electronic management of domestic tasks, activities, and equipment, forms the backbone of this prototype. The integration of IoT technology not only facilitates seamless control and monitoring but also contributes to the enhancement of home security and safety. Positioned as a beacon of IoT advancement, this prototype exemplifies the potential of IoT through the simplicity and accessibility afforded by smartphone assistance.

The system employs a combination of hardware, connection interfaces, and software to interconnect electrical devices, culminating in an automated house with a smart security infrastructure. This innovation carries significant implications for diverse user demographics, including the elderly, children, and individuals with disabilities, providing both convenience and a robust security system. Central to its design is a focus on modernizing IoT security through features such as a smart door lock system, CCTV monitoring at the entrance, and gas or fire detection mechanisms, all capable of alerting homeowners promptly.

A notable aspect of this prototype is the incorporation of a voice-activated home automation system, empowering users to control various electronic devices effortlessly. In the context of the 21st century, often referred to as the "Industry 4.0" era, characterized by rapid technological change, interconnectedness, and smart automation, this system represents a practical manifestation of the transformative power of IoT. Security is enhanced through the system's ability to detect unplanned activities, a crucial aspect in the contemporary landscape where safety and automation intersect.

For commercial applications, a six-digit keypad electronic door lock system is proposed, providing an added layer of safety and notifying the owner of any approaching individuals or objects. The system further extends its utility through remote device monitoring via the internet, allowing users to identify and manage

energy usage even when away. The incorporation of micro-controller-based smart security and automated home support, coupled with various sensors, underscores the comprehensive nature of this prototype, offering a glimpse into the future possibilities of IoT technology in fostering security, convenience, and efficiency in everyday life.

### **SMART LAMP BEBRBASIC ARDUINO UNO USING AN ANDROID SMARTPHONE [34]**

In the dynamic landscape of the digital era, the intersection of the Internet of Things (IoT) and the widespread use of smartphone control applications has paved the way for groundbreaking innovations in automation and device control systems. This research project represents a concerted effort to design and develop a smart lamp, offering a tangible application of these technological advancements through the integration of an Arduino-based smartphone device. The synergy between the evolving realm of IoT and the burgeoning demand for remote control solutions renders this project both relevant and captivating.

The primary objective of this endeavor is to create a smart lighting system that empowers users to control their home lighting seamlessly through a dedicated smartphone application. This innovation not only introduces a new level of flexibility in lighting management but also holds the potential for substantial energy savings, aligning with the contemporary emphasis on sustainability and efficient resource utilization. By leveraging the capabilities of Arduino-based technology, the project aims to provide an accessible and user-friendly platform for individuals to enhance their home automation experience.

Beyond its practical applications, this project also serves as a platform for skill development in the interdisciplinary domains of programming, electronics, and design. As contributors to the open-source community, the researchers aim to share the design and source code of the smart lamp, fostering collaboration, knowledge exchange, and further advancements in the field. This commitment to openness aligns with the collaborative ethos of the digital age, promoting collective progress and innovation.

The significance of this project extends beyond the realm of home automation, with potential impacts on daily life and applications across various industrial sectors. The

emphasis on energy efficiency in smart lighting design addresses a critical need in contemporary society, where sustainable practices are increasingly prioritized. Furthermore, the integration of smartphone technology enhances the accessibility and user experience, aligning with the evolving expectations of a technologically savvy populace.

In essence, this research project encapsulates the spirit of innovation in the digital age, leveraging IoT and smartphone technologies to create a tangible and impactful solution. By focusing on the development of a smart lamp with a commitment to energy efficiency and seamless integration with smartphone control, the project not only contributes to the growing body of knowledge in automation but also anticipates a future where intelligent, connected devices play a central role in shaping our daily lives and industrial practices.

### **Towards truly sustainable IoT systems: the SUPERIOT project [35]**

This paper presents an insightful overview of the SUPERIOT project, a significant initiative under the EU SNS JU (Smart Networks and Services Joint Undertaking). The primary focus of the SUPERIOT project is the development of truly sustainable Internet of Things (IoT) systems, representing a paradigm shift towards holistic sustainability throughout the entire lifecycle of IoT devices. Unlike traditional approaches that often address sustainability in isolation, the SUPERIOT concept adopts a unique approach, actively considering sustainability factors at every stage, from design and implementation to usage and eventual disposal or reuse.

The core of the SUPERIOT concept lies in the integration of radio and optical technologies, enabling dual-mode wireless connectivity and dual-mode energy harvesting. This dual-mode capability not only enhances the robustness and flexibility of IoT systems but also contributes significantly to sustainable practices by optimizing energy utilization. Additionally, the project incorporates a dual-mode IoT node positioning system, further emphasizing the multifaceted approach to sustainability.

In terms of implementation, the SUPERIOT project leverages sustainable printed electronics technologies, a key enabler in maximizing the project's sustainability goals. This includes the utilization of printed components, conductive inks, and

substrates, highlighting a commitment to environmentally friendly materials and manufacturing processes.

The paper delves into the technical approaches employed by the SUPERIOT project, providing a comprehensive understanding of the methods and technologies at the project's core. It outlines promising scenarios and applications where the SUPERIOT concept can be effectively applied, emphasizing its potential impact across various domains. The paper also outlines the project goals and discusses the development of demonstrators that will bring the concept to the proof-of-concept stage, showcasing the tangible outcomes of the research.

Furthermore, the paper hints at the future trajectory of this technology, offering glimpses into potential developments and expansions. By doing so, it invites readers to contemplate the long-term implications and possibilities that may arise from the innovative SUPERIOT project.

In summary, the SUPERIOT project represents a significant step towards advancing sustainable IoT systems. Through its holistic approach, integration of advanced technologies, and commitment to environmentally friendly practices, SUPERIOT emerges as a pioneering initiative with the potential to shape the future landscape of IoT technology while addressing crucial sustainability challenges.

### **IoT Based Smart Agricultural Crop Monitoring in Terms of Temperature and Moisture [36]**

The agricultural sector is undergoing a profound transformation due to the advent of the Internet of Things (IoT), ushering in innovative solutions for crop monitoring and management. This article presents a comprehensive analysis of a smart agricultural IoT system specifically designed for the effective monitoring of crop moisture and temperature. The primary objective of this research is to develop a sophisticated system capable of continuously tracking temperature and moisture levels in agricultural fields, providing farmers with valuable insights for informed and strategic crop management decisions.

The IoT-based system integrates various components, including wireless sensors, actuators, and cloud-based data analytics, to continuously monitor and analyze crucial environmental parameters that impact crop growth. Among these parameters,

temperature and moisture emerge as pivotal factors determining crop health, yield, and overall quality. Real-time data on temperature and moisture are collected from multiple points within the agricultural field through wireless sensors. The gathered information is then processed and interpreted using advanced data analytics algorithms deployed on a cloud-based platform.

The findings of the study reveal that the IoT-based system effectively regulates environmental temperature, resulting in a noteworthy average decrease to 26.2°C. Simultaneously, the system maintains or enhances soil moisture content, evidenced by an increase to 45%. These outcomes signify the system's potential to empower farmers with actionable insights, enabling them to make data-driven decisions that can lead to improved agricultural yield, sustainability, and economic outcomes by leveraging the capabilities of IoT.

The significance of this research extends beyond individual farms, as the integration of IoT in agriculture has the potential to revolutionize global farming practices. In the face of shifting climatic conditions and rising population demands, the continuous development of IoT capabilities holds promise for enhancing food security. The system's ability to provide real-time data and insights enables farmers to adapt and optimize their practices, mitigating the impact of environmental challenges on crop production.

As the article concludes, it emphasizes the need for further research and development in this domain, highlighting the ongoing evolution of IoT technologies. Continued advancements in smart agricultural systems have the potential to play a pivotal role in addressing the complexities of modern agriculture, contributing to sustainable practices, increased productivity, and resilience in the face of a changing climate and growing global population.

## **Chapter 3**

### **METHODOLOGY**

#### **3.1 Methodology**

Patients may neglect to take their medications at the appropriate times. Additionally, patients occasionally forget which medication to take when. Additionally, it is challenging for a doctor or compounder to continuously monitor patients. We created this medication reminder system for patients using Arduino to get around this issue. When we turn on this system, the 16\*2 and 20\*4 LCD displays the time using a real-time clock. Additionally, we must hit the set crazy buttons, which are attached to pin number 8 of the Arduino, in order to set the alarm time for the medication. We used three push switch for medicine reminder. The Yellow push switch is connected the Arduino digital pin 8, this switch is used for mode function. The Red switch used for increase time, this switch is connected the Arduino digital pin 9. The White switch is used for next option and confirm option, this switch is connected the Arduino digital pin D10. A buzzer begins continuously buzzing as the name of the drug group appears on the LCD. In order to indicate when to take a medication, a buzzer is directly attached to Arduino pin number 13. Data pins D4, D3, D2, and D2 of a 16x2 LCD are connected to pins 5, 4, 3, and 2 of an Arduino. Additionally, pins 7, 6, and EN of the command pin are directly connected to the Arduino. The LCD's RWpin is directly connected to ground. All of the connections between the Arduino board, microcontroller board, and the modules used in this system are clearly depicted in the circuit diagram Fig. The temperature sensor, LCD, WiFi module, Gyro sensor, and VCC and GND connections have all been linked to the Arduino and microcontroller. When the Arduino-nano and the Wi-Fi module are turned on simultaneously, a link is created between them and the access point, enabling the uploading and accessing of the sensor value over the internet. The Arduino Nano is used to provide the user's control, which is then uploaded to the cloud server. A Wi-Fi module is used by the controller to retrieve data from the cloud server and carry out the necessary action depending on the regulator signal provided by the user. The appendix contains a full description of the transmitter, receiver, and health monitoring portion of the program.

This is our system block diagram, seen in Fig. 3.1 above. Here is a block diagram

showing the components of our system. Our system makes use of the temperature sensor, gyro sensor, and MAX30100, which measure the patient's temperature, heart rate, oxygen saturation, and fall detection, respectively. These are used by our system as inputs. We will do the work of medicine reminder through real time medicine taking time which medicine prescribe the doctor. The information about the patient will be sent to the server via the internet, and we will get it by entering the user ID and password, which will also be displayed on the LCD display. For this reason, we are using the Internet of Things to transmit system data to the server. This task is performed using an SD card. The SD card will be in the SD card reader. Arduino will compare the data that we have stored on the SD card with what is on the card. The voice will be audible through the speaker and amplifier if they match. The speaker and amplifier will allow us to hear the voice clearly.

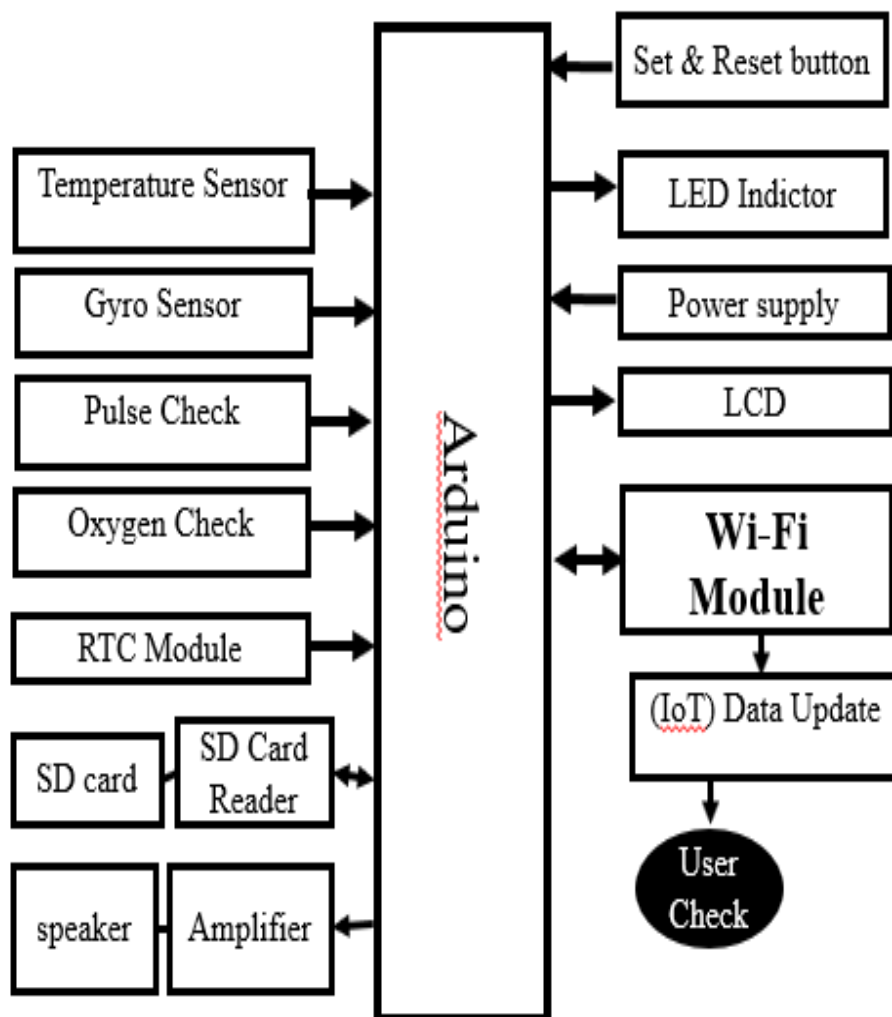


Figure 3.1: Block Diagram of Our Proposed System

### 3.2 Flow Chart

The entire system flow chart is shown in Fig. 3.2 below. It covers, among other things, the steps taken to finish the work, sensor condition checks, and the workings of the entire system. Here, we can observe that the user set the medication taking time and date after selecting the real-time clock (time and date). Then system checking the preset time value, finally ringing the medicine taking time and show the notification at LCD. The sensor receives input from the human body, processes the data, and outputs the outcome. However, if the sensor and the data don't match, the system will revert to using human input.

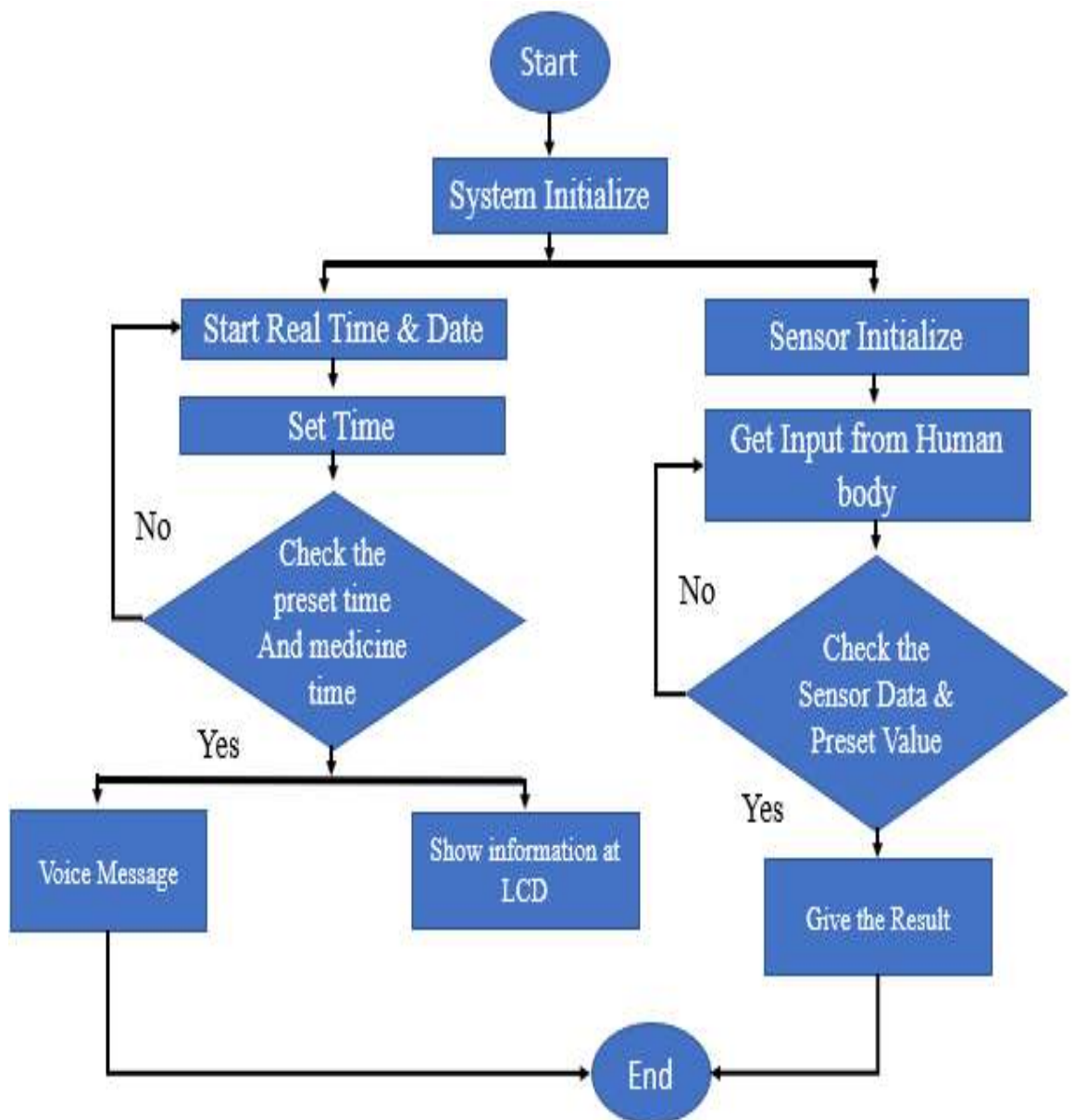


Figure 3.2: Flow Chart for the proposed model of the system

### 3.3 Circuit Diagram

The circuit design for the whole system is shown in Fig. 3.3 which includes the medicine reminder section SD card reader, which is connected Arduino Nano Digital pin D7, D8, D9 and D10. We also used a speaker and speaker amplifier, the amplifier has three pin like positive, ground, signal, the signal pin is connected the Arduino nano digital pin D6.

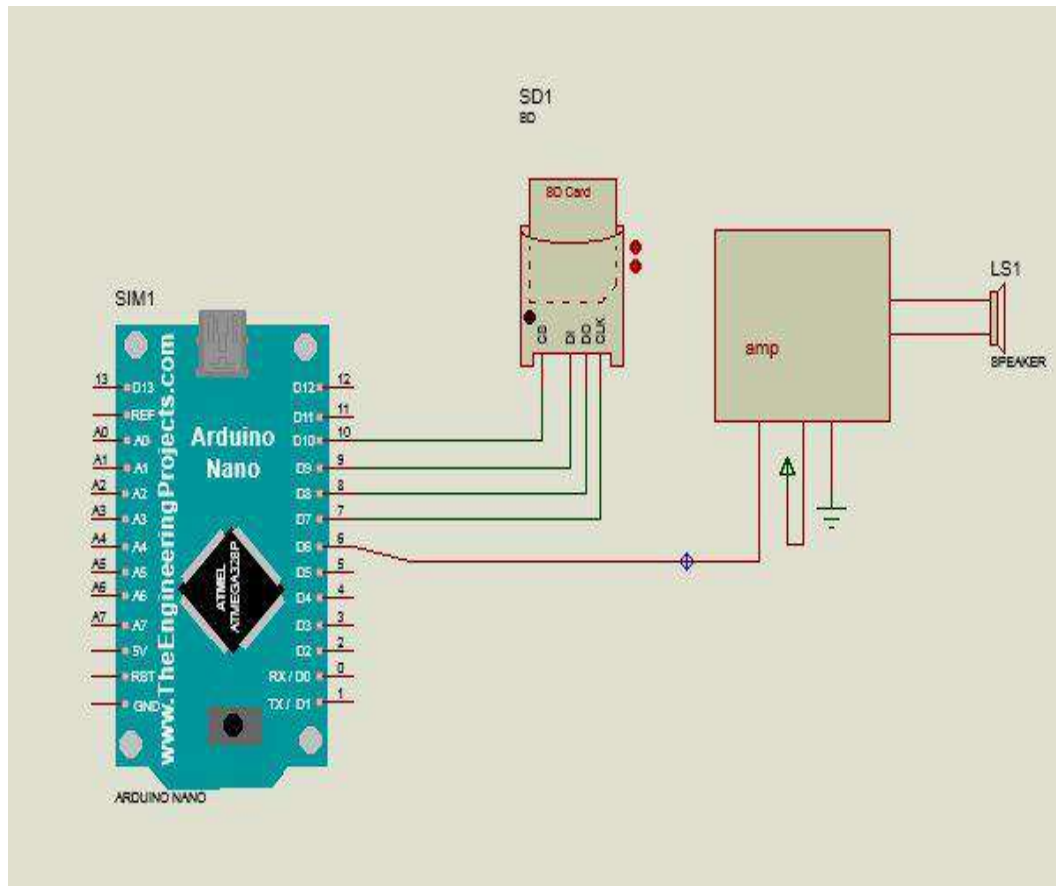


Figure.3.3: Controlling Circuit of Voice Message Section

The circuit design for the whole system is shown in Fig. 3.4, which includes the controlling device as well as additional parameters such as the LCD, Wi-Fi module, and sensors. The LCD is connected the Arduino Nano digital pin D4, D5, D6, D7, D8. The Wi-Fi module has four pins, like positive, ground, TX and RX. The positive and ground pin are connected the controlling circuit positive and ground, the TX pin is connected the Arduino Nano RX pin and RX pin is connected the Arduino Nano TX pin. The pulse oximeter is connected the Arudino Nano digital pin D2 and D3. The accelerometer is connected the Arduino Nano analog pin A1 and A2. The temperature sensor is connected the Arduino Nano analog pin A7. Integrating these

sensors with the controlling device enhances the system's functionality, enabling comprehensive health monitoring and analysis.

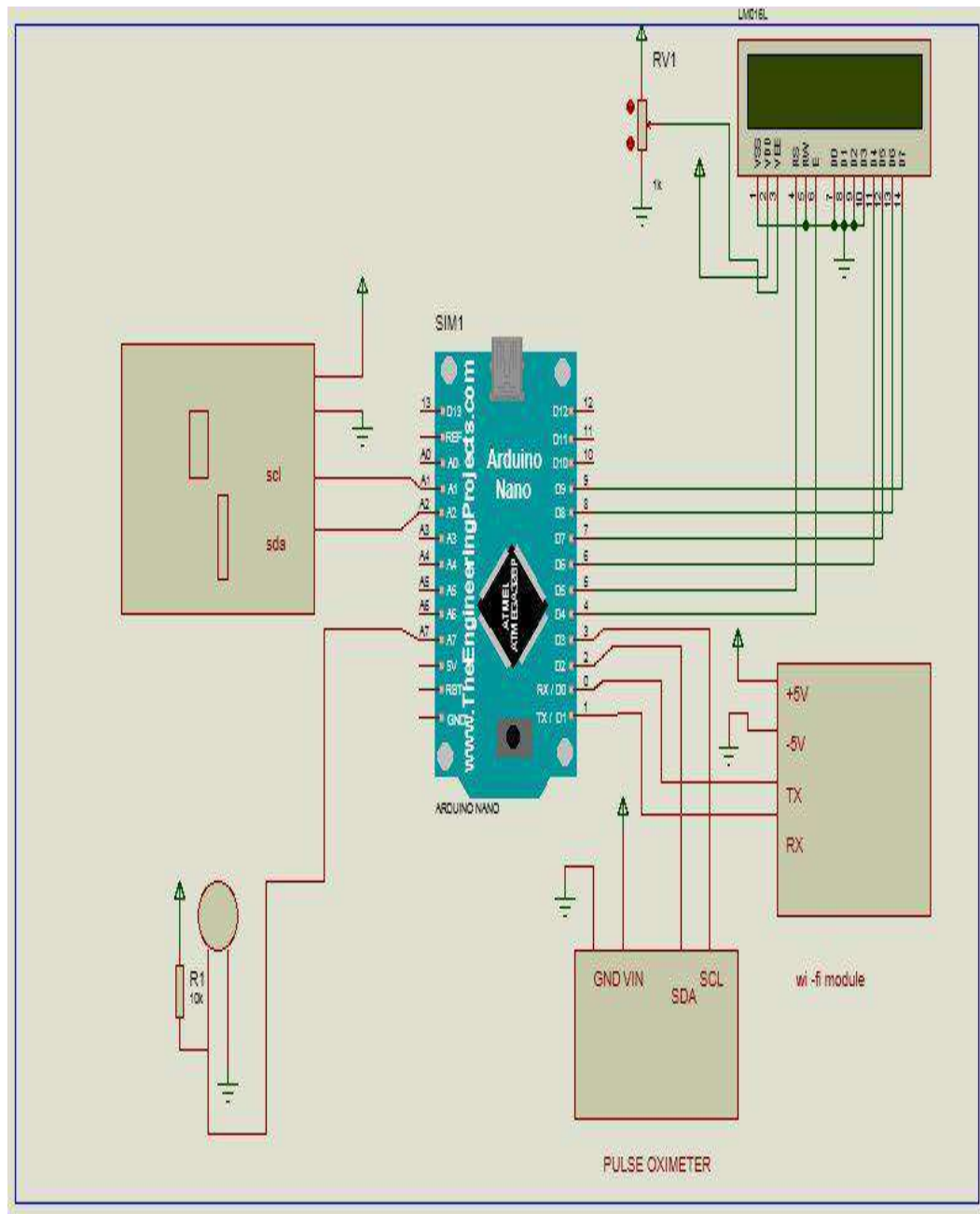


Figure 3.4: Controlling Circuit of IoT Health Monitoring Section

The circuit design for the whole system is shown in Fig. 3.5, which includes the medicine reminder section Arduino Mega, push switch, LCD, buzzer, real time clock module etc. The LCD is connected the Arduino Nano digital pin D7, D6, D5, D4 and three push switch is connected the D8, D9, D10. Those push switch are used for medicine taking time set, time increasing and confirmation button. The buzzer positive wire is connected the Arduino Nano digital pin D13. The real-time clock

(RTC) module plays a crucial role in ensuring accurate timing for the medicine reminder function. Connected to the Arduino Mega, it provides the system with precise timekeeping capabilities, allowing users to schedule medication reminders at specific times.

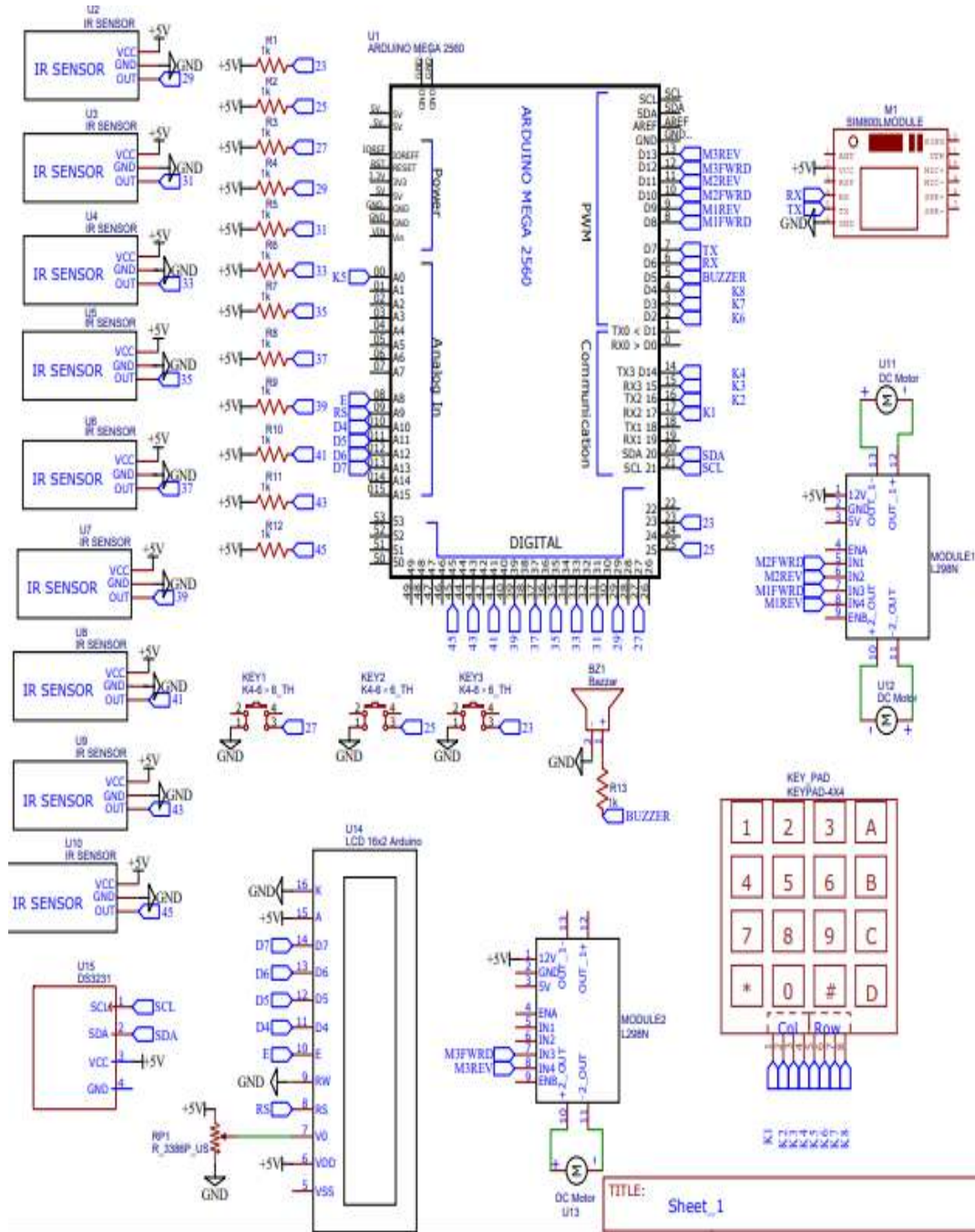


Figure 3.5: Controlling Circuit of Medicine Reminder Section

This integration enhances the reliability and effectiveness of the medicine reminder feature, ensuring timely administration of medications for improved health management.

### **3.4 Components of the Project**

The creation of the project involves the utilization of a wide range of sensors, each of which is designed to collect data by analyzing the environment in which the cylinder is located. The sensors capture analog data from the cylinder with the assistance of an Arduino Mega and Nano, which is then converted to digital form, sent to a server, and saved there.

The following is a list of the components that are utilized in this undertaking:

- Arduino Nano and Mega
- Wi-Fi Module
- Temperature Sensor
- Accelerometer
- MAX30100
- SD Card Module
- SD Card
- RTC Module
- LED Indicator
- LCD
- SMPS
- Push Switch
- Speaker
- Gsm Module

### **3.5 Arduino**

Arduino is a company that produces and sells single-board microcontrollers and microcontroller kits using open-source hardware and software. The GNU General Public License (GPL) or the GNU Lesser General Public License (LGPL) apply to

Arduino boards and software (GPL). Commercially available Arduino boards are available as DIY kits or pre-assembled. Arduino boards are equipped with many microprocessors and controllers. Through digital and analog I/O ports, the boards can be connected to expansion boards, breadboards (shields), and other devices. Software from a personal computer can be loaded onto the boards via serial ports. C and C++ are programming languages that are supported by microcontrollers. An IDE based on Processing is available for Arduino development in addition to standard compiler toolchains. Scholars at Italy's Interaction Develop Institute (IDI) launched this program in 2005, providing sensors and actuators to enable developers of all skill levels to create interactive devices. Technological devices that are easy for beginners to use include motion sensors, thermostats, and robots.

An Arduino Nano board (pin 27) can be powered by an Arduino Mini-B USB connection, an external regulated 5V power supply, or an unregulated 6–20V power source (pin 30). The densest voltage sources are taken into account while selecting a power source.

The ATmega328 has 32 kilobytes of internal memory (plus an additional 2 KB for the bootloader). The ATmega328's SRAM and EEPROM each have a capacity of one kilobyte (kb).

The digital Write(), digital Read(), and pinMode() routines can be used to enable a digital input or output on each of the Nano's fourteen pins. All these devices are powered by a single 5 volt battery.

It is capable of delivering or receiving current up to 40 mA thanks to built-in pull-up resistors on each pin. There is also a large selection of pins with specific functions accessible, such as:

- For TX and RX (TX), there is a 1 (TX) and a 0 (RX). This gadget can send and receive TTL serial data. These are connected to the appropriate pins on the FTDI USB-to-TTL Serial chip.
- There were two and three outside interruptions. Depending on the pin value, these pins can be used to generate programmed interrupts by being set to low, high, or rising or falling edges. See the attach Interrupt() function for more details.

- Eleven PWM outputs are present in all. In total, there are eleven PWM outputs. You can generate an 8-bit PWM output by using the `analogWrite()` function.
- SS, MISO, 13, and MOSI (MOSI) are the first four SPIs that make up the SPI (SCK). The Arduino language does not currently support the two SPI pins on the Arduino that can be used for SPI communication.
- This design contains a total of 13 LEDs. Digital pin 13 is connected to an integrated LED via a wire. When the pin is HIGH, the LED is on; when it is LOW, the LED is off.[8]

The eight analog inputs on the Nano each have ten-bit resolution, or 1024 different values. The measuring range can be adjusted from 0 to 5 volts by modifying the `analogReference()` function. Digital pins 6 and 7 cannot in any manner be used as analog pins.

SDA and I2C are interfaced with via pins A4 and A5. (SCL). A TWI connection can be established using the `Wire` library (credentials on the Cabling website).

The circuit board may have extra pins in the following places:

- This voltage, known as AREF, is used as a reference by the analog inputs. Concerning analog information sources (`analogRead()`).
- Put another way, begin anew. This line needs to be set to LOW in order to reset the microcontroller. As an afterthought, reset buttons are frequently affixed to shields that obstruct the reset button.

An Arduino Nano can be connected to a PC or another microcontroller with this board. To connect the ATmega328 to a UART TTL (5V) serial connection, utilize digital pins 0 (RX) and 1 (TX) (TX). In the Arduino application, FTDI drivers send USB serial connectivity to the PC via an FTDI FT232RL. Basic text data can be sent and received using the serial monitor included in the Arduino program. The RX and TX LEDs on the board will light up when data is transferred to the PC via the FTDI chip and USB connection (but not for serial communication on pins 0 and 1). A `SoftwareSerial` library can be used to serially communicate all of the digital pins on the Nano. The ATmega328 supports SPI and I2C (TWI) communication. The `Wire`

library can be used to easily connect the Arduino to the I2C bus. You may find more information on SPI in the ATmega328 datasheet.

The Arduino Nano can be programmed using the Arduino software, which can be downloaded. Select "Arduino Duemilanove or Nano with ATmega328" from the Tools > Board menu, depending on the microcontroller on your board. A preburned bootloader on the Arduino Nano's ATmega328 allows new code to be uploaded without the need for a hardware programmer. Data is delivered over the STK500 protocol. If you prefer not to use the loader, you can program the microcontroller directly using the ICSP connection (In-Circuit Serial Programming).

### 3.5.1 Automatic (Software) Reset

The Arduino Nano (depicted in Fig. 3.5) can be reset with software on a linked PC before uploading. A 100 nanofarad capacitor (DTR) connects the hardware flow control line of the FT232RL to the reset pin of the Atmega328. The reset line lowers long enough to reset the chip (taken low) when it is asserted. The software makes advantage of an Arduino platform capability called uploading code. This drop in DTR right before upload starts could shorten the bootloader's timeout. [8] The Nano resets (via USB) upon attempting a new software connection after it has been connected to a Mac or Linux computer. It will be there as long as the Nano's bootloader is running. As soon as a connection is made, it intercepts data sent to the panel (i.e. anything other than a new code upload). It's crucial to pause for one second after receiving configuration or other data before sending data to a sketch on the board. The Arduino Specification is displayed in Table 3.1, and the board's components are shown in Fig. 3.6.

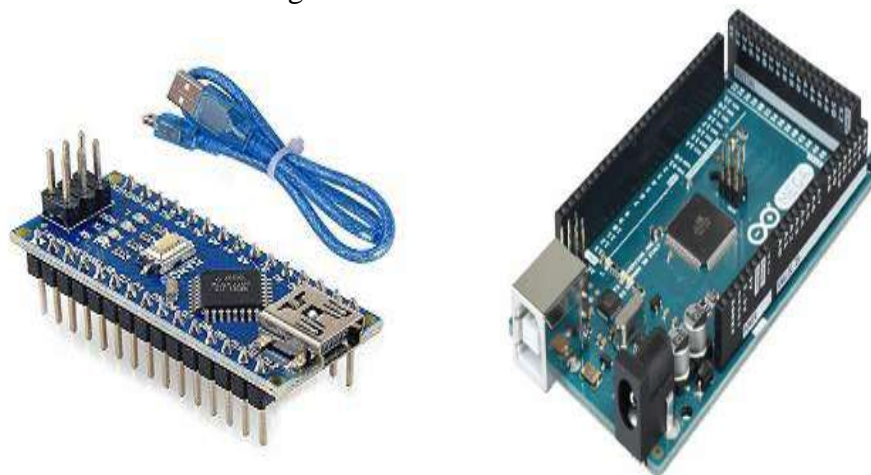


Figure 3.5: Arduino Board[3]

TABLE I: ARDUINO SPECIFICATION

<b>Product</b>	<b>Description</b>
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)

### 3.6 Relay

Relays, which are an alternative type of switch, are powered by electricity. Although different operating principles including solid-state relays can be used to activate switches in various relays, electromagnetic is the most widely used method. Relays can be used to control low-power circuits if both systems are electrically isolated from one another. Multiple circuits can be operated by a single signal. Early relays served as amplifiers for long-distance telegraph networks, retransmitting signals between them. Relays played a major role in the logic operations of early computers

and telephone exchanges for many years. Direct operation of an electric motor or other load requires a contactor or relay that can handle high power. Solid-state relays manage power using semiconductor chips rather than mechanical parts. More sophisticated devices like "relays with calibrated operating characteristics and numerous operational coils" are becoming more frequent, even though digital devices like "protection relays" are still commonly used in today's environment. A figure of the 05-pin relay is shown in Fig. 3.6.

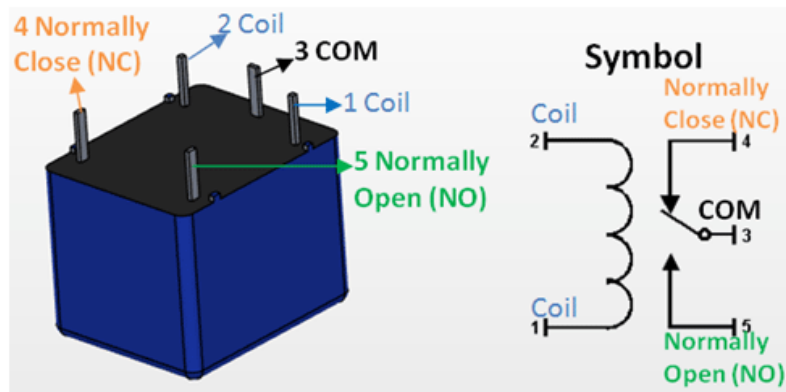


Figure 3.6: Relay Module

### 3.6.1 Relay Switch Circuit

Devices that use an electromagnet to influence the state of two moving contacts are known as electromechanical devices. Examples include heating components or supplying high-power AC circuits with only a minimal amount of electrical energy required to run the relay coil. In electrical circuits, electromechanical relays are output devices, or actuators, that can carry out a variety of functions. can select from an array of sizes and forms. This circuit can be used to turn large currents or voltages from ON to OFF in low-power computer and electrical devices. Transistors and MOSFETs are frequently used as the primary switching devices in small electrical projects due to their quick switching of DC (ON-OFF) control of the relay coil. Relays can be switched in a number of ways [3].

### 3.6.2 Npn Relay Switch Circuit

An NPN transistor switch, TR1, is utilized as a typical relay switch in the image. A transistor may form an open switch (or negative switch) when its base voltage is 0. A relay coil cannot move any current if the Base is not receiving any current. [18] If an adequate amount of positive current is applied to the NPN transistor, the larger

relay coil current can be regulated by the current that flows from Base to Emitter (B to E). Saturation is obtained in the majority of bipolar switching transistors by delivering a current 50–800 times larger than the required base current into the collector from the relay coil. The beta value() of the BC109 at 2mA is now approximately 290. (Sheet of data). The relay-based NPN transistor switching circuit is shown in Fig. 8

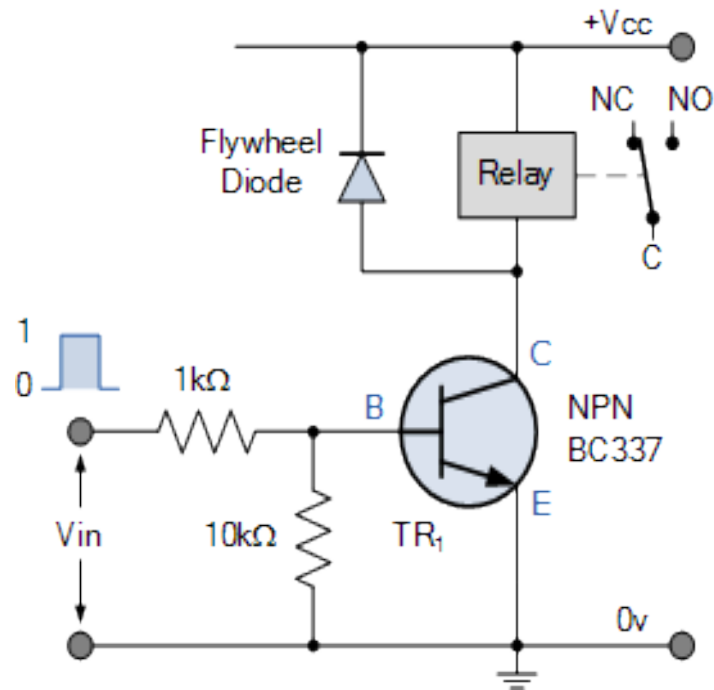


Figure 8: NPN Relay Switching Circuit [3]

Remember that the relay coil functions as both an inductor and an electromagnet. Ohm's Law ( $I = V/R$ ) states that the coil's DC confrontation generates the most current when the transistor switches power to the coil. Part of this energy is preserved by the magnetic field of the relay coil. Turning off the transistor reduces the magnetic field and the current flowing through the relay coil. A reverse voltage rises across the coil as a result of the magnetic field's stored energy needing to be released in order to maintain the relay coil current flowing. over instance, allowing the voltage to accumulate over an extended period of time may cause the switching NPN transistor to fail [3].

### 3.7 Push Button

A push-button, also referred to as a pushbutton or just a button, is a basic switch mechanism that can be used to control a number of machine or process tasks. Buttons

are made of durable materials and are typically made of metal or plastic.

A push button switch is a tiny, sealed device that, when pressed, completes an electrical circuit. When it is turned on, a tiny metal spring within makes contact with two wires, allowing electricity to flow. A push button-like switch only operates while it is being pressed, as opposed to a traditional "on/off" switch, which latches in its fixed position. Momentary switches typically have two states: open and closed. A normally open switch does not make contact until it is depressed [4].

A part known as an electric switch is one that halts the flow of electrons via a circuit. Light switches have a straightforward design and are often binary devices that can only be fully on or off. The circuit is broken and the power flow is stopped when the switch is turned off. The two elements of a circuit are a power source and a load. Fig. 3.7 shows the push switch of our proposed system used.



Figure 3.7: Push Button [4]

### **3.8 SD Card**

The Secure Digital (SD) non-volatile memory card format was developed by the SD Card Association (SDA) for use in portable electronics.

In August 1999, SanDisk, Panasonic (Matsushita Electric), and Toshiba jointly established the standard as an improvement over Multi Media Cards (MMC). It has since become the standard in the business. Together, the three companies established SD-3C, LLC, which licenses and protects intellectual property related to SD memory cards, SD hosts, and associated products. [5].

To promote and develop SD Card standards, the businesses also established the SD Association (SDA), a non-profit organization, in January 2000. Currently, SDA has roughly 1,000 member businesses. To ensure adherence to its specifications and user compatibility, the SDA employs a number of trademarked trademarks owned and

licensed by SD-3C. Fig. 3.8 shows the SD Card of our proposed system used.

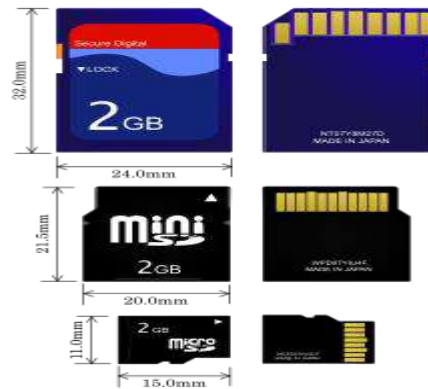


Figure 3.8: SD Card [5]

### 3.8.1 SD Card Adapter

An SD and MMC card adaptor called SatanDisk is available for Atari 16-bit computers like the 2007-invented Atari ST. Atari's SH204, SH205, and Megafile mechanical hard drives as well as related devices are intended to be replaced. The pre-production phase is complete, and the majority of clients have received their orders. The interface, which has been tested to work with TOS versions 1.02 to 2.06, enables the attachment of an SD or MMC card to the ACSI (hard disc) port of Atari systems. The largest size that is supported is 4 GB. The device can currently only be utilized successfully with the proprietary and paid HDDriver driver package and appears to the OS as any standard ACSI mounted hard disk. [6]



Figure 11: SD card Adapter [6]

The sequel UltraSatan, developed by Jookie (Miroslav NOHAJ), was released in 2009 and supports two SD/MMC cards concurrently. The adapter incorporates a battery-backed RTC chip and hot-plug functionality for the cards. It is supported by the free ICD PRO in addition to the paid HDDriver. Fig. 11 shows the SD Card reader of our proposed system used.

### 3.9 Power Adapter

To connect to the Arduino, we use a 5V 2A power adapter; to connect to the GSM module, we need a 12V 1A power adapter. Fig. 10 shows the hardware overview of the power supply, which has an output voltage of 02 amps at 05 volts DC and an AC input of 220 volts. This comprehensive approach to power supply design enhances the stability and safety of the entire system, contributing to its overall performance and durability.



Figure 3.9: Power adapter [7]

A power supply is an electrical device that supplies power to a load. A power supply's main job is to transform incoming electrical current into the voltage, current, and frequency required to operate a load. Electric motors/power converters and electricity generators are made possible for this reason. Power supplies can be built inside the appliance itself, or they can be linked directly to the load appliances they are intended to power. Consumer gadgets such as laptops and desktop PCs frequently require this type of power source. Power supplies, for instance, can exercise to keep electronic noise from reaching the load, limit the current load resistance to acceptable limits, shut off the current in the event of a power outage, and store energy so that, in the event that the source power fails (an uninterruptible power supply), they can still keep the load powered. [7] While a source receives energy, an output connection transfers power from the power supply to the load. Anything from batteries to fuel cells to generators to alternators to solar power converters can be used as a power source. A power supply does not always require hardwired circuit connections, but most of them do. Certain power supplies, for instance, provide extra inputs and outputs that can be utilized for external control and monitoring.

### 3.10 Liquid-Crystal Display

Liquid crystals and polarizers are used by LCDs and other electronically altered optical devices to regulate the amount of light that is emitted. Using liquid crystals to create color or monochrome images requires a reflector or backlight. LCDs can show or hide random images or preprogrammed text, numbers, and seven-segment displays (like a digital clock) (such as a general-purpose computer display). On screens, some make use of larger components, while others create random images using a grid of tiny pixels. LCDs can be turned on or off according to the polarizer configuration (negative). Character negative LCDs display white text against a black background that matches the color of the backlight, as opposed to white text against a black background. These devices are electronic devices that have LCD screens that are found both indoors and outside. Tiny LCD screens can be found in mobile phones, digital cameras, and calculators, among other devices. Alarm clocks, DVD players, and video game consoles are examples of devices with LCD screens. Most monitors that used cathode ray tubes (CRTs) have been replaced with displays that use liquid crystal displays (LCDs). Hardware specifications for a 16x2 LCD are shown in Fig. 11 A total of 32 digits may be shown at a time on this LCD.

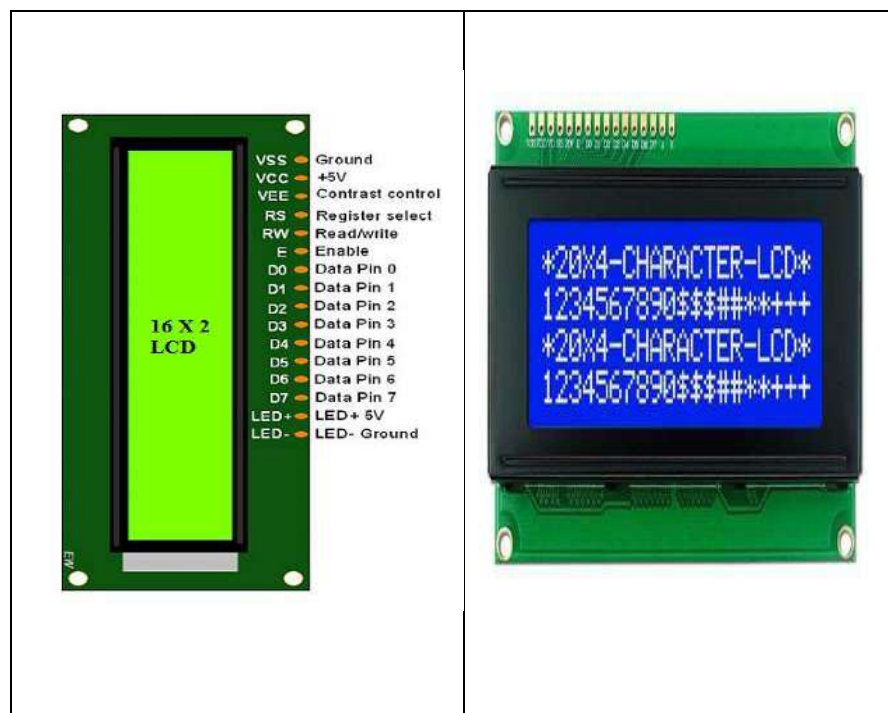


Figure 3.10: LCD Display [8]

From tiny digital watches to enormous television sets, CRT and plasma displays are

available in a variety of sizes. OLEDs use a single glass or plastic panel instead of two separate glass panels, which increases in thickness with screen size and is more noticeable on LCDs (as the display is only "on" where needed and there is no backlight). This results in a lower load, thinner profile, and likely lower power consumption for a given display size. Because phosphors are expensive EL materials required for a specific display size, OLEDs are more expensive. LCDs can be recycled, but OLED display recycling technology is not yet widely available. Screen burn-in may occur from the phosphors used in OLEDs and other optoelectronic devices. The advent of quantum dot displays has increased the longevity of LCDs.

### 3.10.1 Specifications

- Reaching a conclusion We may use a pixel count of 1024768 to estimate LCD resolution because red, green, and blue subpixels make up the majority of each pixel. There were few constants among LCD displays. Quattron uses sub-pixel sharing between pixels to raise the apparent resolution of a display without raising the real resolution.
- At close range, phrases like "pixels per inch" or "dot pitch" may be used to characterize the resolution of a computer monitor or other display. On TVs, the display density is good for close-up detail, but it is low for long-distance viewing.
- One essential factor to take into account when assessing an LCD display's ability to accurately and quickly relay visual changes is how often it displays data. With LCD panels, there is no refresh-induced flicker because the pixels do not flash in between frames. Smearred or ghosted images might appear when the refresh rate is lowered for rapidly moving pictures. Due to the inherent latency that displays have while transmitting a picture, a fast-changing projected image has the potential to generate visual anomalies on any given display. One major difficulty is the reaction time of each individual pixel.
- The color performance of the display can be described in a number of different ways. Unfortunately, color gamut a measurement of how finely the spectrum may be split is not included in marketing brochures unless they are

utilized by specialists. Conversely, color depth describes the spectrum of colors that are accessible. As having a color range that exceeds the information on the screen has no value, displays are only made to function within or below a preset standard. Two of these additional characteristics that assist identify white and show how it differs from other colors are white point correction and gamma correction. [8]

- The contrast ratio of a picture is the difference between the brightness of a on pixel and the brightness of an off pixel. The LCD uses a light valve to give lighting; the backlight, which could be LEDs or fluorescents, doesn't. An LCD's transparency and backlight brightness are two of the many variables that might impact the screen's brightness. Brightness is sacrificed for a longer battery life..

### 3.11 Wi-Fi Module (Esp8266)

The Wi-Fi networking functions of the ESP8266 can be offloaded or hosted on an application processor. The gadget may boot from flash memory if the ESP8266 is the only processor inside. An inbuilt TCP/IP protocol stack allows the self-contained ESP8266 Wi-Fi Module to be used to connect any microcontroller to a Wi-Fi network. and stress on the module. The front-end module is integrated on-chip to minimize the amount of external circuitry needed. Fig. 3.11 shows the ESP8266 Wi-Fi module.

#### 3.11.1 Wi-Fi Module (Esp8266) Pin Configuration

**Table 2** presents the pin setup and working technique for the ESP-8266 Wi-Fi Module.



Figure 3.11: Wi-Fi Module (ESP8266) [9]

Table II: WI-FI MODULE (Esp8266) PIN CONFIGURATION

Pin Number	Pin Name	Normally used for	Alternate purpose
1	Ground	Connected to the ground of the circuit.	
2	TX	To upload a program, it is connected to the programmer's Rx pin.	When not being utilized as a TX, can function as a general-purpose input/output pin.
3	GPIO-2	General purpose Input/output pin.	
4	CH_EN	Chip Enable – Active high	
5	GPIO-0	General purpose Input/output pin.	holds the module into serial programming when the start button is depressed.
6	Reset	Resets the module.	
7	RX	general intent output/input pin.	When not being used as RX, can function as a general-purpose input/output pin. [13]
8	VCC	Connect to +3.3V only	

### 3.11.2 Wi-Fi Module (Esp8266) Features

- Wi-Fi Module that is low-cost, small, and powerful
- Maximum input/output voltage: 3.6V
- Maximum input/output voltage: 3.6V
- 12 mA is the input/output source current, and (+3.3V) is the power supply.  
Maximum input/output voltage: 3.6V
- Encourages deep sleep (10 uA)

### 3.12 Accelerometer

Electromechanical accelerometers can be used to measure acceleration forces. Only the gravitational force of  $g$  allows for the detection of acceleration in this location. The unit of measurement for acceleration. [10]

- The ADXL335 is an accelerometer in terms of measuring axes; it measures x, y, and z accelerations within a 3g range.
- This module's output voltage varies in response to changes in acceleration.
- Signal conditioning circuits and polysilicon sensors are made by surface micromachining.
- An accelerometer hardware overview is shown in Fig. 3.12, which illustrates the various axis of module instructions (x, y, and z).
- To measure acceleration in X, Y, and Z, an analog voltage must be applied
- The accelerometers can detect acceleration and convert it into measurable quantities like electrical signals.

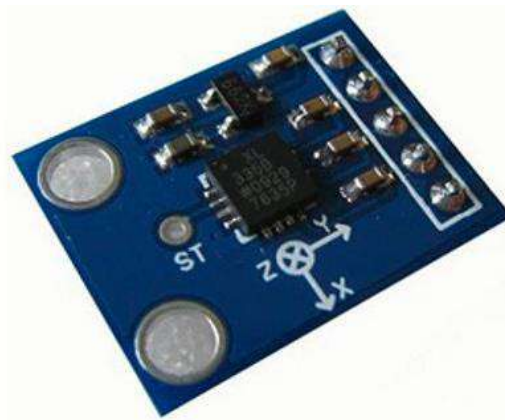


Figure 3.12: Accelerometer [10]

#### 3.12.1 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.

To measure acceleration in X, Y, and Z, an analog voltage must be applied to each of the output pins of the ADXL335 accelerometer. The hardware overview of the accelerometer pin design is shown in Fig 13

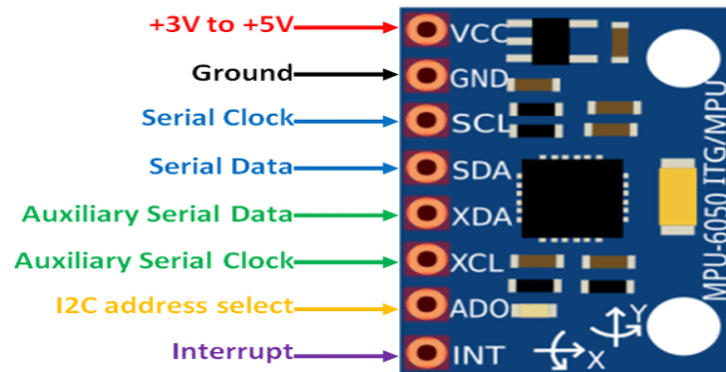


Figure 16: Pin Diagram [10]

### 3.12.2 Use MPU6050

The MPU6050 has three-axis gyroscope and accelerometer. This method can be used to calculate an object's acceleration, velocity, and direction in addition to other motion-related properties. The Digital Motion Processor (DMP), another feature of this module, allows it to perform intricate calculations while using less CPU power. Two auxiliary pins can be used to connect external IIC modules, like a magnetometer, however this is not required. Several sensors can be connected to the microcontroller via the ADO pin since the MPU6050 sensor module's IIC address is modifiable. It's very simple to use this module in your project because libraries for popular platforms like Arduino are included. This motion sensor is the best for RC cars, drones, self-balancing robots, humans, and bipeds. [10]

### 3.13 Temperature Sensor

This resistor's resistance changes in response to temperature changes. These NTC MOSFETs have a negative electrical resistance versus temperature (R/T) relationship because they are composed of oxide that has already undergone sintering. Negative temperature coefficient (NTC) characteristics make it suitable for precise temperature measurements across a wide range of operating conditions, enhancing the accuracy and efficiency of temperature monitoring systems. The

hardware overview of a temperature sensor model manufactured by NTC, such this model 103, is depicted in Fig. 14



Figure 3.13: NTC [11]

Transducer is a solid-state thermistor device, much like an electrical resistor. An apparatus that generates an analogous output voltage in response to temperature variations is called a transducer. Thus, physical and external changes in heat have an impact on a substance's electrical characteristics. [9] A two-terminal solid-state temperature transducer, consisting of a ceramic disc or bead and two metal oxides, is molded together to create a thermistor. This enables the thermistor to react to minute variations in the surrounding temperature by adjusting its resistance value. The term "thermistor" is an acronym for "THERM-ally sensitive resistor" since a change in temperature causes a change in resistance. In some circumstances, temperature sensing circuits may profit from the change in resistance brought on by heat rather than standard resistors. Thermometers are frequently employed as temperature sensors because they are non-linear changing devices that can measure the temperature of both liquids and the surrounding air. Their chemical behavior is based on the change in temperature of the thermistor, which causes the outer (valence) electrons to become more or less active. As a result, the thermistor's temperature coefficient might be either positive or negative. They can therefore easily tolerate temperatures of up to 200 degrees Celsius. In addition to being used as resistive temperature sensors, thermocouples can also be used in conjunction with another device to regulate the amount of electrical current that passes through them. These devices are sensitive to temperature changes in addition to serving as current limiters. The reaction times and working temperatures of thermistors vary depending on their kind, composition, and dimensions. Hermetically sealed thermistors can also be used to eliminate measurement inaccuracies caused by moisture. The bead, disk, and glass-encased variants of thermistors are the three most popular varieties.

### **3.13.1 Negative Temperature Coefficient Thermistor**

When the ambient temperature rises, NTC thermistors—also known as negative temperature coefficient of resistance thermistors—either entirely or substantially reduce their resistive value. NTC thermistors are the most popular kind of temperature sensor since they may be used in almost any kind of equipment that is sensitive to temperature. NTC temperature thermistors have a negative electrical resistance to temperature (R/T) relationship. The high negative sensitivity of an NTC thermistor means that even small temperature changes can result in noticeable increases in electrical resistance. As a result, they work well for monitoring and controlling temperature. Because the thermistor's resistance is extremely sensitive to temperature, we may measure it at any temperature by passing a continuous current through it and then monitoring the voltage drop that occurs at its junction. NTC thermistors' resistance lowers with rising heat due to the large range of base resistances and temperature curves that are available. The base resistance of NTC thermistors at room temperature, or 77 degrees Fahrenheit, is frequently used to identify them since it offers a simple reference point. Examples of temperature ranges are 2k $\Omega$  at 25 °C, 10k $\Omega$  at 25 °C, 47k $\Omega$  at 25 °C, and so forth. The "B" value of a thermistor is also significant. The fixed value of the B value is dependent on the type of ceramic material used. Applying it to a certain temperature range reveals the resistive (R/T) curve's slope. Because every thermistor has a unique material constant, the resistance vs. temperature curve will differ from one another. The B value will specify the resistive value of the thermistors at the first temperature, or base point, T<sub>1</sub>, and the B value will specify the resistive value of the thermistors at the second temperature point, T<sub>2</sub>, which is 100 $^{\circ}$ C. As a result, between T<sub>1</sub> and T<sub>2</sub>, the B value will determine the thermistors' material constant. That is,  $B_{T_1/T_2}$  or  $B_{25/100}$ , where the usual B values of NTC thermistor range from around 3000 to 5000 [11]. These NTC MOSFETs have a negative electrical resistance versus temperature (R/T) relationship because they are composed of oxide

### **3.14 MAX30100 Pulse Oximeter and Heart-Rate Sensor**

In addition, the MAX30100 sensor has pulse oximetry and a heart rate monitor. It makes use of two LEDs, a choice, better optics, low-noise analog-to-digital processing, and pulse oximetry and breathing rate detection. Fig. 3.14 shows a

hardware overview of the MAX30100, which may be found here. The MAX30100 sensor combines a heart rate monitor and an oximeter. After two LEDs emit two distinct light wavelengths—red and infrared—this optical sensor uses a photodetector to measure the absorbance of pulsing blood. The MAX30100's hardware overview contains a schematic and pin diagram descriptions



Figure 3.14: MAX30100 [12]

This mix of LED colors is suitable for reading data with the tip of your finger. The MAX30100's pulse oximetry subsystem consists of a discrete temporal filter, a 16-bit sigma delta ADC, and ambient light cancellation (ALC). Because it uses so little power, it is perfect for devices that run on batteries. A 1.8-to 3.3-volt supply is required for the MAX30100 to function properly. It could be useful for any form of wearable technology, including medical monitors and fitness trackers. The 1.8V and 3.3V power sources of the MAX30100 may have their standby current reduced by software, negating the need to remove the power supply while the device is not in use. As can be seen in Fig. 3.14, the MAX30100's hardware overview contains a schematic and pin diagram descriptions.

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

### 3.14.1 Pin Configuration of MAX30100

The MAX30100's hardware overview contains a schematic and pin diagram descriptions. The 1.8V and 3.3V power sources of the MAX30100 may have their standby current reduced by software

As can be seen in Fig. 3.19, the MAX30100's hardware overview contains a schematic and pin diagram descriptions.

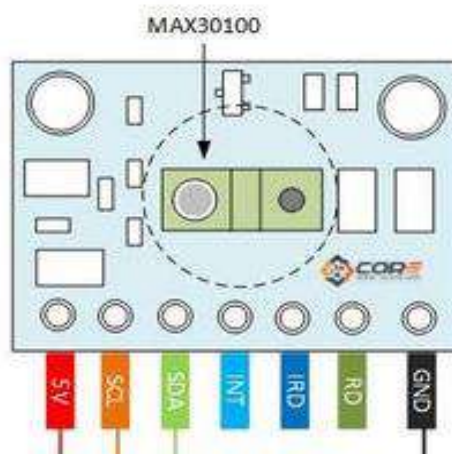


Figure 19. Pin diagram of MAX30100 [12]

### 3.14.2 Specifications and Features of MAX30100

- This pulse oximetry and heart rate monitoring sensor is integrated with LEDs, photosensors, and an analog front end.
- 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
- 5.6 x 2.8 x 1.2 mm optically improved System-in-Package
- 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

## Chapter 04

### RESULT ANALYSIS

#### 4.1 Introduction

This chapter discusses the entire project and includes the findings. We have also talked about system approach and objectives. The major tools utilized in this project are the Arduino Nano, RTC module, SD Card, SD Card reader, push switch, LED, Relay Switching Circuit, etc., each of which provides the correct value. According to the state of the plant, these system and input values produce the right results. The project's outcomes are shown in the table below. For the additional aim of health monitoring, this industry employs two methods, one of which is website-based (automatic) control and the other of which is manual control.

Website Result:

Website is two parts:

1. Controlling.
2. Monitoring the whole System.

#### 4.2 System Result

After the system initialize the LCD show this message, the system need to set the medicine reminder time.



Figure 4.1: System initialize



Figure 4.2: Medicine Reminder time 01



Figure 4.3: Medicine Reminder time 02



Figure 4.4: Medicine Reminder time 03

The above Fig. 4.2, 4.3, 4.4 show the medicine reminder time. Our propose system we can select three times for patient respectively morning, noon and night. To select the times we have to press the yellow switch and enter the function. Here we can select hours, minutes, seconds respectively, for this reason we increase and decrease the time through the red swtich.



Figure 4.5: Medicine Taken Time Set



Figure 4.6: Show the real time after declaring the medicine taking time

Once the time is determined, we will directly set the time by confirming with the white switch, which is shown in Fig. 4.5, after selecting the time the, the calculated

times will appear on the display, as shown in Fig. 4.6. The Fig. 4.7 show medicine reminder box and all section is mentioned.



Figure 4.7: Medicine Reminder Box

The below Fig. 4.8 show the patient heart rate, temperature, fall status, 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.

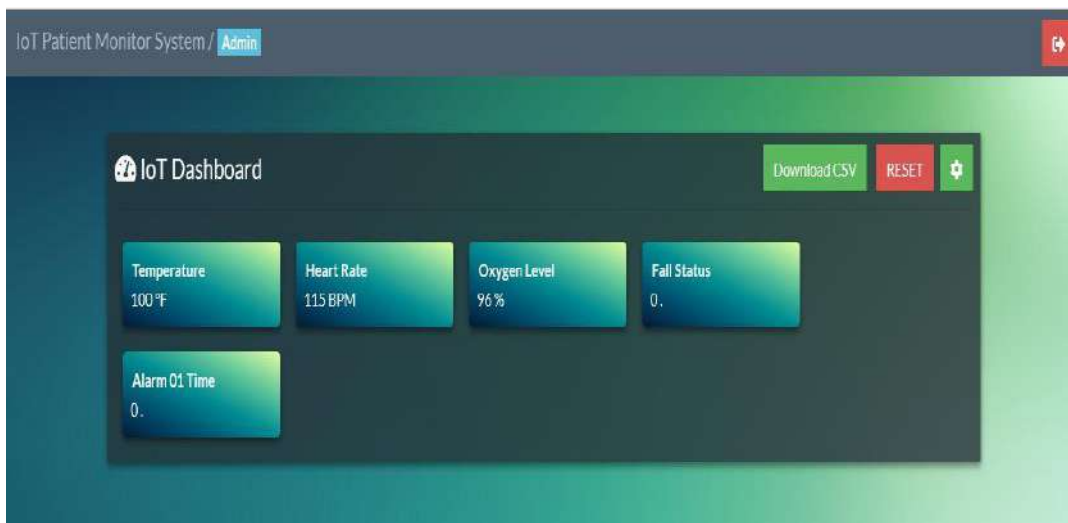


Figure 4.8: Server Data for attempt 01

TABLE III HEART RATE DATA ANALYSIS

Standard Value		Given Vlaue of our Proposed System
60 bpm	Normal	49 bpm (Fig. 4.9)
80 bpm	Normal	72 bpm (Fig. 4.10)
100 bpm	Normal	99 bpm (Fig. 4.12)
150 bpm	Abnormal	156 bpm (Fig. 4.14)

TABLE IV BODY TEMPERATURE ANALYSIS

Standard Value		Given Vlaue of our Proposed System
60 F	Normal	98 F (Fig. 5.9)
80 F	Normal	99 F (Fig. 5.10)
90 F	Normal	97 F (Fig. 5.13)
100 F	Abnormal	100 F (Fig. 5.14)

TABLE V OXYGEN LEVEL ANALYSIS

Standard Value		Given Vlaue of our Proposed System
95 %	Normal	94 % (Fig. 5.9)
97 %	Normal	95% (Fig. 5.10)
100 %	Normal	95 F (Fig. 5.13)
80 %	Abnormal	No Data Collect

The below Fig. 4.9 to Fig. 4.14 is showing the six patient body heart rate vale, temperature value, oxygen level, show the LCD.



Figure 4.9: Patient Health data 01

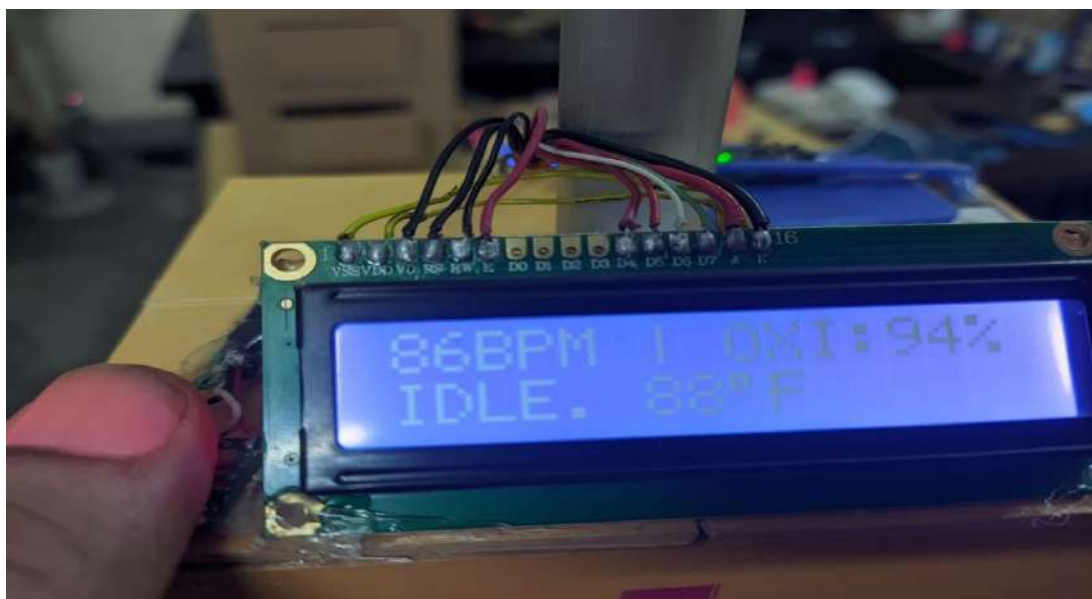


Figure 4.10: Patient Health data 02

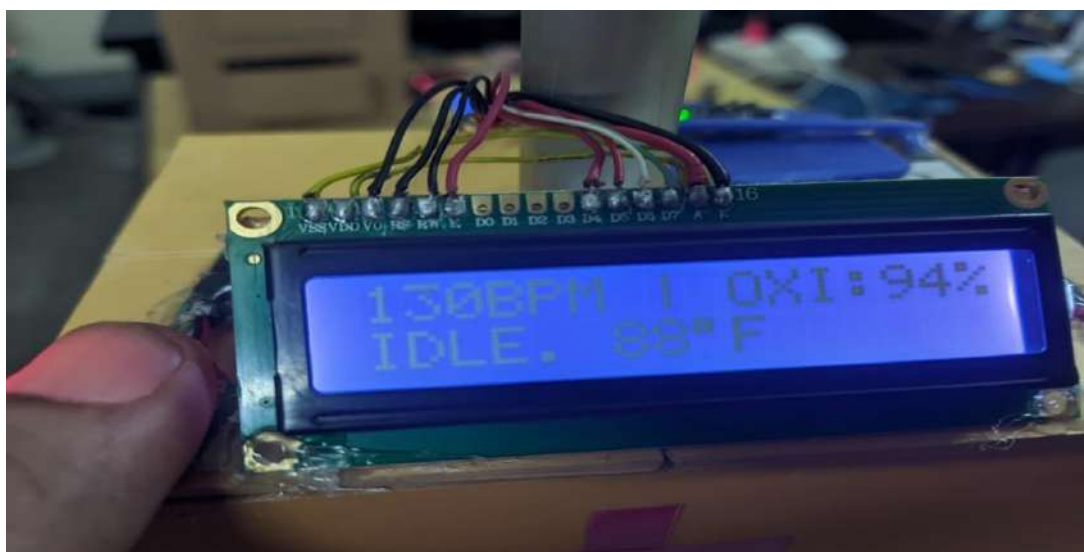


Figure 4.11. Patient Health data 03

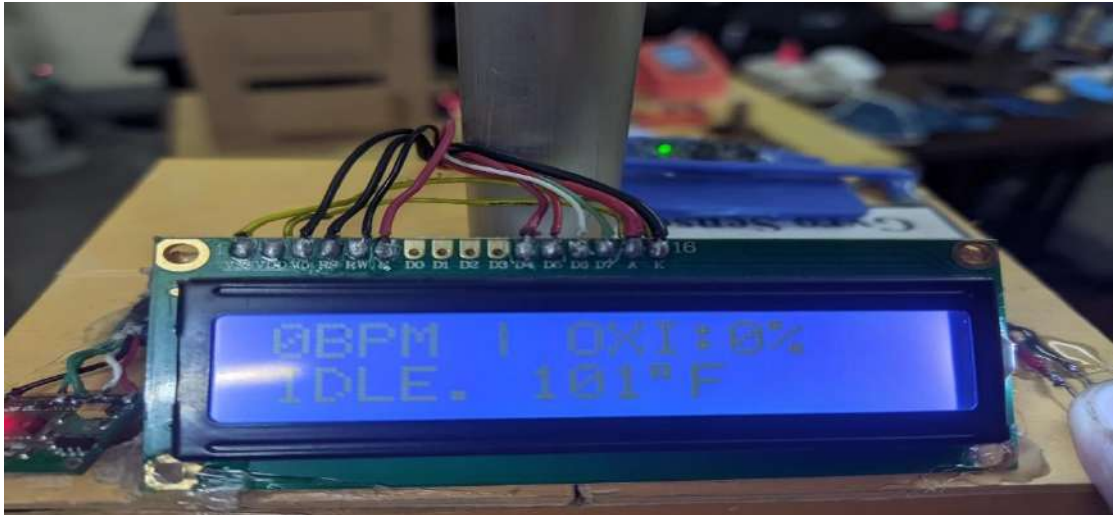


Figure 4.12: Patient Health data 04



Figure 4.13: Patient Health data 05

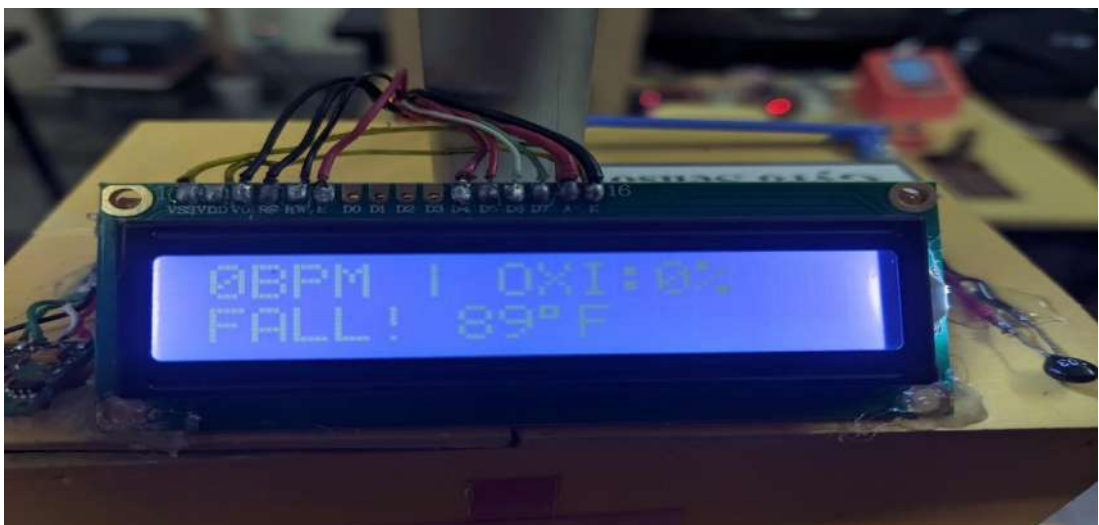


Figure 4.14: Patient Health data 06

### 4.3 Hardware Overview

The medicine reminder time setting depicted in Fig. 4.15 allows users to configure specific time periods for medication reminders, such as morning, noon, and night. This intuitive interface simplifies the process of scheduling medication doses according to the user's daily routine, enhancing adherence to prescribed medication regimens. With clear visual cues and easy-to-use controls, the medicine reminder feature becomes more accessible and user-friendly, facilitating better medication management and promoting overall health and wellness.

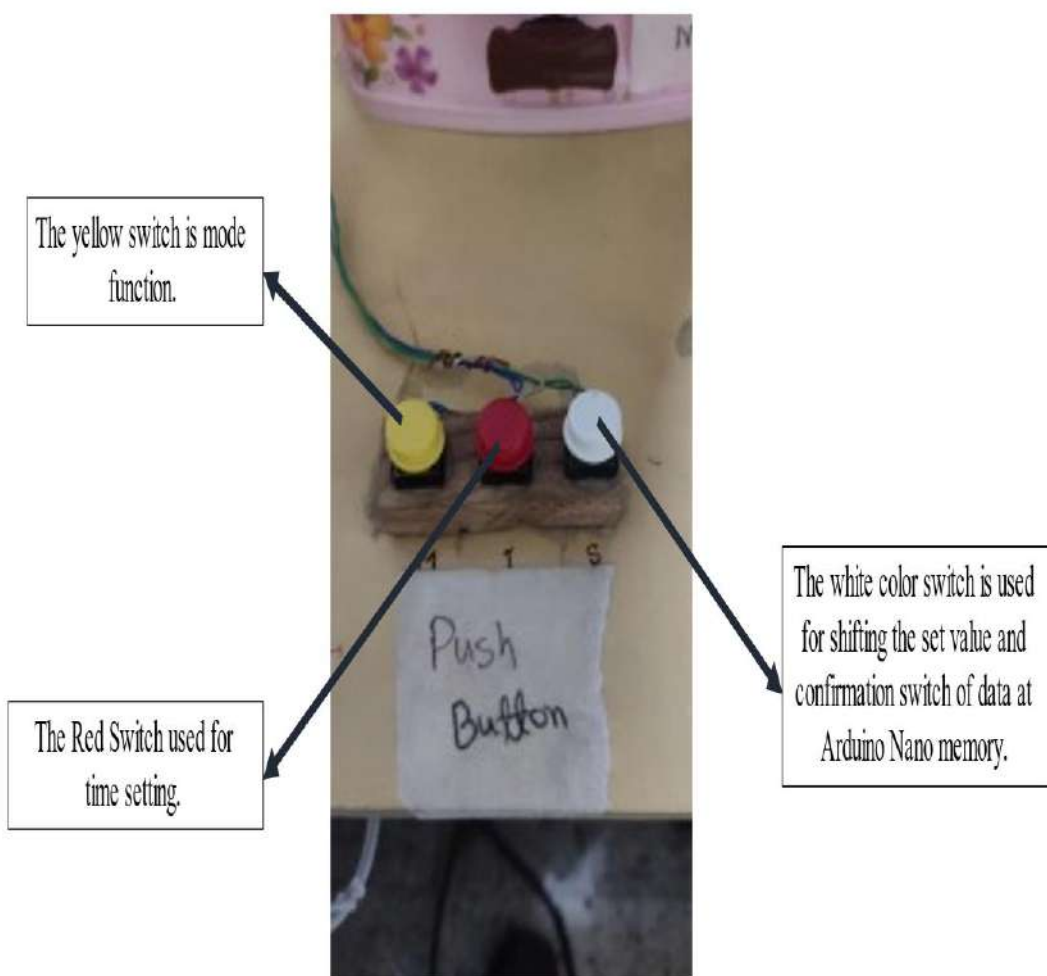


Figure 4.15: Medicine Reminder Time Setting Section

The yellow switch insert the time setting function mode on, the red switch is increase the time value and the white switch is shifting the cursor of time setting posstion, and also confirmation of time setting. The below Fig. 4.16, the comprehensive system overview showcases the integration of various components, including the medicine

reminder section, health monitoring section, and potentially other features such as communication modules and data storage capabilities.

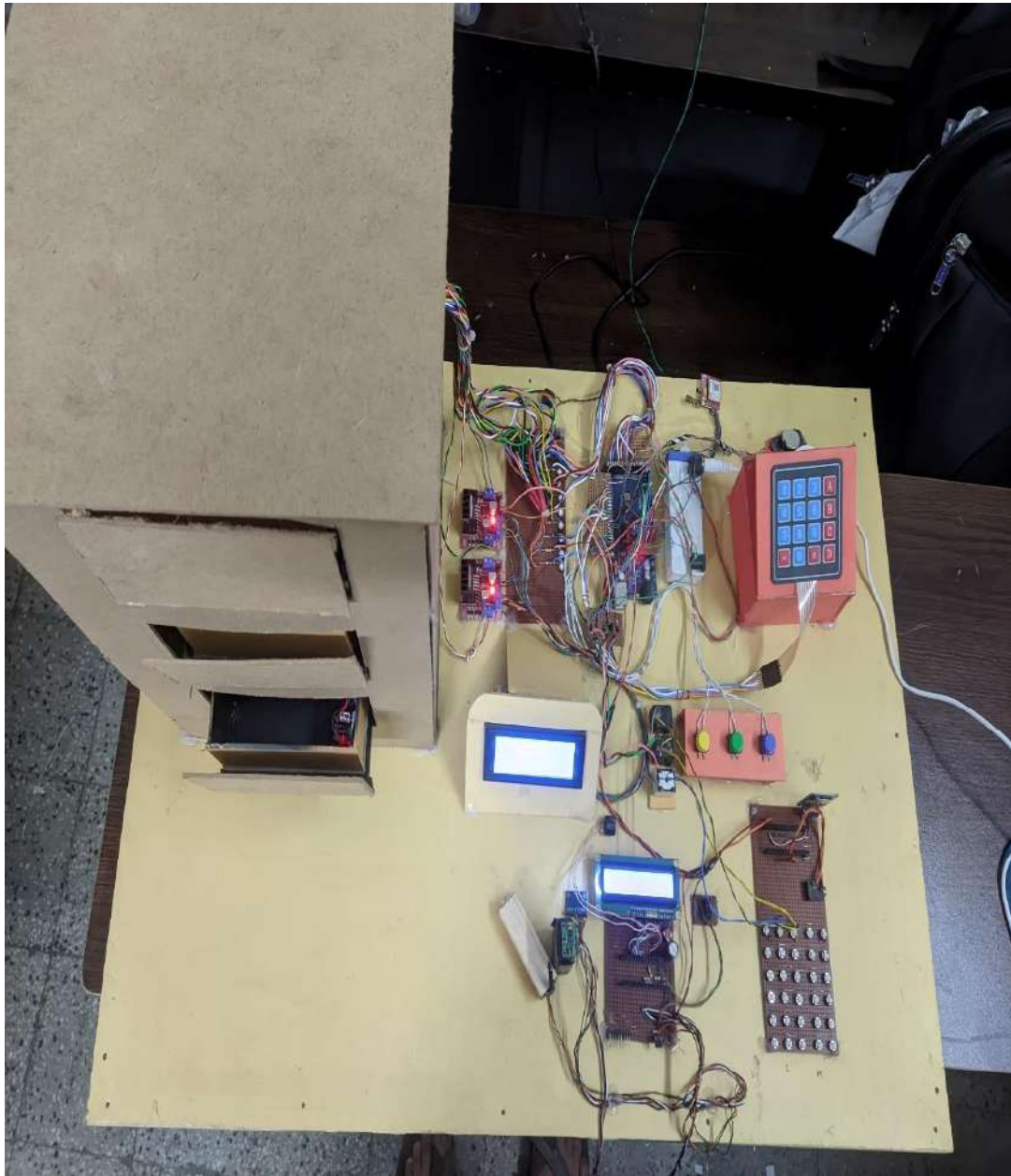


Figure 4.16: Our System Overview

This holistic view provides a clear understanding of how different functionalities interact within the system, facilitating efficient operation and maintenance. By incorporating user-friendly controls and intuitive interfaces, the system ensures seamless interaction for users, enabling them to manage medication schedules, monitor health parameters, and access vital information with ease. Additionally, the inclusion of connectivity features allows for remote monitoring and data sharing, enhancing accessibility and enabling healthcare professionals to provide timely interventions and support as needed.

#### 4.4 Cost of the Components

The below Table 4.4 of Cost of these project equipment's are given below:

TABLE VI COST OF THE COMPONENTS

SL. No	Components Name	Quantity	Price (BDT)
1	Arduino Nano	02 Pcs	800/-
2	Wi-Fi module esp8266	01 Pcs	320/-
3	Medicine Box	01 Pcs	300/-
4	Temperature Sensor	01 Pcs	10-
5	Gyro Sensor	01 Pcs	280/-
6	Max30100	01 Pcs	340/-
7	SD Card Module	01 Pcs	130-
8	LCD Display	02 Pcs	540/-
9	Power Supply	01 Pcs	250/-
10	GSM Module	01 Pcs	450/-
11	RTC Module	01 Pcs	190/-
12	Battery	01 Pcs	140/-
13	Arduino Mega	01 Pcs	1300/-
	Others	-----	1450/-
		<b>Total =</b>	<b>6500/-</b>

## **Chapter 05**

### **CONCLUSION**

#### **5.1 Conclusion**

The "Design and Implementation of Smart Medicine Reminder Box" project, which is the best economical, accessible energy solution for regular people, has been successfully tested and executed. The device's primary function is to remind elderly individuals or patients to take their medications on schedule and in the proper dosage. In this paper, we introduce a case study of a medication reminder system that helps, mainly, elderly patients who forget to take their medicines at prescribed time. Since this box is transportable, patients can bring it everywhere they go. The device's power consumption is also excessively low. The system used in this instance is a prototype. The gadget can be made smaller and more energy-efficient by using a multilayer PCB with SMD (Surface Mount gadget) IC packaging. Additionally, the system has several drawbacks. It won't alert the patient's attendant if the patient purposefully resets the system without taking the medication. This device may eventually get a notification system so that the patient attendant will be alerted if a patient forgets to take their medication.

#### **5.2 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.

#### **5.3 Limitation**

- Internet support.
- The Complexity of the installation makes it hard for the user to fix the error.
- The whole process depends on the network, so if there is no network, the system will not work.

## **5.2 Future Scope**

In the future, we can develop a nearby reminding or remotely by sending an SMS message to the distant patient after a specific period. We intend to concentrate on enhancing the system's overall performance. Additionally, attention will be paid to interactions between patients and doctors via secure prescriptions and video chatting. We'll concentrate on a few more strategies for achieving drug adherence. The patients will receive a schedule of medication intake times along with a description of the medication, its beginning and ending dates, notice through message or email, an automated alert system, and a navigation system. In the future, we intend to enhance our medication remembrance system by adding more functions via a mobile app and incorporating additional medical services like giving liquid doses and measuring blood pressure, blood glucose, and giving insulin injection.

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## APPENDIX

### Medicine Reminder Set Time:

```
#include <Keypad.h>

#include <Wire.h>

#include<EEPROM.h>

#include <RTCLib.h>

#include <Servo.h>

#include <SoftwareSerial.h>

#include <LiquidCrystal.h>

int value = 1;

int buttonState = 1;

const int rs = A8, en = A9, d4 = A10, d5 = A11, d6 = A12, d7 = A13;

LiquidCrystal lcd(rs, en, d4, d5, d6, d7);

// GSM Module Configuration

#define GSM_TX_PIN 6

#define GSM_RX_PIN 7

SoftwareSerial gsmSerial(GSM_TX_PIN, GSM_RX_PIN);

// Keypad Configuration

const byte ROWS = 4; // Four rows

const byte COLS = 4; // Four columns

char keys[ROWS][COLS] = {
```

```

    {'1', '2', '3', 'A'},

    {'4', '5', '6', 'B'},

    {'7', '8', '9', 'C'},

    {'*', '0', '#', 'D'}

};

byte rowPins[ROWS] = {17, 16, 15, 14}; // Connect to the row pinouts of
the keypad

byte colPins[COLS] = {A2, 2, 3, 4}; // Connect to the column pinouts of
the keypad

Keypad keypad = Keypad(makeKeymap(keys), rowPins, colPins, ROWS,
COLS);

// Mobile Number Storage

#define MOBILE_NUMBER_ADDRESS 0

#define MOBILE_NUMBER_LENGTH 20 // Update the length to
accommodate more digits

// Flag for Number Save Mode

bool numberSaveMode = false;

// Mobile Number

String mobileNumber;

//RTC_DS1307 iRTC;

```

```
RTC_DS3231 RTC;

int temp, inc, hours1, minut, add = 11;

int next = 23;

int INC = 25;

int set_mad = 27;

int LED1 = A1;

int LED2 = A2;

int LED3 = A3;

#define buzzer 6

int buzzer1 = 5;

int HOUR, MINUT, SECOND, oldSec;

byte alarm = 0;

long prevMs;

int tem[17];

int buttonPin1_1 = 29; // Button 1 pin for Servo 1

int buttonPin1_2 = 31; // Button 2 pin for Servo 1

int buttonPin1_3 = 33; // Button 3 pin for Servo 1

int buttonPin2_1 = 35; // Button 1 pin for Servo 2

int buttonPin2_2 = 37; // Button 2 pin for Servo 2

int buttonPin2_3 = 39; // Button 3 pin for Servo 2
```

```

int buttonPin3_1 = 41; // Button 1 pin for Servo 3

int buttonPin3_2 = 43; // Button 2 pin for Servo 3

int buttonPin3_3 = 45; // Button 3 pin for Servo 3

// Define variables for relay control pins and motor movement flags

int iRelay1_1 = 8; // Pin for controlling relay 1, terminal 1

int iRelay1_2 = 9; // Pin for controlling relay 1, terminal 2

int iRelay2_1 = 10; // Pin for controlling relay 2, terminal 1

int iRelay2_2 = 11; // Pin for controlling relay 2, terminal 2

int iRelay3_1 = 12; // Pin for controlling relay 3, terminal 1

int iRelay3_2 = 13; // Pin for controlling relay 3, terminal 2

// Flags to track motor movement status

bool imotorMoved = false; // Flag for motor 1 movement status

bool imotorMoved1 = false; // Flag for motor 2 movement status

bool imotorMoved2 = false; // Flag for motor 3 movement status

//int alarm =1; // Alarm variable0.

bool slot1Complete = false;

bool slot2Complete = false;

bool slot3Complete = false;

bool slot4Complete = false;

```

```

bool slot5Complete = false;

bool slot6Complete = false;

bool slot7Complete = false;

bool slot8Complete = false;

bool slot9Complete = false;

void setup() {

    Wire.begin();

    // Initialize GSM module

    gsmSerial.begin(9600);

    delay(2000); // Wait for the GSM module to stabilize

    sendATCommand("AT"); // Check if the GSM module is responsive

    // Initialize fRTC imodule

    RTC.begin();

    // Initialize I2C display

    //lcd.backlight(); // Turn on the backlight

    lcd.setCursor(0, 0);

    lcd.print("Mobile Number"); // Display initial text

    // Check if a mobile number is already saved in EEPROM

    if (isMobileNumberSaved()) {

        mobileNumber = readMobileNumber();

```

```

    lcd.setCursor(0, 1);

    lcd.print("Saved: " + mobileNumber);

    delay(2000); // Display saved mobile number for 2 seconds

} else {

    mobileNumber = "";

    lcd.setCursor(0, 1);

    lcd.print("Not saved");

    delay(2000); // Display "Not saved" for 2 seconds

}

lcd.clear(); // Clear the display

// Set pin modes for various pins

pinMode(INC, INPUT_PULLUP); // Configure pin INC as input with internal
pull-up resistor enabled

pinMode(next, INPUT_PULLUP); // Configure pin next as input with internal
pull-up resistor enabled

pinMode(set_mad, INPUT); // Configure pin set_mad as input

pinMode(buzzer, OUTPUT); // Configure pin buzzer as output

pinMode(LED1, OUTPUT); // Configure pin LED1 as output

pinMode(LED2, OUTPUT); // Configure pin LED2 as output

pinMode(LED3, OUTPUT); // Configure pin LED3 as output

pinMode(buzzer1, OUTPUT); // Configure pin buzzer1 as output

```

```

//RTC.adjust(DateTime(DATE,TIME));

RTC.adjust(DateTime(2023, 9, 6, 20, 10, 0));

    for (int i = 11; i < 17; i++) {

        tem[i] = EEPROM.read(i);

    }

// Set pin modes for button pins in group 1

pinMode(buttonPin1_1, INPUT_PULLUP); // Configure buttonPin1_1 as input
with internal pull-up resistor enabled

pinMode(buttonPin1_2, INPUT_PULLUP); // Configure buttonPin1_2 as input
with internal pull-up resistor enabled

pinMode(buttonPin1_3, INPUT_PULLUP); // Configure buttonPin1_3 as input
with internal pull-up resistor enabled

// Set pin modes for button pins in group 2

pinMode(buttonPin2_1, INPUT_PULLUP); // Configure buttonPin2_1 as input
with internal pull-up resistor enabled

pinMode(buttonPin2_2, INPUT_PULLUP); // Configure buttonPin2_2 as input
with internal pull-up resistor enabled

pinMode(buttonPin2_3, INPUT_PULLUP); // Configure buttonPin2_3 as input
with internal pull-up resistor enabled

// Set pin modes for button pins in group 3

pinMode(buttonPin3_1, INPUT_PULLUP); // Configure buttonPin3_1 as input
with internal pull-up resistor enabled

```

```
pinMode(buttonPin3_2, INPUT_PULLUP); // Configure buttonPin3_2 as input
with internal pull-up resistor enabled
```

```
pinMode(buttonPin3_3, INPUT_PULLUP); // Configure buttonPin3_3 as input
with internal pull-up resistor enabled
```

```
pinMode(Relay1_1, OUTPUT);
```

```
pinMode(Relay1_2, OUTPUT);
```

```
pinMode(Relay2_1, OUTPUT);
```

```
pinMode(Relay2_2, OUTPUT);
```

```
pinMode(Relay3_1, OUTPUT);
```

```
pinMode(Relay3_2, OUTPUT);
```

```
digitalWrite(Relay1_2, HIGH);
```

```
delay(1500); // Motor moves forward for 1 second
```

```
digitalWrite(Relay1_2, LOW);
```

```
digitalWrite(Relay2_2, HIGH);
```

```
delay(1500); // Motor moves forward for 1 second
```

```
digitalWrite(Relay2_2, LOW);
```

```
digitalWrite(Relay3_2, HIGH);
```

```
delay(1500); // Motor moves forward for 1 second
```

```
digitalWrite(Relay3_2, LOW);
```

```

    lcd.clear();

    lcd.print("GSM: Connected");

    delay(1000);

    lcd.clear();
}

void loop() {

    // Check for keypad input

    char key = keypad.getKey(); // Retrieve key from keypad

    if (key != NO_KEY) { // If a key is pressed

        handleKeypadInput(key); // Handle keypad input

    }

    // Retrieve current time from RTC module

    DateTime now = RTC.now(); // Get current date and time

    int HOUR = now.hour(); // Retrieve current hour

    int MINUTE = now.minute(); // Retrieve current minute

    int SECOND = now.second(); // Retrieve current second

}

if (SECOND != oldSec) { // If the second has changed since the last update

    lcd.clear(); // Clear the LCD screen

    lcd.setCursor(4, 2); // Set the cursor position to row 2, column 4

    lcd.print("Medicine Reminder"); // Display "Medicine Reminder"

```

```

lcd.setCursor(4, 3); // Set the cursor position to row 3, column 4

lcd.print("Time:"); // Display "Time:"

lcd.print(HOUR, DEC); // Display the current hour

lcd.print(":"); // Display the colon separator

lcd.print(MINUTE, DEC); // Display the current minute

lcd.print(":"); // Display the colon separator

lcd.print(SECOND, DEC); // Display the current second

match(); // Call the match function

oldSec = SECOND; // Update the old second value for comparison in the next
iteration
}

i if (digitalRead(set_mad) == 0) { // If the set medicine reminder button is pressed

    lcd.setCursor(0, 0); // Set the cursor position to row 0, column 0

    lcd.print(" Set Medicine "); // Display "Set Medicine"

    lcd.setCursor(0, 1); // Set the cursor position to row 1, column 0

    lcd.print(" Reminder time "); // Display "Reminder time"

    delay(2000); // Wait for 2 seconds

    lcd.clear(); // Clear the LCD screen

    lcd.setCursor(0, 0); // Set the cursor position to row 0, column 0

    lcd.print("Enter Time 1"); // Prompt user to enter time 1

    default(); // Call the default function

    time(1); // Call the time function to set time 1

```

```

delay(1000); // Wait for 1 second

lcd.clear(); // Clear the LCD screen

lcd.setCursor(0, 0); // Set the cursor position to row 0, column 0

lcd.print("Enter Time 2"); // Prompt user to enter time 2

default(); // Call the default function

delay(1000); // Wait for 1 second

time(2); // Call the time function to set time 2

lcd.clear(); // Clear the LCD screen

lcd.setCursor(0, 0); // Set the cursor position to row 0, column 0

lcd.print("Enter Time 3"); // Prompt user to enter time 3

default(); // Call the default function

time(3); // Call the time function to set time 3

lcd.setCursor(0, 0); // Set the cursor position to row 0, column 0

lcd.print("Medicine reminder"); // Display "Medicine reminder"

lcd.setCursor(0, 1); // Set the cursor position to row 1, column 0

lcd.print(" time has set "); // Display "time has set"

delay(2000); // Wait for 2 seconds

} // This loop iterates from 11 to 16

for (int i = 11; i < 17; i++) {
    tem[i] = EEPROM.read(i);

```

```

    }

}

void default() {

    lcd.setCursor(0, 1); // Set the cursor position to row 1, column 0

    lcd.print(HOUR); // Display the current hour

    lcd.print(":"); // Display the colon separator

    lcd.print(MINUTE); // Display the current minute

    lcd.print(":"); // Display the colon separator

    lcd.print(SECOND); // Display the current second

}

// Function to set alarm time and feed time into Internal eeprom /

void time(int x) {

    int temp = 1, minuts = 0, hours = 0, seconds = 0;

    // This loop runs as long as the value of 'temp' is equal to 2.

    while (temp == 1) { // While temp equals 1 (condition to loop)

        if (digitalRead(INC) == 0) { // If the INC button is pressed

            HOUR++; // Increment the hour value

            if (HOUR == 24) { // If the hour reaches 24

                HOUR = 0; // Reset hour value to 0

            }

        }

    }

}

```

```

} while (digitalRead(INC) == 0) {

    // The loop will continue as long as the INC button is pressed (input is LOW)

    lcd.clear();

    lcd.setCursor(0, 0);

    lcd.print("Enter Time ");

    lcd.print(x);

    lcd.setCursor(0, 1);

    lcd.print(HOUR);

    lcd.print(":");

    lcd.print(MINUT);

    lcd.print(":");

    lcd.print(SECOND);

    delay(100);

    i i if (digitalRead(next) == 0) { // If the next button is pressed

        hours1 = HOUR; // Store the current hour value in variable hours1

        EEPROM.write(add++, hours1); // Write the value of hours1 to EEPROM and
increment the EEPROM address

        temp = 2; // Set temp to 2

        while (digitalRead(next) == 0) {

            // The loop will continue as long as the next button is pressed (input is LOW)

            // This loop ensures that the next button needs to be released before
proceeding

```

```

}

}

while (temp == 2) {

// Check if the button connected to the INC pin is pressed.

i i if (digitalRead(INC) == 0) { // If the INC button is pressed

MINUTE++; // Increment the minute value

if (MINUTE == 60) { // If the minute reaches 60

MINUTE = 0; // Reset minute value to 0

}

while (digitalRead(INC) == 0) {

// The loop will continue as long as the INC button is pressed (input is LOW)

// This loop ensures that the INC button needs to be released before
proceeding

}

// Clear the LCD display.

lcd.clear();

lcd.setCursor(0, 0);

lcd.print("Enter Time ");

lcd.print(x);

lcd.setCursor(0, 1);

lcd.print(HOUR);

```

```

    lcd.print(":");

    lcd.print(MINUT);

    lcd.print(":");

    lcd.print(SECOND);

    idelay(100);

if (digitalRead(next) == 0) { // If the next button is pressed

    minut = MINUTE; // Store the current minute value in variable minut

    EEPROM.write(add++, minut); // Write the value of minut to EEPROM and
increment the EEPROM address

    temp = 0; // Set temp to 0

    // Wait until the button is released.

    while (digitalRead(next) == 0) {

        // The loop will continue as long as the next button is pressed (input is LOW)

        // This loop ensures that the next button needs to be released before
proceeding

    }

}

delay(1000); // Delay for 1000 milliseconds (1 second)

}

/* Function to check medication time */

void match() {

    if (HOUR == tem[11] && MINUT == tem[12] && SECOND == 0)
alarm = 1;

    else if (HOUR == tem[13] && MINUT == tem[14] && SECOND ==

```

```

0) alarm = 2;

    else if (HOUR == tem[15] && MINUT == tem[16] && SECOND ==
0) alarm = 3;

if (alarm == 1) {

    lcd.clear();

    lcd.setCursor(0, 0);

    lcd.print("  Take Morning  ");

    lcd.setCursor(0, 1);

    lcd.print("      Medicine      ");

if (alarm == 1 && !motorMoved) {

    digitalWrite(Relay1_1, HIGH);

    delay(450); // Motor moves forward for 1 second

    digitalWrite(Relay1_1, LOW);

    motorMoved = true; // Set the flag to indicate the motor has moved
}

i // Slot 1

if (!slot1Complete) {

    //servo1.write(60); // Move servo1 to 60 degree

    // Check if Button 1 is pressed

    if (digitalRead(buttonPin1_1) == HIGH) {

        sendSMS("Take morning group 01 medicine"); // Send SMS

        delay(200); // Wait for 2 seconds

```

```

        // Check if Button 1 is still pressed

        if (digitalRead(buttonPin1_1) == LOW) {

            delay(5000); // Wait for 5 second

digitalWrite(Relay1_1, HIGH);

delay(350); // Motor moves forward for 1 second

digitalWrite(Relay1_1, LOW);

        // servo1.write(120); // Move servo1 to 120 degrees

            sendSMS("<Morning group 01 Medicine has been taken"); //
Send SMS

            delay(200); // Wait for 5 seconds

                slot1Complete = true;

            }

        }

    }

// Slot 2

if (slot1Complete && !slot2Complete) {

    // Check if Button 2 is pressed

    if (digitalRead(buttonPin1_2) == HIGH) {

        sendSMS(" Take morning group 02 medicine "); // Send SMS

        delay(2000); // Wait for 2 seconds

```

```

        // Check if Button 2 is still pressed

        if (digitalRead(buttonPin1_2) == LOW) {

delay(5000); // Wait for 5 second

        digitalWrite(Relay1_1, HIGH);

        delay(350); // Motor moves forward for 1 second

        digitalWrite(Relay1_1, LOW);

                // servo1.write(180); // Move servo1 ito 180 degrees

                sendSMS("Morning group 02 Medicine has been taken"); // Send
SMS

                delay(2000); // Wait for 5 seconds

                slot2Complete = true;

                }

        }

}

// Slot 3

if (slot1Complete && slot2Complete && !slot3Complete) {

// Check if Button 3 is pressed

        if (digitalRead(buttonPin1_3) == HIGH) {

                sendSMS("Take morning group 03 medicine"); // Send SMS

                delay(200); // Wait for 2 seconds

                // Check if Button 3 is still pressed

```

```

        if (digitalRead(buttonPin1_3) == LOW) {
delay(5000); // Motor moves forward for 1 second

        digitalWrite(Relay1_2, HIGH);

        delay(2000); // Motor moves forward for 1 second

        digitalWrite(Relay1_2, LOW);

                sendSMS("Morning group 03 Medicine has been taken"); //
Send SMS

                delay(2000); // Wait for 5 seconds

                slot3Complete = true;

                //motorMoved = false;

                }

        }

}

if (slot1Complete && slot2Complete && slot3Complete) {

        alarm = 0;

}

digitalWrite(buzzer1, HIGH);

        delay(450); // Motor moves forward for 1 second

        digitalWrite(buzzer1, LOW);

}

else if (alarm == 2) {

        // lcd.clear();

```

```

lcd.setCursor(0, 0);

lcd.print("  Take Non  ");

lcd.setCursor(0, 1);

lcd.print("      Medicine      ");

// alarmming(LED2);

if (alarm == 2 && !motorMoved1) {

    digitalWrite(Relay2_1, HIGH);

    delay(350); // Motor moves forward for 1 second

    digitalWrite(Relay2_1, LOW);

    motorMoved1 = true; // Set the flag to indicate the motor has moved
}

// Slot 4

if (!slot4Complete) {

    // Check if Button 1 is pressed

    if (digitalRead(buttonPin2_1) == HIGH) {

        sendSMS("Take noon group 01 medicine"); // Send SMS

        delay(200); // Wait for 2 seconds

        // Check if Button 1 is still pressed

        if (digitalRead(buttonPin2_1) == LOW) {

delay(5000); // Wait for 5 second

        digitalWrite(Relay2_1, HIGH);

        delay(350); // Motor moves forward for 1 second

```

```

digitalWrite(Relay2_1, LOW);

        sendSMS("noon group 01 Medicine has been taken"); // Send
SMS

        delay(5000); // Wait for 5 second

        slot4Complete = true;

    }

}

}

// Slot 5

if (slot4Complete && !slot5Complete) {

    // Check if Button 2 is pressed

    if (digitalRead(buttonPin2_2) == HIGH) {

        sendSMS("Take noon group 02 medicine"); // Send SMS

        delay(200); // Wait for 2 seconds

        // Check if Button 2 is still pressed

        if (digitalRead(buttonPin2_2) == LOW) {

            delay(5000); // Wait for 5 second

            digitalWrite(Relay2_1, HIGH);

            delay(350); // Motor moves forward for 1 second

            digitalWrite(Relay2_1, LOW);

            sendSMS("noon group 02 Medicine has been taken");

            // Send SMS

            delay(5000); // Wait for 5 seconds

```

```

        slot5Complete = true;

    }

}

}

// Slot 6

if (slot4Complete && slot5Complete && !slot6Complete) {

// Check if Button 3 is pressed

    if (digitalRead(buttonPin2_3) == HIGH) {

        sendSMS("Take noon group 03 medicine"); // Send SMS

        delay(200); // Wait for 2 seconds

        // Check if Button 3 is still pressed

        if (digitalRead(buttonPin2_3) == LOW) {

            // servo2.write(0); // Move servo1 to 0 degrees

            delay(5000); // Motor moves forward for 1 second

digitalWrite(Relay2_2, HIGH);

delay(2000); // Motor moves forward for 1 second

digitalWrite(Relay2_2, LOW);

// motorMoved = false;

        sendSMS("noon group 03 Medicine has been taken"); // Send SMS

        delay(5000); // Wait for 5 seconds

        slot6Complete = true;

```

```

        }

    }

}

if (slot4Complete && slot5Complete && slot6Complete) {

    alarm = 0;

}

digitalWrite(buzzer1, HIGH);

    delay(450); // Motor moves forward for 1 second

    digitalWrite(buzzer1, LOW);

}

else if (alarm == 3) {

    // lcd.clear();

    lcd.setCursor(0, 0);

    lcd.print("Take Night ");

    lcd.setCursor(0, 1);

    lcd.print("    Medicine    ");

    // alarmming(LED3);

if (alarm == 3 && !motorMoved2) {

    digitalWrite(Relay3_1, HIGH);

    delay(450); // Motor moves forward for 1 second

    digitalWrite(Relay3_1, LOW);

    motorMoved2 = true; // Set the flag to indicate the motor has moved

}

```

```

// Slot 7

if (!slot7Complete) {

    // Check if Button 1 is pressed

    if (digitalRead(buttonPin3_1) == HIGH) {

        sendSMS("Take night group 01 medicine"); // Send SMS

        delay(200); // Wait for 2 seconds

        // Check if Button 1 is still pressed

        if (digitalRead(buttonPin3_1) == LOW) {

            delay(5000); // Wait for 5 second

            // servo2.write(120); // Move servo1 to 120 degrees

            digitalWrite(Relay3_1, HIGH);

            delay(400); // Motor moves forward for 1 second

            digitalWrite(Relay3_1, LOW);

            sendSMS("night group 01 Medicine has been taken"); // Send
SMS

            slot7Complete = true;

        }

    }

}

// Slot 8

if (slot7Complete && !slot8Complete) {

    // Check if Button 2 is pressed

    if (digitalRead(buttonPin3_2) == HIGH) {

```

```

        sendSMS("Take night group 02 medicine"); // Send SMS

        delay(200); // Wait for 2 seconds

        // Check if Button 2 is still pressed
if (digitalRead(buttonPin3_2) == LOW) {

        digitalWrite(Relay3_1, HIGH);

        delay(400); // Motor moves forward for 1 second

        digitalWrite(Relay3_1, LOW);

        sendSMS("night group 02 Medicine has been taken"); // Send SMS

                delay(2000); // Wait for 5 secon

                slot8Complete = true;

        }

}

}

// Slot 9

if (slot7Complete && slot8Complete && !slot9Complete) {

        // Check if Button 3 is pressed

        if (digitalRead(buttonPin3_3) == HIGH) {

                sendSMS("Take night group 03 medicine"); // Send SMS

                delay(200); // Wait for 2 seconds

                // Check if Button 3 is still pressed

                if (digitalRead(buttonPin3_3) == LOW) {

                        // servo2.write(0); // Move servo1 to 0 degrees

                delay(5000); // Motor moves forward for 1 second

```

```

digitalWrite(Relay3_2, HIGH);

delay(2000); // Motor moves forward for 1 second

digitalWrite(Relay3_2, LOW);

motorMoved = false;

    sendSMS("night group 03 Medicine has been taken"); // Send SMS

    delay(2000); // Wait for 5 seconds

        slot9Complete = true;

    }

}

}

if (slot7Complete && slot8Complete && slot9Complete) {

    alarm = 0;

}

digitalWrite(buzzer1, HIGH);

    delay(450); // Motor moves forward for 1 second

    digitalWrite(buzzer1, LOW);

}

}

void alarmming(byte led) {

    while (alarm != 0) { // While alarm is not equal to 0

        digitalWrite(buzzer, HIGH); // Turn on the buzzer

        delay(1000); // Delay for 1000 milliseconds (1 second)

        digitalWrite(buzzer, LOW); // Turn off the buzzer

```

```

    delay(100); // Delay for 100 milliseconds

    // Check if the next button is pressed to stop the alarm

    if (digitalRead(next) == 0)

        alarm = 0; // Set alarm to 0 to stop the alarm

    }

    alarm = 0; // Reset alarm to 0 after stopping the alarm

}

void handleKeypadInput(char key) {

    if (key == '#') { // If '#' key is pressed

        numberSaveMode = true; // Enable number save mode

        lcd.setCursor(0, 0); // Set cursor to row 0, column 0

        lcd.print("Enter mobile num:"); // Prompt user to enter mobile number

        lcd.setCursor(0, 3); // Set cursor to row 3, column 0

        lcd.print("                "); // Clear the second line of LCD

    } else if (key == '*') { // If '*' key is pressed

        numberSaveMode = false; // Disable number save mode

        saveMobileNumber(); // Update mobile number in EEPROM

        lcd.setCursor(0, 1); // Set cursor to row 1, column 0

        lcd.print("Mobile number saved!"); // Display "Mobile number saved!"

        delay(2000); // Display message for 2 seconds

        lcd.clear(); // Clear the display

    } else if (key == 'D') { // If 'D' key is pressed

        deleteLastDigit(); // Delete the last digit entered

```

```

    } else if (numberSaveMode) { // If in number save mode

        addDigitToMobileNumber(key); // Add digit to mobile number

    }

}

void addDigitToMobileNumber(char digit) {

    if (digit >= '0' && digit <= '9') { // Check if the input digit is a number

        if (mobileNumber.length() < MOBILE_NUMBER_LENGTH) {

            // Check if the mobile number length is within limits

            mobileNumber += digit; // Append the digit to the mobile number

            lcd.setCursor(mobileNumber.length() - 1, 1); // Set cursor position to the
end of the mobile number on the LCD

            lcd.print(digit); // Print the digit on the LCD

        }

    }

}

void deleteLastDigit() {

    if (mobileNumber.length() > 0) { // Check if there are digits in the mobile
number

        mobileNumber.remove(mobileNumber.length() - 1); // Remove the last digit
from the mobile number

        lcd.setCursor(mobileNumber.length(), 1); // Set cursor position to the end of
the mobile number on the LCD

        lcd.print(" "); // Print a space to clear the deleted digit from the LCD

    }

}

```

```

}

// Check if a mobile number is saved in EEPROM

bool isMobileNumberSaved() {

    char firstChar = EEPROM.read(MOBILE_NUMBER_ADDRESS); // Read the
first character of the mobile number stored in EEPROM

    return firstChar != 0xFF; // If the first character is not 0xFF, it indicates that a
mobile number is saved

}

// Read the mobile number from EEPROM and return it as a string

String readMobileNumber() {

    String mobileNumber; // Create an empty string to store the mobile number

    for (int i = 0; i < MOBILE_NUMBER_LENGTH; i++) { // Loop through each
character of the mobile number stored in EEPROM

        char digit = EEPROM.read(MOBILE_NUMBER_ADDRESS + i); // Read
the digit from EEPROM

        if (digit == '\0') { // If the digit is NULL character, indicating the end of the
mobile number

            break; // Exit the loop

        }

        mobileNumber += digit; // Append the digit to the mobile number string

    }

    return mobileNumber; // Return the mobile number string

}

void saveMobileNumber() {

```

```

int length = mobileNumber.length(); // Get the length of the mobile number

for (int i = 0; i < MOBILE_NUMBER_LENGTH; i++) { // Loop through each
character of the mobile number

    if (i < length) { // If the current index is within the length of the mobile
number

        EEPROM.write(MOBILE_NUMBER_ADDRESS + i,
mobileNumber.charAt(i)); // Write the character to EEPROM

    } else { // If the current index is beyond the length of the mobile number

        EEPROM.write(MOBILE_NUMBER_ADDRESS + i, '\0'); // Write NULL
character to indicate the end of the mobile number

    }

}

}

}

void sendSMS(const String& message) {

    sendATCommand("AT+CMGF=1"); // Set SMS text mode

    delay(100); // Wait for 100 milliseconds for the command to be processed

    // Prepare AT command to send SMS to the updated mobile number

    String command = "AT+CMGS=\"";

    command += mobileNumber;

    command += "\"";

    sendATCommand(command); // Send the AT command to set the recipient
mobile number

    delay(100); // Wait for 100 milliseconds for the command to be processed

    gsmSerial.print(message); // Send the message content

```

```

    delay(100); // Wait for 100 milliseconds for the message to be sent

    gsmSerial.write(0x1A); // End of message character
}

void sendATCommand(const char* command) {

    gsmSerial.println(command); // Send the AT command to the GSM module

    delay(100); // Wait for 100 milliseconds for the command to be processed

    // Read and print the response from the GSM module

    while (gsmSerial.available()) { // While data is available to read from the GSM
module

        Serial.write(gsmSerial.read()); // Read and print data from the GSM module

    }

}

void sendATCommand(const String& command) {

    sendATCommand(command.c_str()); // Call the original sendATCommand
function with the command string converted to a C-style string

}

```

### **Appendix for Voice Command:**

```

#include <Keypad.h>

#include <SD.h>

#define SD_ChipSelectPin 10

#include <TMRpcm.h>

#include <SPI.h>

```

```

const byte ROWS = 5;

const byte COLS = 6;

char hexaKeys[ROWS][COLS] = {

  {'a','b','c','d','e','f'},

  {'g','h','i','j','k','l'},

  {'m','n','o','p','q','r'},

  {'s','t','u','v','w','x'},

  {'y','z','1','2','3','4'}

};

byte rowPins[ROWS] = {2, 3, 4, 5, 6};

byte colPins[COLS] = {A0, A1, A2, A3, A4, A5};

TMRpcm player;

Keypad keyPad = Keypad(makeKeymap(hexaKeys), rowPins, colPins,
  ROWS, COLS);

void setup(){

  // This loop runs as long as the value of 'temp' is equal to 2.

  player.speakerPin = 9;

  Serial.begin(9600);

  if(!SD.begin(SD_ChipSelectPin)) { // If SD card initialization fails

    Serial.println("SD card not present. Resetting..."); // Print error message

    delay(2000); // Delay for 2000 milliseconds (2 seconds)

    setup(); // Reset and set up again

  }

```

```

    player.setVolume(5);
}

void loop() {

    char key = keypad.getKey(); // Read a key from the keypad

    if (key) { // If a key is pressed (i.e., not equal to NO_KEY)

        Serial.println(key); // Print the key value to the serial monitor

    }

}

switch(key){

    case 'a': playMusic("morn.wav"); break;

    case 'b': playMusic("morn.wav"); break;

    case 'c': playMusic("morn.wav"); break;

    case 'd': playMusic("morn.wav"); break;

    case 'e': playMusic("morn.wav"); break;

    case 'f': playMusic("morn.wav"); break;

    case 'g': playMusic("morn.wav"); break;

    case 'h': playMusic("nigh.wav"); break;

    case 'i': playMusic("nigh.wav"); break;

    case 'j': playMusic("nigh.wav"); break;

    case 'k': playMusic("nigh.wav"); break;

    case 'l': playMusic("noon.wav"); break;

    case 'm': playMusic("noon.wav"); break;
}

```

```

        case 'n': playMusic("noon.wav"); break;
        case 'o': playMusic("noon.wav"); break;
        case 'p': playMusic("noon.wav"); break;
        case 'q': playMusic("morn.wav"); break;
        case 'r': playMusic("morn.wav"); break;
        case 's': playMusic("morn.wav"); break;
        case 't': playMusic("morn.wav"); break;
        case 'u': playMusic("nigh.wav"); break;
        case 'v': playMusic("nigh.wav"); break;
        case 'w': playMusic("nigh.wav"); break;
        case 'x': playMusic("nigh.wav"); break;
        case 'y': playMusic("noon.wav"); break;
        case 'z': playMusic("noon.wav"); break;
        case '1': playMusic("noon.wav"); break;
        case '2': playMusic("noon.wav"); break;
        case '3': playMusic("noon.wav"); break;
        case '4': playMusic("noon.wav"); break;
    }
}
}

void playMusic(char *filename){

// Check if the button connected to the INC pin is pressed

    player.play(filename);

```

```
}
```

### **Appendix for IoT Health Monitoring:**

```
#include <LiquidCrystal.h>
```

```
#include <Wire.h>
```

```
#include <SoftwareSerial.h>
```

```
#include "MAX30100_PulseOximeter.h"
```

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

```
#define REPORTING_MS 2000
```

```
#define SERVER_UPDATE_MS 15000
```

```
#define link
```

```
"WEB=http://esinebd.com/projects/PatientMonitor/update_machine.php?"
```

```
#define buzz 2
```

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

```
PulseOximeter pox;
```

```
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, smsFlag;

void (*RESET)(void) = 0x00; // Define a function pointer named RESET and
initialize it to the address 0x00

void setup() {

    // Delay for 1000 milliseconds (1 second) to allow for initialization

    delay(1000);

    // Begin serial communication at a baud rate of 9600

    Serial.begin(9600);

    // Initialize the LCD with 16 columns and 2 rows

    lcd.begin(16, 2);

    // Additional setup code can be added here

}

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() {

    // Call the fallDetector function to check for any falls

    fallDetector();

    // Update the pulse oximeter readings

    pox.update();

    // Check if it's time to report the readings

    if (millis() - lastReport > REPORTING_MS) {

        // Get heart rate and SpO2 readings from the pulse oximeter

        int bpm = pox.getHeartRate();

        int spo2 = pox.getSpO2();

        // Read temperature

        readTemp();

        // Set the cursor position on the LCD

        lcd.setCursor(0, 0); // Set cursor to the first row and first column

        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 ");

        else if (bpm >= 150) {

            RESET();

        }

        else if (spo2 >= 10 && spo2 <= 80) {

```

```

        RESET();

    }}

#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);

        }    }

        tsLastReport = millis();

    }

#if DEBUG == 0

```

```

if (millis() - ct > SERVER_UPDATE_MS) {

    Serial.println((String)link

                    + "bpm1=" + bpm

                    + "&oxi1=" + spo2

                    + "&temp1=" + temp

                    + "&fall1=" + fall

    )

#endif

}

digitalWrite(buzz, 0);

lcd.clear();

smsFlag = 1;

}

void readTemp() {

// Define coefficients for temperature calculation

float c1 = 1.009249522e-03, c2 = 2.378405444e-04, c3 = 2.019202697e-
07;

// Read the analog input from temperature sensor connected to pin A7

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) + 13; // change 0 if needed temp
value manual
}

void fallDetector() {

// Function to request accelerometer data from MPU

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) {  
  
    // Turn on the buzzer by setting the 'buzz' pin to HIGH (1).  
  
    digitalWrite(buzz, 1);  
  
    delay(d);  
  
    digitalWrite(buzz, 0);  
  
}
```