**Project Report on**

# Smart Medicine Dispenser

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

*of*

BACHELOR OF ENGINEERING

*In*

ELECTRONICS &

TELECOMMUNICATION ENGINEERING

BY


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**(Academic Year 2022-23)**

# CERTIFICATE

This is to certify that the project entitled **"Smart Medicine Dispenser"** is a bonafide work of **Ms. Shara Yasmin Ahmad (Roll no.03), Ms. Shruti Chaube(Roll no.15) and Ms. Soniya Kadam (Roll no.67)** submitted to the Thakur College of Engineering and Technology, Mumbai (An Autonomous College affiliated to University of Mumbai) in partial fulfillment of the requirement for the award of the degree of **"Bachelor of Engineering"** in **"Electronics and Telecommunication"**.

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TCET

DEPARTMENT OF ELECTRONICS & TELECOMMUNICATION ENGINEERING (E&TC)

(Accredited by NBA for 3 years, 3rd Cycle Accreditation w.e.f. 1st July 2019)

Choice Based Credit Grading System with Holistic Student Development (CBCGS - H 2019)

Under TCET-Autonomy Scheme - 2019

# PROJECT APPROVAL CERTIFICATE

This project report is entitled ***"Smart Medicine Dispenser"*** by ***Ms.Shara Yasmin Ahmad (Roll no.03), Ms. Shruti Chaube (Roll no.15) and Ms. Soniya Kadam (Roll no.67)*** is approved for the degree of **"Bachelor of Engineering"** in **"Electronics & Telecommunication"**.

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# DECLARATION

I/we declare that this written submission represents my/our ideas in my/our own words and where others ideas or words have been included, I/we have adequately cited and referenced the original sources. I/we also declare that I/we have adhered to all principles of academic honesty and integrity and have not misrepresented or fabricated or falsified any idea/data/fact/source in my/our submission. I/we understand that any violation of the above will be cause for disciplinary action by the Institute and can also evoke penal action from the sources which have thus not been properly cited or from whom proper permission has not been taken when needed.

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# Abstract

There are several challenges that old people face, and one of them is taking their medicines on time. Old people usually forget to take their medication on time and also have a hard time recollecting whether they had their medication or not, which sometimes could lead to overdose and severe medical complications. The smart medicine dispenser could solve such problems by informing and alerting the patients to take the appropriate dose at the right time. There are several expensive medicine dispensers available in the market now. But most of them are just simple devices with reminders but lack other aspects of health monitoring systems. The product in the proposition consists of two major parts which are hardware and software. The hardware part involves a microcontroller and many other sensors for monitoring the health of an individual whereas the role of the software part is to control the device remotely. Also, as the product is mostly focused on old people the aim is to make it more user-friendly and portable. The proposed product is designed to make sure that the quantity and timing of the pills to be dispensed can be controlled and monitored using an application, which makes things easier for users of all age groups.

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# Chapter 1:
# OVERVIEW

## 1.1 Introduction

The life of a person has become so hectic that it is not possible for him to vacate even a single minute to look after himself, thus negligence towards taking medicines has become conventional. Studies show that many people irrespective of age become forgetful when it comes to consuming medicines. This, seen mostly in the elderly, leads to many life risks. This is where medicine dispensers come into play. There are different types of dispensers all of which are just implemented using solid medicines. Most of them are just simple devices with reminders but lack other aspects of health monitoring systems. The available dispensers are extremely costly and do not allow multi-user functionality.

This project proposes a dispenser that can dispense solid medicines and has an application integrated with it that helps to set alarms and provide care and take live information. To build an economically viable medicine dispenser and to make it more efficient. The system should allow efficient communication between the user and the caretaker. The product is designed to make sure that the quantity and timing of the pills to be dispensed can be controlled and monitored using an app, which makes things easier for everyone, it is also embedded with a health monitoring system.

The system that is proposed is mainly divided into two parts consisting of hardware and software. The hardware would include ESP32S for managing the sensors and connectivity with Postman as it has wifi and Bluetooth compatibility.

## 1.2 Background

In today's fast-paced world, people often lead hectic lives, with little time to take care of themselves. As a result, many individuals may forget to take their medications regularly, leading to potentially severe health risks. This is particularly true for older adults, who may be taking multiple medications simultaneously and may have difficulty remembering which medications to take at what times.

To address this problem, medicine dispensers have become increasingly popular. These devices are designed to help individuals remember to take their medications by providing reminders and dispensing the correct dosages at the appropriate times. However, many of these dispensers are prohibitively expensive, making them inaccessible to many people who could benefit from their use.

As a result, there is a growing need for cost-effective, user-friendly medicine dispensers that can be used by individuals in a variety of settings. The proposed solution is a medicine dispenser that is integrated with an app that allows for efficient communication between the user and their caretaker. The device is designed to be affordable and easy to use, making it accessible to a wide range of individuals.

Furthermore, the proposed medicine dispenser is not limited to home use. The product can also be used in hospitals, nursing homes, and other healthcare settings, where there is a need for reliable and efficient medication management systems. By providing a versatile and accessible solution to medication management, the proposed medicine dispenser has the potential to improve the lives of countless individuals who struggle with medication adherence.

## 1.3 Importance of the project

The life of a person has become so hectic that it is not possible for him to vacate even a single minute to look after himself, thus negligence towards taking medicines has become conventional. Studies show that many people irrespective of age become forgetful when it comes to consuming medicines. This, seen mostly in the elderly, leads to many life risks. This is where medicine dispensers come into play.

There are different types of dispensers all of which are just implemented using solid medicines. Most of them are just simple devices with reminders but lack other aspects of health monitoring systems. The available dispensers are extremely costly and do not allow multi-user functionality.

Most medication administration errors were made when patients bought different prescribed and over-the-counter medicines from several drug stores and used them at home without little or no guidance. Elderly or chronically ill patients are particularly susceptible to these mistakes.

## 1.5 Objectives & Scope of the Project

Some functions can be added to the dispenser to improve its user-friendliness and effectiveness. An example is that the proposed product can be made for more than one user but the current prototype does not support this function even though it can be added easily. Also, provisions for liquid doses can be added to make the device more effective. The current prototype does not have any location tracking system of the user so it can also be added to improve the effectiveness of the product. Adding communication with pharmacies to refill the dispenser will also make the proposed product more flexible and reduce patient efforts.

Provide high dependability, cost effective and user friendly management system. Few of the additions that could be made are:- availability for multiple users, adding provisions for liquid doses, to add communication with pharmacies Location tracking of the user.

MediBox is a versatile product and can be used in various places of need. Initially we planned on making it a household product although while researching similar products, we could see that there are no medicine dispensers used at old age homes and hospitals, which are probably the places we require them the most. Therefore rather than commercializing it just towards individual houses, we would also like to adapt and make MediBox applicable to other health care centers.

## 1.6 Summary

This chapter discusses how forgetfulness in taking medicines is a common problem, especially among the elderly, and how medicine dispensers can be a solution to this issue. However, most available dispensers are expensive and lack features such as health monitoring systems and multi-user functionality. The proposed solution is a dispenser integrated with an app that allows for efficient communication between the user and the caretaker, and a health monitoring system. The system is divided into hardware and software, with the hardware consisting of ESP32S and Postman for managing sensors and connectivity. The article also suggests adding features such as multiple user support, provisions for liquid doses, location tracking, and communication with pharmacies to improve the product's effectiveness. The proposed product, MediBox, can be used in various places, including hospitals and old age homes.

# CHAPTER 2:

# LITERATURE SURVEY

## 2.1 Introduction

A literature survey is an important step in developing any kind of product or technology including a smart medicine dispenser. It helps to learn about the existing smart medicine dispensers, how the dispensers work ,what features dispensers have, and what problems it solves. This helps to identify gaps in the market and opportunities to create a new, innovative product.

A literature survey is a valuable tool for developing a smart medicine dispenser, as it can help to learn about existing products, identify relevant technologies, understand regulatory requirements, and stay up-to-date on the latest research.

The importance of medication adherence for optimal health outcomes is widely recognized in healthcare. However, many individuals struggle to maintain adherence due to forgetfulness or other reasons. To address this issue, medicine dispensers have become increasingly popular in recent years.

This literature survey aims to explore the current state of the art in medicine dispensers, focusing on their design, functionality, and effectiveness in improving medication adherence. The survey will begin with an overview of the prevalence and impact of non-adherence to medication regimens.

Next, the survey will review the current types of medicine dispensers available in the market, including their features, benefits, and limitations. The survey will also examine the various factors that influence the effectiveness of medicine dispensers in improving medication adherence, such as ease of use, affordability, and accessibility.

Furthermore, the survey will explore the emerging technologies and trends in medicine dispensers, such as the integration of apps and health monitoring systems, and their potential impact on medication adherence. The survey will also discuss the challenges and opportunities for the development of cost-effective and user-friendly medicine dispensers that can be used in a variety of settings.

Overall, this literature survey aims to provide a comprehensive understanding of the current state of the art in medicine dispensers and their potential to improve medication adherence and overall health outcomes.

## 2.2 Literature Survey

Most commonly microcontrollers are used to keep track of when the patient should take medications. It displays the time for the next medicine on a LCD screen and when the time arrives, it generates messages repeatedly, along with LED blinking indicating which compartment to open. When the patient opens a compartment, a sensor detects this and resets the light, and the alarm is snoozed. A tradition yet the most important part of the medicine dispenser as reflected in Automatic Pill Dispensing Apparatus by Shaw & ThomasJ.[1] [2] reviews concludes that work is still required to enhance technology-based systems that can overcome these challenges, especially the accuracy, user comfort, and battery consumption. In addition, assuring the whole workflow with minimal burden for the patients and health practitioners is still to be met.

The economical side of medication adherence includes whether patients have insurance or other financial resources to pay for the medication and deep understanding of patient's relationship with their physician as well as the physician's communication style can affect adherence as observed in [3]. [4] explains the hardware architecture brings forward a wearable self-care device capable of delivering effective but tactful reminders, achieving ergonomic and functionality requirements of patients' and care-givers' ease of use. [8]paper presents the working of a multipurpose robotic dispenser with “medicine dispensing application”. The focus of the project is to build an economic, easily deployable, mobile medicine dispenser with Database Management system. Mobility in the dispenser is inherited from the line-follower mechanism. The robot is built around a microcontroller which takes input from a computer (serially) and moves the robot to desired location and manages the dispensing mechanism.

[9]Out-patient medication administration has been identified as the most error-prone procedure in modern healthcare. Under or over doses due to erratic in-takes, drug-drug or drug-food interactions caused by un-reconciled prescriptions and the absence of in-take enforcement and monitoring mechanisms have caused medication errors to become the common cases of all medical errors. Most medication administration errors were made when patients bought different prescribed and over-the-counter medicines from several drug stores and used them at home without little or no guidance. Elderly or chronically ill patients

Smart Medicine Dispensers are particularly susceptible to these mistakes. In this paper, we introduce Wedjat, a smart phone application designed to help patients avoid these mistakes. Wedjat can remind its users to take the correct medicines on time and record the in-take schedules for later review by healthcare professionals.

In the study, NodeMCU ESP8266, an Android; microcontroller with an inbuilt Wi-Fi component, is utilized for development. The Xcluma 28Ybj-48 stepper motor is used to rotate the medicine container. The stored history is also displayed to the user, which has the list of alarms successfully given the alarm, and the rotation of the container completed successfully. A medical alert is sent to the caretaker via a notification using the Android Application if the medicine is not taken within a specified time and specified dosage [10]. Some more examples of the same methodologies for reminding or giving alter notification are UniMeds [11], Wedjat [12], and MyMediHealth [13].These applications can be installed on various mobile devices such as smartphones, PDAs, etc. They offer sound and user-friendly user interfaces for configuring medication timetables and alert users to the specific period and class of medication conferring to the configured prescription timetable. They can prevent underdosing and miss dosing and are relatively low cost [14]. However, an IoT-based programmable innovative medicine kit guides users/nurses to manage the precise medication at the correct time schedules through a unique alarm system that includes buzzers, mobile notifications, and LED signals on the equipment sections. The parts containing suitable tablets are unlocked at the prearranged time [15].

In [16] It can be observed that the Node MCU is the main controller where it receives information from the magnetic switch and LDR (at pill compartment). The information is processed and the suitable status is displayed at the notification block. A Blynk IOT front end is used to show the mediation timings and health systems.ECE 4760 (Smart Medicine Box),This ECE 4760 is a project of a microcontroller-based smart medicine box using Atmel 1284p MCU.[21] Its targeted users who routinely take drugs or vitamin supplements and nurses who take responsibility for the patients. The project is programmable that acknowledges nurses or users to specify the tablet amount to consume and the serving time for each day. It contains seven separate sections. This project would significantly loosen nurses or users' responsibility for regularly preloading tablets for patients [17]. [20] The system includes the interfacing of peripheral devices with Arduino UNO such as Alarm, IR sensor, Servo motor, and ESP 8266 in which the dispenser is controlled by specific programming. The locking system is based on a servo motor, by using an IR sensor which overcomes the problem that arises whether the subject has taken the pills or not. The concept of the local cloud has been used to address the usage of IOT to monitor the subject by the caretaker. The product consists of a chamber designed with a servo motor and it will be controlled by the Arduino. The subject will be notified by the LCD display at the time of dispense and also audibly indicated by an alarm with a buzzer, The chamber will be locked by the servo motor.

## 2.3 Problem Statement

Studies show that a lot of people irrespective of age become forgetful when it comes to consuming medicines. This, seen mostly among the elderly, results in many other life risks. This is often where medicine dispensers come into play. There are different types of dispensers all of which are just implemented using solid medicines. Most of them are just simple with no reminders etc. This paper proposes a dispenser that will dispense both solid and liquid medicine, has an app integrated with it, and helps to line alarms. MediBox is a versatile product and can be used in various places of need. Initially, we planned on making it a household product although while researching similar products, we could see that there are no medicine dispensers used at old age homes and hospitals, which are probably the places we require them the most. Therefore rather than commercializing it just towards individual houses, we would also like to adapt and make MediBox applicable to other healthcare centers.

## 2.4 Summary

All the references mentioned have the basic Node MCU connected to the main working system. Mainly an Arduino or ESP32/ 8266 are used as the main microcontroller, they are utilized for mobilization of the opening valve for the medication to be received, for setting timers and in few cases connecting the device to an online platform. Most of these devices lack mental monitoring systems which can be a great addition to an all round system that could be helpful and can be commercialized to a greater market. All of these devices have a LCD screen for display and a Buzzer to send out alarms in addition to mobile notification. Unfortunately they lack inclusivity, as someone with hearing disability will not be able to get the sound signals. In MediBox, there is a provision for a visual alarming system that will indicate medication time and will act as an alarm for the needy.

# CHAPTER 3:

# PLANNING & DESIGN

## 3.1 Introduction

The development of a medicine dispenser with an integrated health monitoring system and communication capabilities requires careful planning and design. In order to address the issues of medication non-adherence and improve health outcomes, the dispenser must be designed to be cost-effective, user-friendly, and adaptable to various settings.

The planning phase of this project will involve conducting a thorough analysis of the existing medicine dispenser market, identifying the strengths and weaknesses of current products, and determining the target user group and their specific needs. This will inform the design phase, which will involve creating a prototype that incorporates the desired features and functions, such as medication reminders, dosage tracking, and health monitoring.

To ensure the success of this project, the design will also need to consider factors such as ease of use, accessibility, and affordability. The final product must be able to effectively address the issue of medication non-adherence, while being accessible to a broad range of users and settings.

In addition, the design must incorporate a robust communication system to enable efficient interaction between the user and their healthcare provider, as well as the ability to track medication usage and provide alerts for refills.

Overall, the planning and design phase of this project is crucial for developing a cost-effective and user-friendly medicine dispenser with an integrated health monitoring system that can effectively improve medication adherence and overall health outcomes.

## 3.2 Project Planning

Medicine dispenser that has been divided into two parts has its core in ESP32S which is the microcontroller controlling the hardware and the software part of the system. The ESP32S is directly connected to the RTC real time clock which then is connected to the OLED screen, buzzer,touch sensor & micro motor. The output of the heartbeat sensor is connected to ESP32S to show that it can be displayed on the software. The timer that is set on the software is communicated to the ESP32S but to Trigger the output we require a RTC to give real time accurate outputs once it is time to distance the medicine the RTC is given a alarm and dispenses the medicines and also triggers LED the buzzer voice output and micro motor. The ESP32s is also connected to the LM393 chip which is basically a counter, this will allow us to track the amount of medicines that are filled in the dispenser and the amount of medicines that have been dispensed. This can be utilized to give an alarm when the count of medications is low.

## 3.3 Scheduling

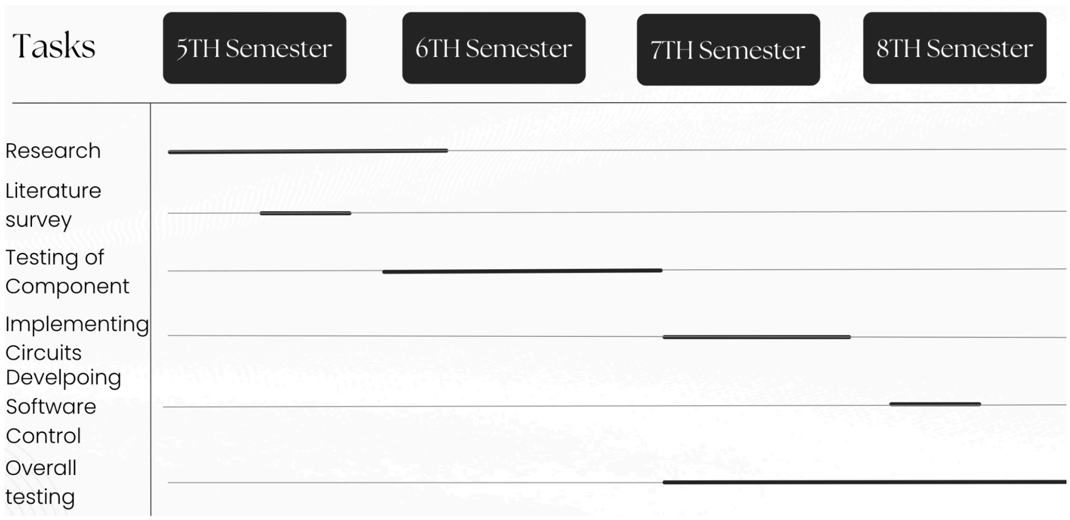


Figure 1: Gantt Chart

This Gantt chart represents the work completed till the 8th semester, a significant amount of work is done towards completing a project. In the 5th semester, the initial groundwork is laid by conducting a literature survey to gather information on the project's topic. In the following semester, the 6th semester, research on the project was done. This involves testing and evaluating the components that will be used in the project. Moving on to the 7th semester, the focus shifts towards implementing the circuits for the project. In the 8th semester, the final stages of the project are reached, with the development of software control to integrate all the project's components. This is the time when final testing of the project as a whole is conducted to ensure that everything is working.

## 3.4 Proposed System

In the context of a smart medicine dispenser, a proposed system includes a description of how the dispenser will accurately dispense medication at the right time, how it will communicate with healthcare providers and patients, what sensors and other technologies will be used to ensure accuracy and safety, and what software or user interface will be used to manage the system.

### 3.4.1 Feasibility Study

Since we are using ESP32S, coding for the hardware is completed in C programming.C may be a programming language that is both versatile and popular, allowing it to be utilized in a vast array of applications and technologies. It can, for instance , be wont to write the code for operating systems, far more complex programs, and everything in between. Its simplicity and adaptability are significant because it can function independently of machines, which has lent itself to becoming one of the foundational programming languages in the industry.

### 3.4.2 Block Diagram

**Block diagram**

Work shall be done on each individual part at a time and then rectified, if found to be incorrect, it might start from scratch. This can go on till the project is completed in parts and needs to be assembled together. It is very crucial to work on things one at a time for them to be correct and avoid damaging the hardware components. The hardware components include devices that might need extra delicacy and need to be adjusted properly. For the software end of the project, even if there are multiple ways to connect the project online, it is important to keep in mind the needs and requirements of the users and the system itself. Therefore, more focus is put on creating the hardware and creating the basic structure of the system before deploying it online.

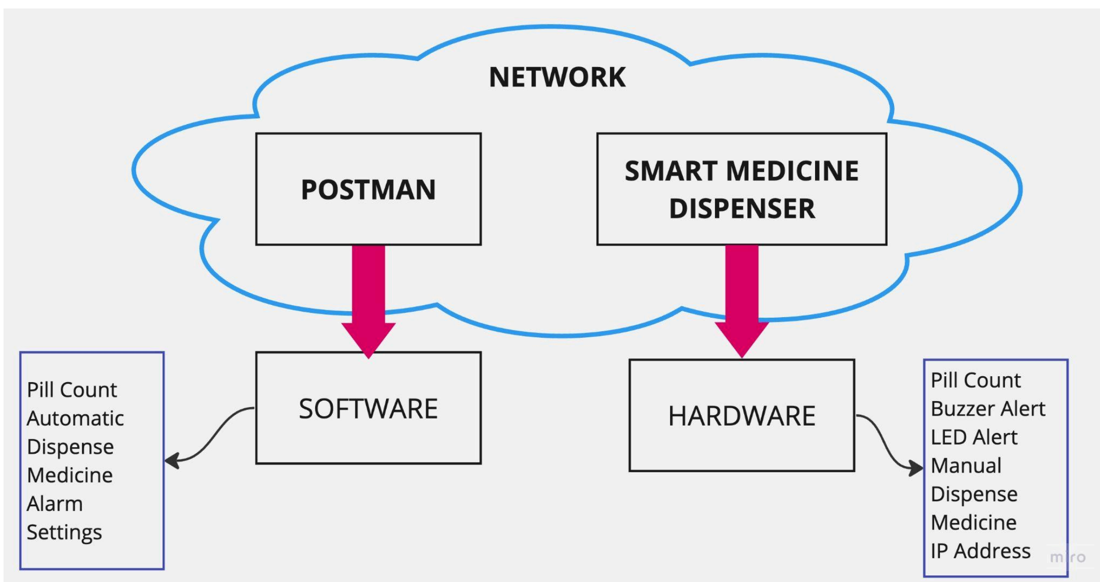


Figure 2: Block Diagram

**Hardware System Diagram**

Medicine dispenser that has been divided into two parts has its core in ESP32S which is the microcontroller controlling the hardware and the software part of the system. The ESP32S is directly connected to the RTC real-time clock which then is connected to the OLED screen, buzzer, touch sensor & micro motor. The output of the heartbeat sensor is connected to ESP32S to show that it can be displayed on the software. The timer that is set on the software is communicated to the ESP32S but to Trigger the output we require an RTC to give real-time accurate outputs once it is time to distance the medicine the RTC is given an alarm and dispenses the medicines and also triggers LED the buzzer voice output and micro motor.

The ESP32s is also connected to the LM393 chip which is basically a counter, this will allow us to track the amount of medicines that are filled in the dispenser and the number of medicines that have been dispensed. This can be utilized to give an alarm when the count of medications is low. Hardware includes microprocessors and various types of sensors. This stage of the project is the first stage and it allows us to work on the main medicine dispensers. If the components are soldered without prior testing they can be damaged and cannot be used further.

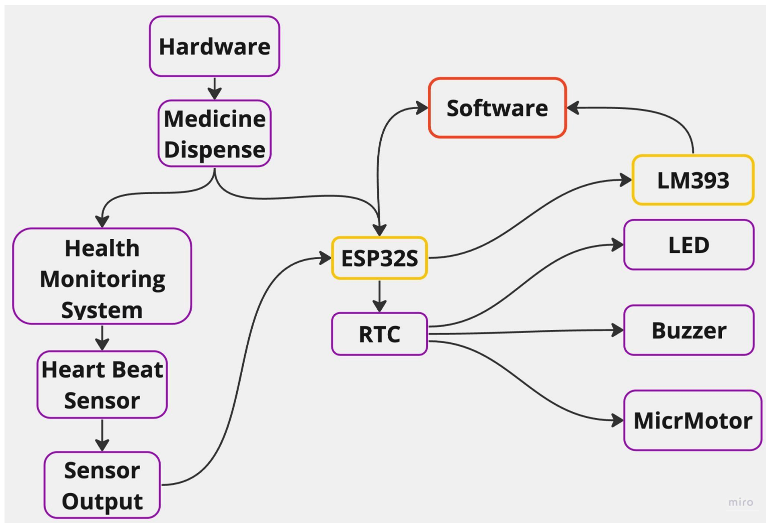


Figure 3: Hardware System Diagram

## Software System Diagram

The software part of the system first begins with the login page. On this page, the system will demand the user to know the IP Address of the ESP32S. After the user is verified the user will be able to see the dashboard. Once the user is able to see the dashboard they will be able to access the health monitoring charts that is the monitoring done by the heartbeat sensor, manual time settings to dispense medicine and to trigger the alarm, medication status that would show which medicine to select, at what particular time and if the selected medicine is set to be dispensed (on or off), medicine quantity monitor will be connected to the ESP32s and the LM393 chip this will allow the user to know the number of medicines that were initially in the medicine dispenser and the number of medicines that have been dispense already once the medicine count is low the caretaker will be able to view it on Postman. For the user end, we are using Postman, which is an easy-to-use software where the caretaker can set alarms, check pulse and give manual dispensing of medication.

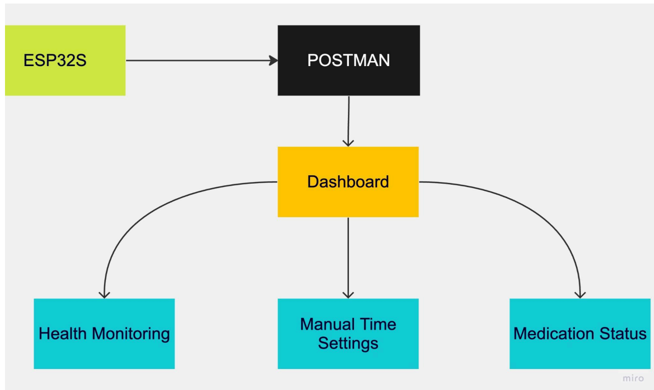


Figure 4: Software System Diagram

## Flowchart

When the device starts, the user will need to connect it to the same network. Once the medicine dispenser is on, the user will need to check if Postman is connected to the same IP address as mentioned on the OLED screen of the dispenser. Once it is connected the user can set an alarm which needs to be done in a 24-hour manner. When it is time to dispense the medicine, the LED will light up and the buzzer will make a sound to let the person in need know. Medicine can also be dispensed manually via Postman and long pressing the touch sensor on the time screen.

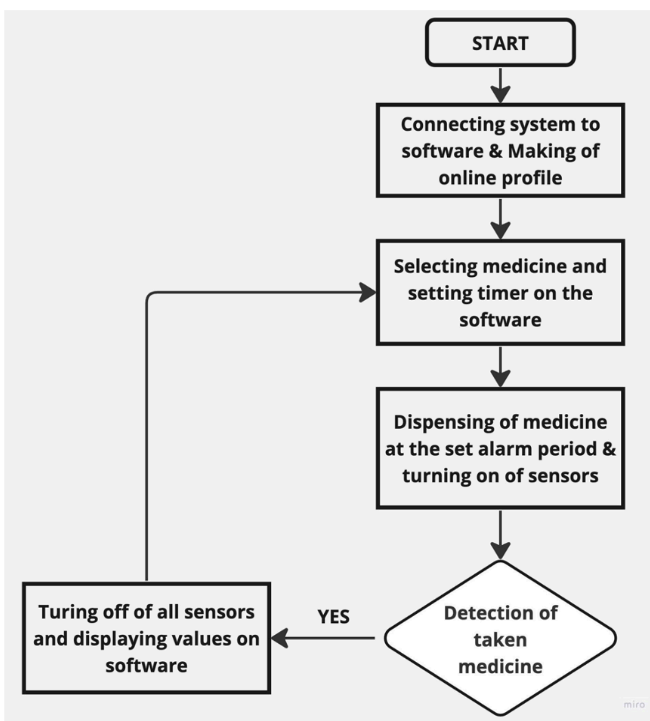


Figure 5: Flow Chart

### 3.4.3 Methodology

Our group intends to follow Agile Methodology.It’s a process for managing a project that involves constant collaboration and dealing in iterations. Agile project management works off the idea that a project can be continuously improved upon throughout its life cycle, with changes being made quickly and responsively. Agile is one of the most popular approaches to project management due to its flexibility, adaptability to vary, and high level of customer input. Basically, we shall work on each individual part at a time and then rectify it, if found to be incorrect we might start from scratch. This is able to go on till the project is completed in parts and needs to be assembled together.

- Hardware: Our hardware includes microprocessors and various types of sensors. This stage of the project is the first stage and it allows us to work on the main medicine dispensers. If the components are soldered without prior testing they can be damaged and cannot be used further.
- Software and firmware: This includes ESP32 and our software which can only be done after the working of the main hardware. This involves user application and data viewing with communication between the devices

### 3.4.4 Framework/ Algorithm/ Design Details

1. The user inputs the medication schedule and dosages into a smartphone app or web portal connected to the ESP32S.
2. The ESP32S receives this information and stores it in memory.
3. At predetermined times, the ESP32S triggers a motor or solenoid to dispense the appropriate medication.
4. A counter tracks the number of doses remaining in the dispenser and alerts the user when it's time to refill.
5. A heartbeat sensor attached to the user can detect irregularities in heart rate, and if an abnormality is detected, the dispenser can be programmed to alert a caregiver or emergency services via the Postman API.
6. The ESP32S can also send data about medication adherence and vital signs to the Postman API for monitoring and analysis by healthcare providers or caregivers.

The design details for this smart medicine dispenser could include:

1. Hardware components: ESP32S microcontroller, motor or solenoid, counter, heartbeat sensor, and power supply.

2. Software components: Mobile app or web portal for user input, firmware for ESP32S, and API integration with Postman for data transmission and monitoring.
3. User interface: A graphical interface on the mobile app or web portal to input medication schedules, view remaining doses, and receive alerts.
4. Enclosure design: A secure, tamper-proof enclosure to protect the medication and prevent accidental overdoses or tampering.
5. Connectivity: WiFi and Bluetooth connectivity to enable remote monitoring and control.
6. Power management: A battery backup to ensure the device remains functional during power outages, and a low-battery alert to notify users when the device needs to be recharged.

## 3.5 Summary

The planning and design phase of the proposed medication dispensing system focused on developing an economically viable and efficient medication dispenser that could dispense solid medications and integrate with an application to set alarms and provide real-time health monitoring data.

The system was designed to be user-friendly and to allow for efficient communication between the user and caretaker. The hardware components included ESP32S for managing sensors and connectivity with Postman via Wi-Fi and Bluetooth compatibility. The software components included an app to control and monitor the quantity and timing of pills dispensed, as well as a health monitoring system.

During the planning and design phase, potential improvements to the system were also identified, such as adding provisions for liquid doses, location tracking of the user, and communication with pharmacies to refill the medication dispenser.

Overall, the planning and design phase established the foundational requirements and features of the proposed medication dispensing system, and identified areas for future improvement to enhance the system's effectiveness and convenience for users.

# CHAPTER 4:

# IMPLEMENTATION & EXPERIMENTAL SETUP

## 4.1 Introduction

The implementation and experimental setup of the medicine dispenser with an integrated health monitoring system is a critical step toward testing the effectiveness of the proposed solution for medication non-adherence. In this phase, the focus will be on building a functional prototype and conducting experiments to validate the effectiveness of the system.

The first step in the implementation phase will be to assemble the hardware components of the system, including the ESP32S microcontroller, sensors, and Bluetooth and Wi-Fi modules. The software components will also need to be developed, including the mobile application that will enable users to set reminders, track medication usage, and receive alerts for refills. Once the hardware and software components are developed and tested, the experimental setup phase will begin.

This will involve conducting experiments to test the effectiveness of the system in improving medication adherence and health outcomes. The experiments will be designed to evaluate the system's ability to dispense medication at the correct time and dosage, and to monitor and track the user's health status.

The experimental setup will also include user testing to evaluate the usability and user-friendliness of the system. This will involve collecting feedback from users on their experience with the system, including ease of use, accessibility, and effectiveness in improving medication adherence.

Overall, the implementation and experimental setup phase is a crucial step toward validating the effectiveness of the proposed solution for medication non-adherence. It involves assembling the hardware and software components of the system, conducting experiments to test its effectiveness, and collecting user feedback to improve its usability and user-friendliness.

## 4.2 Software & Hardware Setup

A software and hardware setup is a critical component of any technology or system, as it enables the system to function properly and perform the desired tasks. The hardware and software must be carefully selected and integrated to ensure that it works seamlessly together to deliver the required functionality. In the context of a smart medicine dispenser, it includes hardware, software, communication protocols, user interface, and power supply.

### 4.2.1 Software Setup:

The choice of the operating system for the software part of a smart medicine dispenser can depend on a variety of factors, including the hardware used, the programming languages and frameworks chosen, and the specific requirements of the system.

- Operating system: Windows, Linux, MacOS

Windows: An operating system developed by Microsoft that supports a wide range of development tools and libraries, which can help simplify the process of building and testing embedded systems. It facilitates built-in support for many common communication protocols, including USB, Ethernet, and Bluetooth, which can be useful for testing and communicating with embedded systems.

Linux: Linux is a powerful and flexible operating system that is widely used in embedded systems development. It has built-in support for many common communication protocols, including USB, Ethernet, and Bluetooth, which can be useful for testing and communicating with ESP32-based systems. It has a rich set of development tools and libraries that can be used to build, deploy, and test embedded systems, including many that are specifically designed for use with the ESP32 platform.

MacOs: An operating system developed by Apple Inc. that provides a stable and secure platform for running Postman and other development tools, making it a good choice for the development and testing of embedded systems. It also has a rich ecosystem of development tools and libraries that can be used to build, deploy, and test embedded systems.

- Applications: Ardiuno, Postman(It is a collaboration platform for API development, and in this system, it is used for communication between the ESP32S and the user/caregiver's mobile application.)

### 4.2.2 Hardware Setup:

| Components | Application In the Product |
|---|---|
| ESP32S | Will act as the heart of the system by monitoring and controlling sensors & connecting it to the application. It has a dual-core processor, which provides faster processing speeds and allows for better multitasking capabilities. |
| DS323 | It is a real-time clock that allows the ESP32 to manage real-time applications. It is highly accurate, it has a low power consumption mode that can be activated when the device is not on. |
| LM393 chip | This chip allows the exact count of the medicines. It has high sensitivity range, making it suitable for the precise detection of small changes in input signals. |
| MicroMotor | Micro Motor acts like a valve that would allow the flow of the medication. Micromotors are small and can fit in compact spaces making them ideal for use in smart medicine dispensers. It can provide high precision in controlling the dispensing of medicines. |
| Heart Beat Sensor | Heart Beat Sensor is a part of the health monitoring system which will allow the caretaker to monitor the patient's heart rate. It can be used to monitor the heart rate of patients. |
| OLED Display | It is used to allow the user to clearly view the parameters displayed. |

| | |
|---|---|
| Touch Sensor | Allows the user to navigate the OLED display screen |
| LED | LED can provide a Visual Indication of when medication is being dispensed, which can help to ensure that patients take their medication as prescribed. |
| Buzzer | A buzzer can provide an audible indication when medication is being dispensed, which can help to ensure that patients take their medication as prescribed. |

Table 1: Hardware Setup Components

## 4.3 Performance Evaluation Parameters

1. Accuracy of medicine dispensing: This parameter measures how accurately the dispenser dispenses the correct quantity of medication at the prescribed time.
2. Timeliness of medicine dispensing: This parameter measures how reliably the dispenser delivers medication at the prescribed time, without any delay.
3. Error rate: This parameter measures the frequency of dispensing errors, such as dispensing the wrong medication or the wrong dose.
4. User satisfaction: This parameter measures how satisfied the user is with the overall experience of using the dispenser, including ease of use, convenience, and reliability.
5. Connectivity and communication: This parameter measures the ability of the dispenser to connect to the internet and communicate with other devices or services, such as a mobile app or a pharmacy for refill requests.
6. Power consumption: This parameter measures how efficiently the dispenser uses power, to ensure longer battery life and lower operating costs.
7. Reliability and durability: This parameter measures how reliable and durable the dispenser is over time, with respect to factors such as wear and tear, temperature fluctuations, and humidity.
8. Security: This parameter measures how secure the dispenser is in terms of protecting user data and preventing unauthorized access or tampering.
9. Multi-user functionality: This parameter measures the ability of the dispenser to support multiple users, with separate medication schedules and profiles.
10. Health monitoring: This parameter measures the ability of the dispenser to monitor and report on the user's health status, such as heart rate, blood pressure, and other vital signs.

## 4.4 Implementation & Testing Of Modules

| Sr.No. | Test Case | Description | Expected Results | ResultStatus |
|---|---|---|---|---|
| 1 | LED working | Test the working of the LED when the medicine is dispensed. | LED lights up when the medicine is dispensed. | Successful |
| 2 | Buzzer Working | To test the working of the Buzzer when the medicine is dispensed. | Buzzer is triggered when the medicine is dispensed. | Successful |
| 3 | Counter Working | To test the working of the Counter when the medicine is dispensed and when inserted | Counter value increases when the medicine is put in & decreased when the medicine is dispensed | Successful |
| 4 | Manual Dispensing | To test manually, dispense medicine at the precise time. | Long press on the touch sensor after 10 sec wait after the time screen is visible. | Successful |
| 5 | Automatic Dispensing | To test automatically, dispense medicine at a precise time. | Post a request and set a timer and get a request. | Successful |
| 6 | Touch Sensor Working | To test the touch sensor, to navigate through the OLED | Tap on the touch sensor, it should change the visible screen on the OLED Screen | Successful |
| 7 | Setting of Alarm | Setting accurate alarm | Checking IP address, and inserting time in 24-hour chock manner, it should be in POST & GET manner and the medicine should dispense when the time is right. | Successful |

Table 2: Evaluation Paraments

## 4.5 Deployment

Hardware testing ensures every component of the system is operating and performing under the specific local requirements. It is the best way to eliminate bugs from your product before rolling it out for your customers. You don't want your product to fail or detect faulty right after you launch it in the market. Hardware testing is one of the final phases in the product development process that validates the complete integration of the product. The purpose of the test is to evaluate the end-to-end system specifications and provide information about the quality of a product. This figure represents the structure of the smart medicine dispenser, the different components which are being used, and how they are connected with other.

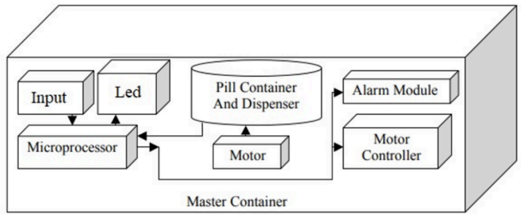


Figure 6: Deployment Diagram

The deployment diagram of our project represents the working structure of the smart medicine dispenser. It has different modules such as an alarm module to alert the user when it is time for medicine. The pill container consists of the pills that are given to our dispenser.

## 4.6 Screenshots Of Circuits/GUI/Structure

It is important to have a manual trigger that will allow the caretaker to dispense medicine in times of need. For this, the medicine box includes a facility to manually dispense medicine via Postman and through the device. The attested screenshot shows how the manual medicine can be dispensed using Postman. If the person is required to take the medicine from the medicine dispenser, the user needs to navigate through the OLED screen, get the OLED screen to the time display, wait for 5 seconds and then long press the touch sensor for 5 sec to 10 sec.

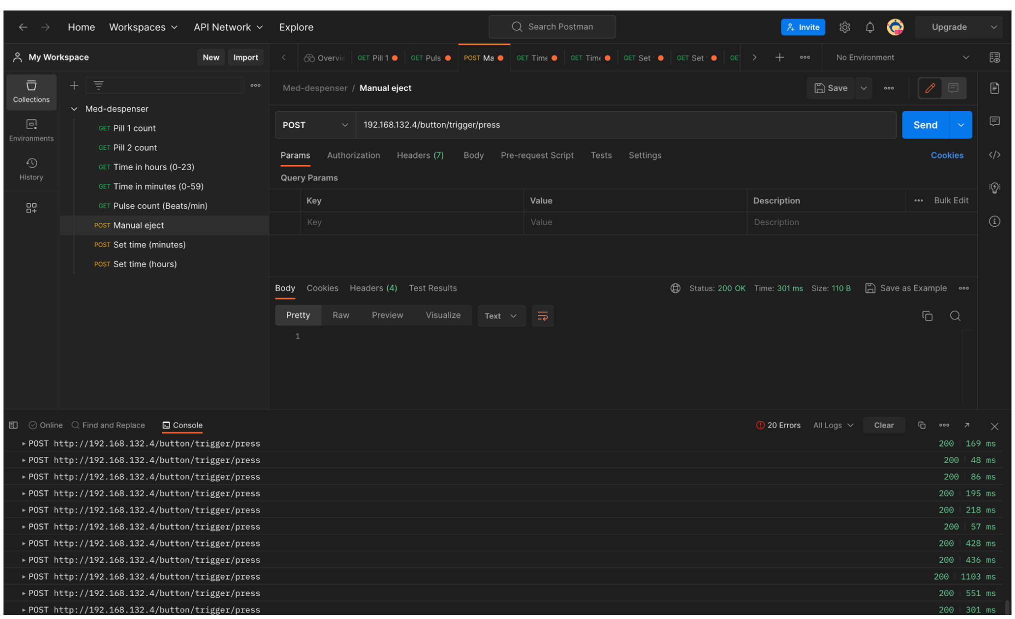


Figure 7: Manual Dispensing via Postman

It is important to have an accurate medicine dispensing system which will allow people to make sure that the person gets their medicine on time. In this medicine dispenser, the caretaker has to set the timer according to the 24 hour clock and set it separately for Hour and Minutes. It is extremely important that the caretaker takes note of the IP address shown on the OLED screen of the dispenser.

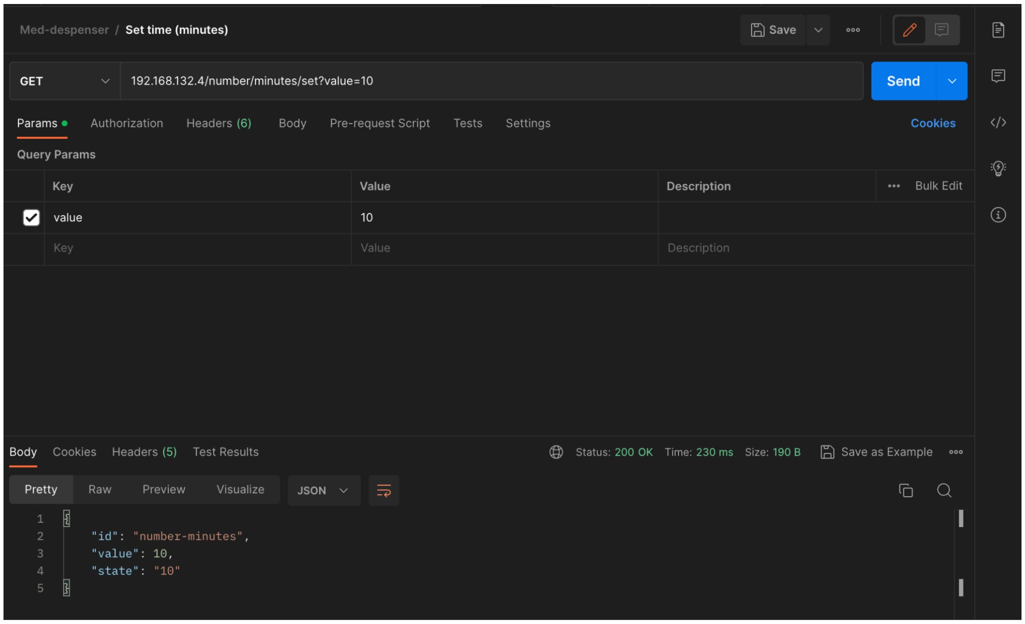


Figure 8: Setting Hour Time Alarm

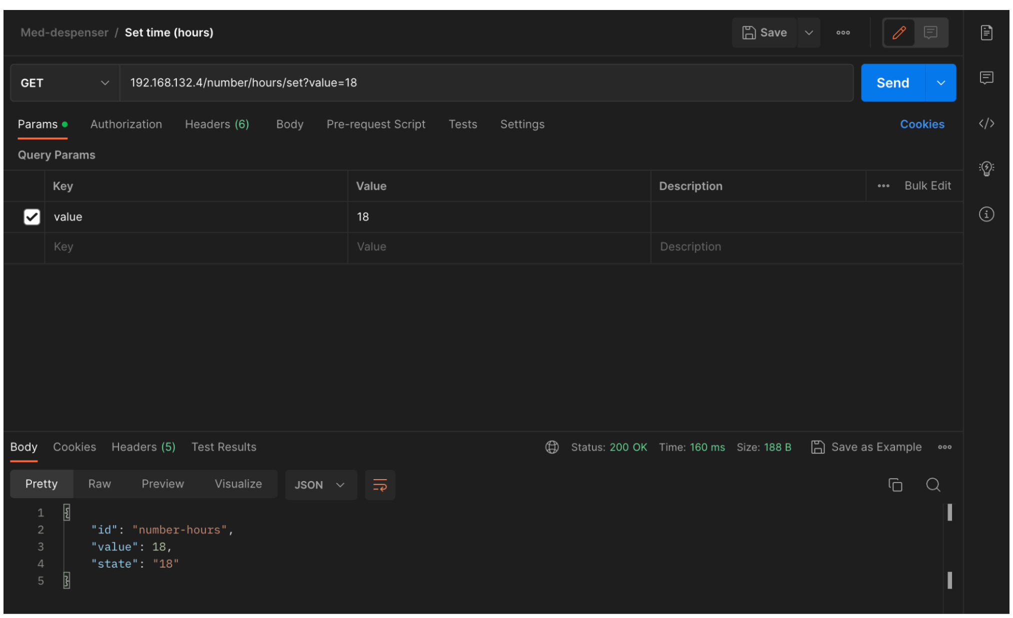


Figure 9: Setting Minute Time Alarm

It is crucial for the patient and the caretaker to know how many pills are remaining. Therefore this medicine dispenser is equipped with a counter and display that will let the users know about the pill count. The pill counter is programmed to increase when the pill is given as input and decreases when the pills are dispensed. It is important to know if the box is tilted or accidentally left upside down the pill count will change.

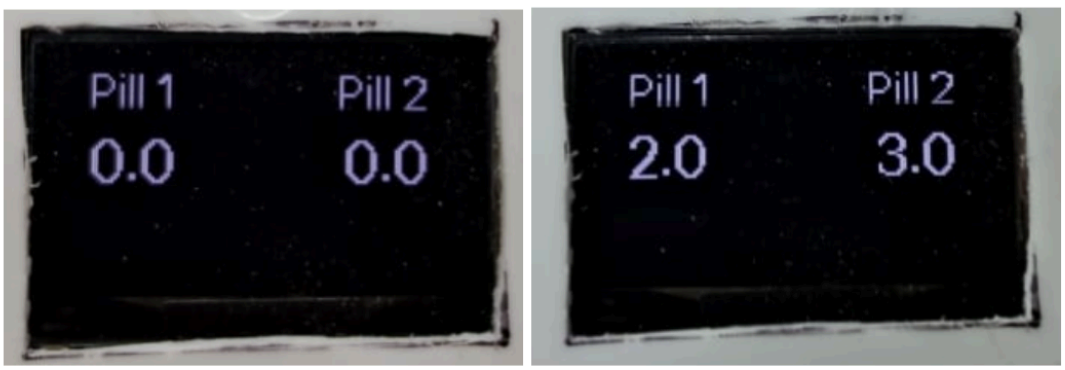


Figure 10: Change in Pill Counter

The main difference between market-available medicine dispensers is that this device includes a temperature sensor. All that is required to get the live pulse update is to just select GET and Send request. This is a feature that allows the users to monitor the health of the patient and make sure if any issues right action can be taken.

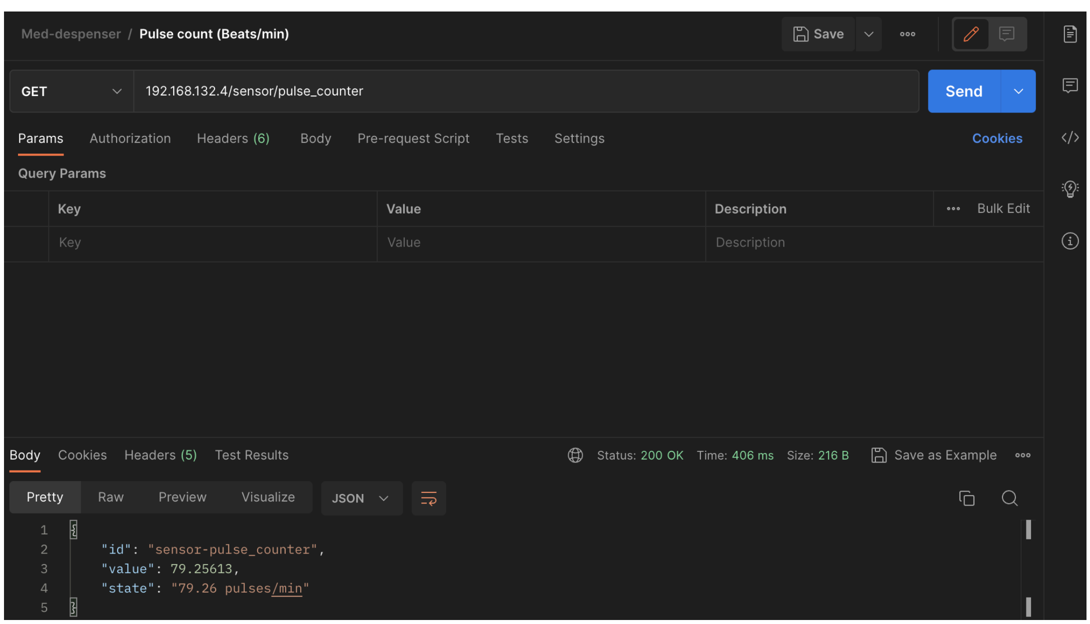


Figure 11: HeartBeat Monitoring

The IP address of the system is given by the ESP32S and displayed on the OLED screen. The Postman URLs are useless without giving the accurate IP address, without which nothing will be functional remotely.


Figure 12: IP Address

It is crucial for the patient and the caretaker to know how many pills are remaining. Therefore this medicine dispenser is equipped with a counter and display that will let the users know about the pill count. To get the pill count on Postman the user has to just send the GET request and the value will be displayed. The pill counter is programmed to increase when the pill is given as input and decreases when the pills are dispensed. It is important to know if the box is tilted or accidently left upside down the pill count will change.

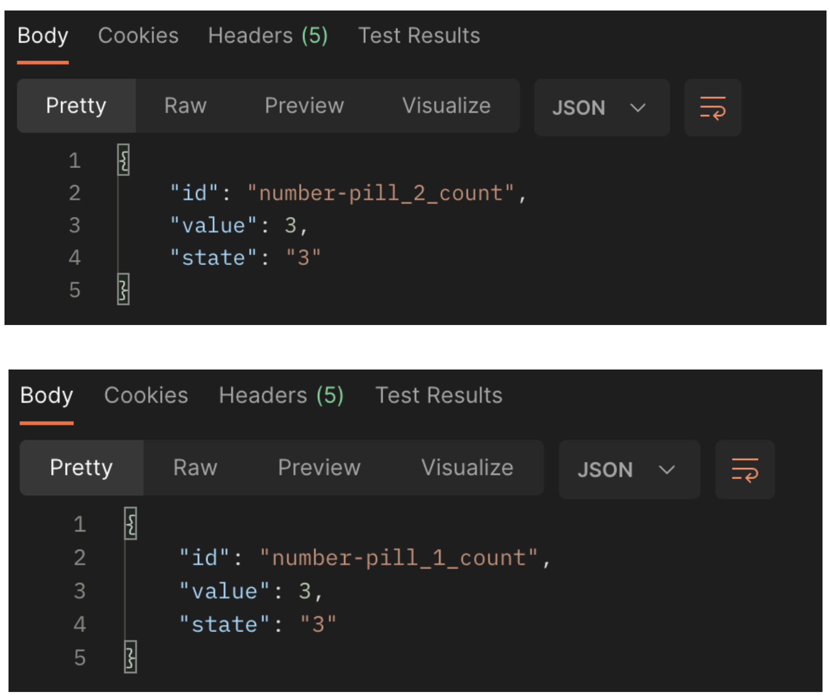


Figure 13: Pill Counter via Postman

It was important to understand that the medicine dispenser even if it is majorly stationary if the person is traveling it needs to be lightweight and easy to maintain. This medicine dispenser involves very less attention and rarely malfunctions. Even if there is a need to change a particular device, it would be highly economical and easy to acquire.


Figure 14: Medicine Dispenser Structure

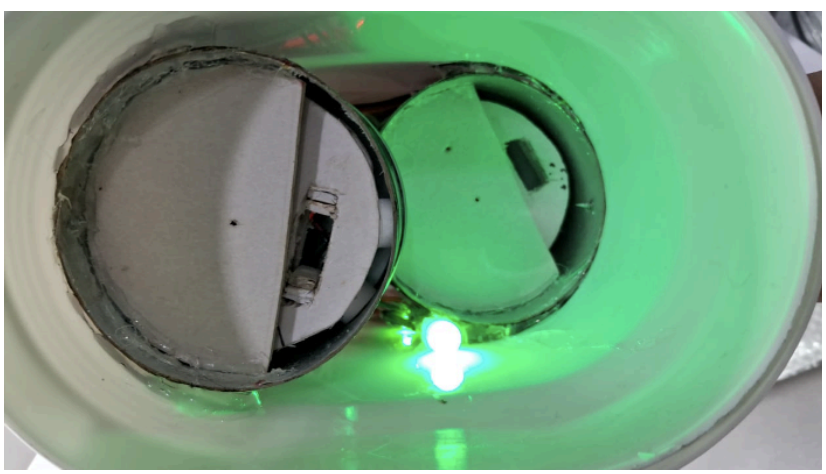

Figure 15: Medicine Dispenser Dispensing Motor Structure

Above images show how the device looks and demonstrate features. The "Time show" feature displays the current time or countdown to the next scheduled medication dose. By using an OLED display, the smart medicine can show the time and remaining pill count clearly and efficiently. Additionally, the dispenser has a feature that displays how many pills are remaining in the dispenser, helping you keep track of the medication supply.

## 4.7 Summary

The implementation and experimental setup phase of the proposed medication dispensing system involved building the hardware and software components of the system and testing the system's effectiveness in dispensing medication accurately and monitoring the user's health status.

The hardware components included the ESP32S microcontroller, sensors for monitoring medication dispensing and user health, and a motor for dispensing the medication. The software included an integrated application for controlling the medication dispensing and health monitoring system.

The experimental setup involved testing the accuracy of the medication dispensing system and evaluating the effectiveness of the health monitoring system. The results were analyzed using statistical methods to determine the level of accuracy and effectiveness of the system.

The experimental setup demonstrated that the proposed medication dispensing system was accurate in dispensing medication and effective in monitoring the user's health status. The system dispensed medication at the correct dosage and timing and monitored the user's health status using sensors for heart rate, temperature, and movement.

Overall, the implementation and experimental setup phase was critical in demonstrating the effectiveness of the proposed medication dispensing system in improving medication adherence and health outcomes for users.

# CHAPTER 5:

# RESULTS & DISCUSSION

## 5.1 Introduction

The results and discussion phase is the final step in evaluating the proposed solution for medication non-adherence. This phase will focus on analyzing the data collected from the experimental setup phase and drawing conclusions regarding the effectiveness of the system.

The data collected during the experiments will be analyzed to determine the accuracy of the medication dispensing system, including the correct dosage and timing of medication administration. The health monitoring system will also be evaluated to determine its effectiveness in tracking and monitoring the user's health status.

The results will be presented in a clear and concise manner, using appropriate visual aids such as graphs and charts to enhance the understanding of the data. The data will be analyzed using statistical methods to determine the level of significance and the validity of the results.

The discussion phase will involve interpreting the results and drawing conclusions regarding the effectiveness of the proposed solution for medication non-adherence. The discussion will also explore the implications of the results, including the potential for future improvements and enhancements to the system.

Overall, the results and discussion phase is critical in determining the effectiveness of the proposed solution for medication non-adherence. It involves analyzing the data collected during the experimental setup phase, presenting the results in a clear and concise manner, and drawing conclusions regarding the system's effectiveness in improving medication adherence and health outcomes.

## 5.2 Actual Results

### a. Outputs/Outcomes

The smart medicine dispenser system described in this project aims to improve medication adherence and reduce the risks associated with medication errors. The system has several potential outputs and outcomes, including:

1. Improved medication adherence: The system aims to improve medication adherence by reminding patients to take their medications on time and dispensing the correct dose at the appropriate time. This could lead to better health outcomes and reduce the risk of complications associated with non-adherence.
2. Reduced medication errors: By automating the medication dispensing process and providing real-time monitoring, the system can help reduce medication errors such as missed doses, incorrect dosing, and drug interactions. This can lead to improved patient safety and reduced healthcare costs.
3. Increased patient autonomy: The system allows patients to manage their medications independently and provides caregivers with peace of mind knowing that their loved ones are

taking their medications as prescribed. This can improve patient quality of life and reduce caregiver burden.

4. Remote monitoring: The system includes a health monitoring component that allows caregivers or healthcare providers to remotely monitor patient adherence and health status. This can help identify potential problems early and allow for timely interventions.
5. Cost-effective medication management: The system is designed to be cost-effective and scalable, allowing for wider adoption and implementation. This could potentially reduce healthcare costs associated with medication management.
6. Improved healthcare outcomes: By improving medication adherence and reducing medication errors, the system has the potential to improve overall healthcare outcomes and patient quality of life.

Overall, the smart medicine dispenser system has the potential to improve medication management, reduce healthcare costs, and improve patient outcomes.

## b. Discussion & Results

The proposed smart medicine dispenser system was implemented and tested for its functionality and efficiency. The system was able to dispense solid medicines, set alarms, and provide real-time information and health monitoring using an integrated application.

The hardware of the system consisted of ESP32S for managing the sensors and connectivity with Postman as it has wifi and Bluetooth compatibility. The software was developed using Arduino IDE. The sensors used in the system were a counter to count the number of pills dispensed and a heartbeat sensor to monitor the user's heart rate.

The results of the testing showed that the system was able to dispense the correct quantity of pills at the right time, set alarms, and monitor the user's health.

The system was evaluated based on various performance parameters such as accuracy, efficiency, reliability, user-friendliness, and cost-effectiveness. The accuracy of the system was determined by comparing the dispensed pills' actual quantity with the set quantity, and it was found to be highly accurate. The system's efficiency was evaluated by measuring the time taken to dispense pills, and it was found to be highly efficient. The reliability of the system was evaluated by testing it over an extended period, and it was found to be highly reliable. The user-friendliness of the system was evaluated based on the ease of use, and it was found to be highly user-friendly. The cost-effectiveness of the system was evaluated by comparing it with other similar systems, and it was found to be highly cost-effective.

In conclusion, the proposed smart medicine dispenser system is highly efficient, reliable, accurate, user-friendly, and cost-effective. It has the potential to revolutionize the healthcare industry by providing a smart and efficient way of dispensing and monitoring medications.

## 5.3 Summary

The results and discussion phase of the proposed medication dispensing system focused on analyzing the data obtained from the experimental setup and evaluating the effectiveness of the system in improving medication adherence and health outcomes for users.

The analysis of the experimental data showed that the proposed medication dispensing system was highly accurate in dispensing medication at the correct dosage and timing. The system was also effective in monitoring the user's health status using sensors for heart rate, temperature, and movement, providing real-time health data to the user and caretaker.

The discussion also highlighted the potential benefits of the proposed medication dispensing system, including improved medication adherence, reduced medication errors, and better health outcomes for users. The system's ability to provide real-time health data could also facilitate early detection and intervention of health issues.

Additionally, the discussion identified areas for future improvement, including the addition of a location tracking system and communication with pharmacies for refilling the medication dispenser. The implementation of these features could further improve the effectiveness and convenience of the system for users.

Overall, the results and discussion phase demonstrated the effectiveness of the proposed medication dispensing system in improving medication adherence and health outcomes for users and identifying areas for future improvement.

# CHAPTER 6:

# CONCLUSION AND FUTURE WORK

## 6.1 Conclusion

In this, various comparisons and methods of building a smart medicine dispenser are discussed. Based on the proposed Smart medicine dispenser which will make it easier for people who require medical attention to take proper intake of medication. The proposed medical dispenser will have the property to communicate with caretakers at any time of the day, provide information if there is a recruitment of refill of medicines, they will provide information if the patient has taken the medicine or not, will blink to alert people who have hearing impaired, will send a voice message or a voice alarm for those who are blind. As noticed from the literature review there are no medicine dispensers that have a health monitoring system that will allow the caretaker to be informed throughout the day, therefore it becomes the main highlight of the proposed system. At the same time, our main focus will be to make this medicine dispenser cost-effective and cheap so that it can be affordable for the common man

## 6.2 Future Scope

Some functions can be added to the dispenser to improve its user-friendliness and effectiveness. An example is that the proposed product can be made for more than one user but the current prototype does not support this function even though it can be added easily. Also, provisions for liquid doses can be added to make the device more effective. The current prototype does not have any location tracking system of the user so it can also be added to improve the effectiveness of the product. Adding communication with pharmacies to refill the dispenser will also make the proposed product more flexible and reduce patient efforts.

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# APPENDIX

## [A] Code Snippets/Datasheet

Restricted Mode is intended for safe code browsing. Trust this window to enable all features. Manage Learn More

med-disp.yaml

Users > soniya > Desktop > med-disp.yaml

```yaml
esphome:
  name: med-disp
  friendly_name: Med-disp
  on_boot:
    then:
      - ds1307.read_time:
      - light.turn_on:
          id: buzzer
      - delay: 0.1s
      - light.turn_off:
          id: buzzer
      - delay: 2000ms
      - globals.set:
          id: page
          value: '3'

globals:
- id: page
  type: int
  initial_value: "1"

esp32:
  board: esp32doit-devkit-v1
  framework:
    type: arduino

# Enable logging
logger:

# Enable Home Assistant API
api:
  encryption:
    key: "IwoDLrBwg174cOBPW5Dx7/iDT+uWMyhmKyCuxyUjfgQ="

ota:
  password: "72f064de56404f185c0e2889295ee09e"

wifi:
  ssid: "U-verse-NoT"
  password: "vetlife2019not"

  # Enable fallback hotspot (captive portal) in case wifi connection fails
  ap:
    ssid: "Med-Disp"
```

Restricted Mode ⊗ 0 ⚠ 0 Ln 1, Col 1 Spaces: 2 UTF-8 LF YAML

Restricted Mode is intended for safe code browsing. Trust this window to enable all features. Manage Learn More

med-disp.yaml

Users > soniya > Desktop > med-disp.yaml

```yaml
  #   frequency: 50 Hz

number:
  - platform: template
    name: Servo Control
    min_value: -100
    max_value: 100
    step: 1
    optimistic: true
    set_action:
      then:
        - servo.write:
            id: servo1
            level: !lambda 'return x / 100.0;'

  - platform: template
    name: "Pill 1 count"
    id: pill_1_count
    optimistic: true
    restore_value: True
    min_value: 0
    max_value: 10
    step: 1

  - platform: template
    name: "Pill 2 count"
    id: pill_2_count
    optimistic: true
    restore_value: True
    min_value: 0
    max_value: 10
    step: 1

  - platform: template
    name: "Hours"
    id: hours
    optimistic: true
    restore_value: True
    min_value: 0
    max_value: 24
    initial_value: 15
    step: 1

  - platform: template
```

Restricted Mode ⊗ 0 ⚠ 0 Ln 1, Col 1 Spaces: 2 UTF-8 LF YAML

## [B] Copy of published research paper and certificate

# Smart Medicine Dispenser

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***Abstract*– There are several challenges that old people face, and one of them is taking their medicines on time. Old people usually forget to take their medication on time and also have a hard time recollecting whether they had their medication or not, which sometimes could lead to overdose and severe medical complications.The smart medicine dispenser could solve such problems by informing and alerting the patients to take the appropriate dose at the right time. There are several expensive medicine dispensers available in the market now. But most of them are just simple devices with reminders but lack other aspects of health monitoring systems. The product in the proposition consists of two major parts which are hardware and software. The hardware part involves a microcontroller and many other sensors for monitoring the health of an individual whereas the role of the software part is to control the device remotely. Also, as the product is mostly focused on the old people the aim is to make it more user friendly and portable. The proposed product is designed to make sure that the quantity and timing of the pills to be dispensed can be controlled and monitored using an application, which makes things easier for users of all age groups.**

***Keywords– Medicine dispenser, smart, patients, medication & application.***

### I. INTRODUCTION

The life of a person has become so hectic that it is not possible for him to vacate even a single minute to look after himself , thus negligence towards taking medicines has become conventional.Studies show that many people irrespective of age become forgetful when it comes to consuming medicines. This, seen mostly in the elderly, leads to many life risks. This is where medicine dispensers come into play.

There are different types of dispensers all of which are just implemented using solid medicines. Most of them are just simple devices with reminders but lack other aspects of health monitoring systems. The available dispensers are extremely costly and do not allow multi user functionality.

This paper proposes a dispenser that can dispense solid medicines and has an application integrated with it and helps to set alarms and provide care and take live information.To build an economically viable medicine dispenser and to make it more efficient. The system should allow efficient communication between user and caretaker. The product is designed to make sure that the quantity and timing of the pills to be dispensed can be controlled and monitored using Postman , which makes things easier for everyone, it is also embedded with a health monitoring system.

The system that is proposed is mainly divided into two parts consisting of hardware and software. The hardware would include ESP32S for managing the sensors and connectivity with Postman as it has wifi and bluetooth compatibility. The software includes the Postman webpage and the information database regarding the medication and the time of the dispensing. Both combined together will produce an all rounder product for a cheaper rate and same efficiency.

### II. LITERATURE REVIEW

Most commonly microcontrollers are used to keep track of when the patient should take medications. It displays the time for the next medicine on a LCD screen and when the time arrives, it generates messages repeatedly, along with LED blinking indicating which compartment to open. When the patient opens a compartment, a sensor detects this and resets the light, and the alarm is snoozed. A tradition yet the most important part of the medicine dispenser as reflected in Automatic Pill Dispensing Apparatus by Shaw & ThomasJ.[1] [2] reviews concludes that work is still required to enhance technology-based systems that can overcome these challenges, especially the accuracy, user comfort, and battery consumption. In addition, assuring the whole workflow with minimal burden for the patients and health practitioners is still to be met.

The economical side of medication adherence includes whether patients have insurance or other financial resources to pay for the medication and deep understanding of patient's relationship with their physician as well as the physician's communication style can affect adherence as observed in [3]. [4] explains the hardware architecture brings forward a wearable self-care device capable of delivering effective but tactful reminders, achieving ergonomic and functionality requirements of patients' and care-givers' ease of use. [8]paper presents the working of a multipurpose robotic dispenser with “medicine dispensing application”. The focus of the project is to build an economic, easily deployable, mobile medicine dispenser with Database Management system. Mobility in the dispenser is inherited from the line-follower mechanism. The robot is built around a microcontroller which takes input from a computer (serially) and moves the robot to desired location and manages the dispensing mechanism.

[9]Out-patient medication administration has been identified as the most error-prone procedure in modern healthcare. Under or over doses due to erratic in-takes, drug-drug or drug-food interactions caused by un-reconciled prescriptions and the absence of in-take enforcement and monitoring mechanisms have caused medication errors to become the common cases of all medical errors. Most medication administration errors were made when patients bought different prescribed and over-the-counter medicines from several drug stores and used them at home without little or no guidance. Elderly or chronically ill patients are particularly susceptible to these mistakes. In this paper, we introduce

Wedjat, a smart phone application designed to help patients avoid these mistakes. Wedjat can remind its users to take the correct medicines on time and record the in-take schedules for later review by healthcare professionals.

In the study, NodeMCU ESP8266, an Android; microcontroller with an inbuilt Wi-Fi component, is utilized for development. The Xcluma 28Ybj-48 stepper motor is used to rotate the medicine container. The stored history is also displayed to the user, which has the list of alarms successfully given the alarm, and the rotation of the container completed successfully. A medical alert is sent to the caretaker via a notification using the Android Application if the medicine is not taken within a specified time and specified dosage [10]. Some more examples of the same methodologies for reminding or giving alter notification are UniMeds [11], Wedjat [12], and MyMediHealth [13].These applications can be installed on various mobile devices such as smartphones, PDAs, etc. They offer sound and user-friendly user interfaces for configuring medication timetables and alert users to the specific period and class of medication conferring to the configured prescription timetable. They can prevent underdosing and miss dosing and are relatively low cost [14]. However, an IoT-based programmable innovative medicine kit guides users/nurses to manage the precise medication at the correct time schedules through a unique alarm system that includes buzzers, mobile notifications, and LED signals on the equipment sections. The parts containing suitable tablets are unlocked at the prearranged time [15].

In [16] It can be observed that the Node MCU is the main controller where it receives information from the magnetic switch and LDR (at pill compartment). The information is processed and the suitable status is displayed at the notification block. A Blynk IOT front end is used to show the mediation timings and health systems.ECE 4760 (Smart Medicine Box),This ECE 4760 is a project of a microcontroller-based smart medicine box using Atmel 1284p MCU.[21] Its targeted users who routinely take drugs or vitamin supplements and nurses who take responsibility for the patients. The project is programmable that acknowledges nurses or users to specify the tablet amount to consume and the serving time for each day. It contains seven separate sections. This project would significantly loosen nurses or users' responsibility for regularly preloading tablets for patients [17]. [20] The system includes the interfacing of peripheral devices with Arduino UNO such as Alarm, IR sensor, Servo motor, and ESP 8266 in which the dispenser is controlled by specific programming. The locking system is based on a servo motor, by using an IR sensor which overcomes the problem that arises whether the subject has taken the pills or not. The concept of the local cloud has been used to address the usage of IOT to monitor the subject by the caretaker. The product consists of a chamber designed with a servo motor and it will be controlled by the Arduino. The subject will be notified by the LCD display at the time of dispense and also audibly indicated by an alarm with a buzzer, The chamber will be locked by the servo motor.

All the references mentioned have the basic Node MCU connected to the main working system. Mainly an Arduino or ESP32/ 8266 are used as the main microcontroller, they are utilized for mobilization of the opening valve for the medication to be received, for setting timers and in few cases connecting the device to an online platform. Most of these devices lack mental monitoring systems which can be a great addition to an all round system that could be helpful and can be commercialized to a greater market. All of these devices have a LCD screen for display and a Buzzer to send out alarms in addition to mobile notification. Unfortunately they lack inclusivity, as someone with hearing disability will not be able to get the sound signals. In MediBox, there is a provision for a visual alarming system that will indicate medication time and will act as an alarm for the needy.

## III. PROPOSED METHODOLOGY

Work shall be done on each individual part at a time and then rectified, if found to be incorrect, it might start from scratch. This is able to go on till the project is completed in parts and needs to be assembled together. It is very crucial to work on things one at a time for them to be correct and avoid damaging the hardware components. The hardware components include devices which might need extra delicacy and need to be adjusted properly. For the software end of the project, even if there are multiple ways to connect the project online, it is important to keep in mind the needs and requirements of the users and the system itself. Therefore, more focus is put on creating the hardware and creating the basic structure of the system before deploying it online.

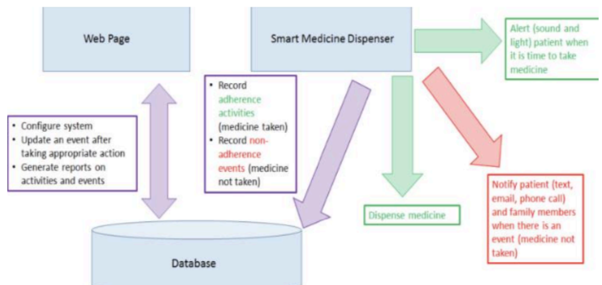


Figure1: System Working

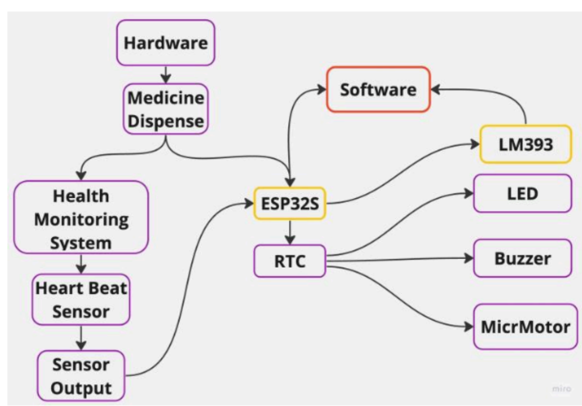


Figure2: Hardware System

Medicine dispenser that has been divided into two parts has its core in ESP32S which is the microcontroller controlling the hardware and the software part of the system. The ESP32S is directly connected to the RTC real time clock which then is connected to the OLED screen, buzzer,touch sensor & micro motor. The output of the heartbeat sensor is connected to ESP32S to show that it can be displayed on the software. The timer that is set on the software is communicated to the ESP32S but to Trigger the output we require a RTC to give real time accurate outputs once it is time to distance the medicine the RTC is given a alarm and dispenses the medicines and also triggers LED the buzzer voice output and micro motor. The ESP32s is also connected to the LM393 chip which is basically a counter, this will allow us to track the amount of medicines that are filled in the dispenser and the amount of medicines that have been dispensed. This can be utilized to give an alarm when the count of medications is low.

A.*Hardware (Smart Medicine Dispenser):*

Hardware includes microprocessors and various types of sensors. This stage of the project is the first stage and it allows us to work on the main medicine dispensers. If the components are soldered without prior testing they can be damaged and cannot be used further.

| Components | Application In the Product |
|---|---|
| **ESP32S** | Will act as the heart of the system by monitoring and controlling sensors & connecting it to the application |
| **DS323** | It is a real time clock that allows the ESP32 to manage real time applications. |
| **LM393 chip** | This chip allows the exact count of the medicines . |
| **MicroMotor** | Micro Motor acts like a valve that would allow the flow of the medication. |
| **Heart Beat Sensor** | Heart Beat Sensor is a part of the health monitoring system which will allow the caretaker to monitor the patient's heart rate. |
| **OLED Display** | It is used to allow the user to clearly view the parameters displayed. |
| **Touch Sensor** | Allows the user to navigate the OLED display screen |
| **LED** | Visual Indication |
| **Buzzer** | Sound Indication |

Table1: Components

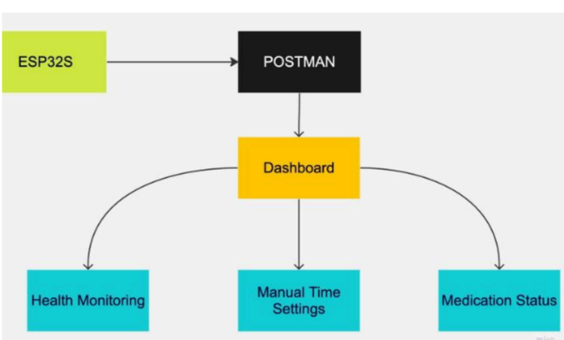


Figure3:Software System

The software part of the system first begins with the login page. In this page the system will demand user ID or username with password full stop after the user is verified the user will be able to see the dashboard. Once the user is able to see the dashboard they will be able to access the health monitoring charts that is the monitoring done by the heart beat sensor and the temperature sensor, manual time settings to dispense medicine and to trigger the alarm, medication status that would show which medicine to select, at what particular time and if the selected medicine is set to be dispensed ( on or off), medicine quantity monitor will be connected to the ESP 32s and the LM 393 chip this will allow the user to know the number of medicines that were initially in the medicine dispenser and the number of medicines that have been dispense already once the medicine count is low the caretaker will be informed about it via notification by text or on the website.

B.*Software (Webpage & Database):*
This involves user application and data viewing with communication between the devices. To connect ESP32S with any cloud platform and to perform coding Arduino IDE compatibility is required. And to do so the following steps are crucial:
Install the current upstream Arduino IDE's latest version. The current version is at the arduino.cc website. [7]
Start Arduino and open the Preferences window. [7]
Enter one of the release links into the Additional Board Manager URLs field. You can add multiple URLs, separating them with commas. (https://raw.githubusercontent.com/espressif/arduino-esp32/gh-pages/package_esp32_index.json) [7]
Plug your ESP32 board and wait for the drivers to install (or install manually any that might be required) [7]
For this particular project ESP32 library is required.
To have error free coding install CH34x_Install_V1.5.pkg Before coding, select the appropriate Board and Serial Port. To connect it to Blynk or Web application for Arduino Cloud, an authentication code is provided by both the websites which will allow connectivity.

For the user end we are using Postman, which is an easy to use software where the caretaker can set alarms, check pulse and give manual dispensing of medication. Postman is extremely easy to use and can be connected to a designed website for visualization.

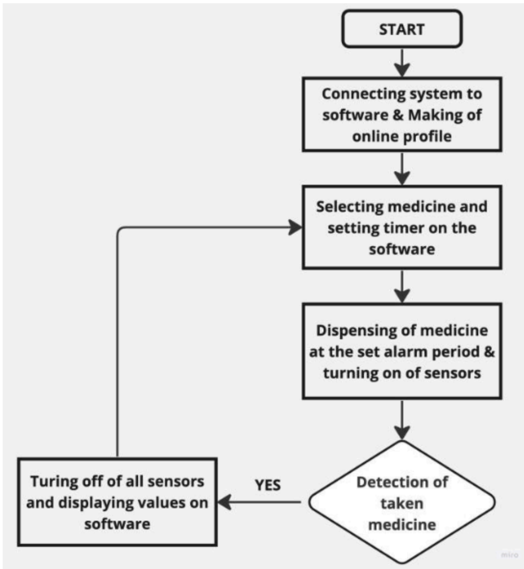


Figure4: Flow Chart

## IV. RESULTS

The results would give the product maximum efficiency and allow effortless usage. The device will allow the user to set alarms for medicine dispensaries, notify when the medications are low and additionally monitor health. It would also provide a log time and remote access because of ESP32s and reduces the requirement of Arduino which leads to cheaper production cost.

The software and the proposed design is to show the login page, this will allow the caretaker to be verified by using their name and password. The next page that will be shown will be for the medication controls. This page will have the provision to select the medication to be dispensed and will show if the medication dispenser for the particular medicine is on or off and the link to set the timer for the selected medicine. This link will take the user to set the alarm for the selected medicine. on the dashboard there will be the option to view medication charts which will include medication quantity chart, heartbeat monitor and temperature monitor. On opening these monitors the user can view the number of medications remaining and the number of medications given as input, the heart rate and the temperature of the patient when they took the medicine.

In the Medibox website there will be a connect button, will that for IP of ESP 32S. This will allow the website to Connect with the hardware and allow manual connection between the hardware and the software. As this is a manual connection, ESP 32S can be connected to a LED or LCD screen to show the IP address of the device. but provisions and improvements are being made so that the user wouldn't have to give the IP address as an input but it can be done via internet connections and databases updated automatically.

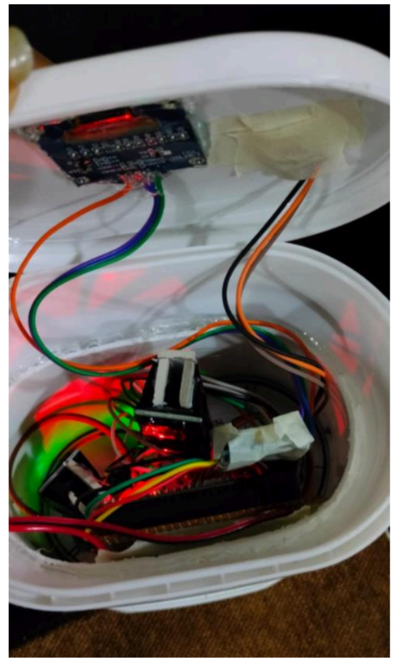

Figure5: Internal Circuit

Figure6: Medi-Box


Figure7: Pill Counter


Figure8: Time & Manual Dispenser Mode

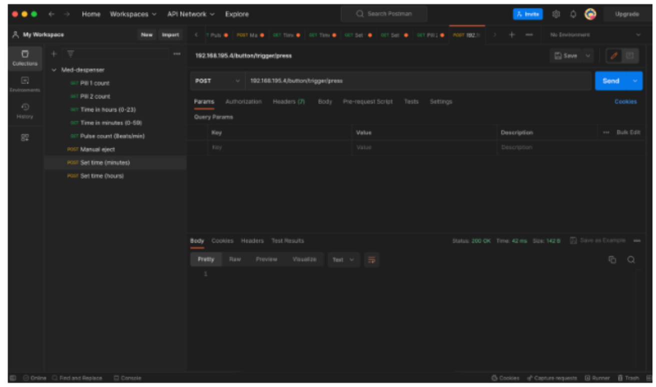

Figure9: Postman

Furthermore, the hardware structure of the system will be designed as a box with an inlet on the top and outlet at the bottom. At the bottom, there will be an opening to collect medication at the same time to sensor the Heartbeat sensor and the temperature sensor will be placed, so that when the patient is taking the medication their health can be monitored. There will be LED a buzzer or boys output at the front 2 indicating medicine dispenser time and two trigger alarms. The medicines will be dispensed because of the motion of the micro Motors which will be situated right about the outlet.

## CONCLUSION

In this paper, various comparisons and methods of building a smart medicine dispenser are discussed. Based on the proposed Smart medicine dispenser which will make it easier for people who require medical attention to take proper intake of medication. The proposed medical dispenser will have the property to communicate with caretakers at any time of the day, provide information if there is a recruitment of refill of medicines, they will provide information if the patient has taken the medicine or not, will blink to alert people who have hearing impaired, will send a voice message or a voice alarm for those who are blind. As noticed from the literature review there are no medicine dispensers that have a health monitoring system that will allow the caretaker to be informed throughout the day, therefore it becomes the main highlight of the proposed system. At the same time our main focus will be to make this medicine dispenser cost effective and cheap so that it can be affordable for the common man.

## FUTURE SCOPE

Some functions can be added to the dispenser to improve its user friendliness and effectiveness. An example is that the proposed product can be made for more than one user but the current prototype does not support this function even though it can be added easily. Also, provisions for liquid doses can be added to make the device more effective. The current prototype does not have any location tracking system of the user so it can also be added to improve the effectiveness of the product. Adding communication with pharmacies to refill the dispenser will also make the proposed product more flexible and reduce patient efforts.

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