DESIGN OF SMART MEDICINE BOX FOR ELDER PEOPLE USING ARDUINO

Minor project-II report submitted
in partial fulfillment of the requirement for award of the degree of

Bachelor of Technology
in
Computer Science & Engineering

By

N. Sai Preethi (21UECS0428) **(VTU 19944)**
T. Dhanunjay (21UECS0635) **(VTU 19525)**
CH. Lakshmana Kotesh (21UECS0112) **(VTU 19809)**

Under the guidance of
Mr. V. CHARLES PRABU, B.E.,M.E.,
ASSISTANT PROFESSOR

DEPARTMENT OF COMPUTER SCIENCE & ENGINEERING
SCHOOL OF COMPUTING

VEL TECH RANGARAJAN DR. SAGUNTHALA R&D INSTITUTE OF SCIENCE & TECHNOLOGY

(Deemed to be University Estd u/s 3 of UGC Act, 1956)
Accredited by NAAC with A++ Grade
CHENNAI 600 062, TAMILNADU, INDIA

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CERTIFICATE

It is certified that the work contained in the project report titled "DESIGN OF SMART MEDICINE BOX FOR ELDER PEOPLE USING ARDUINO" by "N.SAI PREETHI (21UECS0428), T.DHANUNJAY (21UECS0635), CH.LAKSHMANA KOTESH (21UECS0112)" has been carried out under my supervision and that this work has not been submitted elsewhere for a degree.

Signature of Supervisor
Mr. V. Charles Prabu
Assistant Professor.
Computer Science & Engineering
School of Computing
Vel Tech Rangarajan Dr. Sagunthala R&D
Institute of Science & Technology
May, 2024

Signature of Professor In-charge
Dr. Peter Soosai Anandaraj A
Associate Professor
Computer Science & Engineering
School of Computing
Vel Tech Rangarajan Dr. Sagunthala R&D
Institute of Science & Technology
May, 2024

DECLARATION

We declare that this written submission represents our ideas in our own words and where others' ideas or words have been included, we have adequately cited and referenced the original sources. We also declare that 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 our submission. 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.

N. SAI PREETHI
Date: / /

T. DHANUNJAY
Date: / /

CH. LAKSHMANA KOTESH
Date: / /

APPROVAL SHEET

This project report entitled ”DESIGN OF SMART MEDICINE BOX FOR ELDER PEOPLE USING ARDUINO” by ”N.SAI PREETHI (21UECS0428), ”T.DHANUNJAY (21UECS0635), ”CH.LAKSHMANA KOTESH (21UECS0112) is approved for the degree of B.Tech in Computer Science & Engineering.

Examiners **Supervisor**

Mr. V. CHARLES PRABU, B.E.,M.E.,
ASSISTANT PROFESSOR

Date: / /
Place:

ACKNOWLEDGEMENT

We express our deepest gratitude to our respected **Founder Chancellor and President Col. Prof. Dr. R. RANGARAJAN B.E. (EEE), B.E. (MECH), M.S (AUTO),D.Sc., Foundress President Dr. R. SAGUNTHALA RANGARAJAN M.B.B.S.** Chairperson Managing Trustee and Vice President.

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N.SAI PREETHI (21UECS0428)

T.DHANUNJAY (21UECS0635)

CH.LAKSHMANA KOTESH (21UECS0112)

ABSTRACT

This project proposes the design and implementation of a Smart Medicine Box (SMB) tailored for the unique needs of elderly individuals, utilizing Arduino-based technology. The primary objective is to enhance medication adherence among the elderly by providing a user-friendly and intelligent solution. The Smart Medicine Box incorporates an Arduino microcontroller to manage medication schedules and dispensing. The system includes various features such as a user-friendly interface with a digital display, audible reminders, and automated dispensing mechanisms. The device aims to simplify the medication management process for the elderly, reducing the risk of missed doses and promoting a healthier lifestyle. The old people live alone, some of them are suffering from disability, making it harder to take care of themselves. Any delay in taking their medicine or even taking it at the wrong time may cause or raise potential health issues. The proposed SMB can be used by patients as well as nurses or caregivers in order to monitor and ensure that the correct dosage of each medicine is being taken at the right time.

Keywords:

Medication adherence, Smart medicine dispenser, Intelligent pill organizer, Automated medication scheduling.

LIST OF FIGURES

LIST OF ACRONYMS AND ABBREVIATIONS

ACRONYMS	ABBREVIATION
CPU	Central Processing Uni
EHR	Electronic Health Record
GUI	Graphical User Interface
GPRS	General Packet Radio Service
LCD	Liquid Crystal Display
LED	Light Emitting Diode
MCU	Microcontroller Unit
RTC	Real Time Clock
SD	Secure Digital
SMB	Smart Medicine Box
SMS	Short Message Service
UART	Universal Asynchronous Receiver

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Chapter 1

INTRODUCTION

1.1 Introduction

Nowadays as technology advances in the healthcare filed, more number of diseases are being diagnosed and treated. The treatment ranges from surgery, medication and these medication are prescribed even after surgery to maintain body's immune response etc. People take a medication for a wide variety of reason, it may be due to some vitamin deficiency, chronic illness, old age, genetic disorder etc. The old as well as the young are getting affected by diseases. After consulting health professional they obtain the medication to relieve their symptoms that might be causing them nausea, pain, headache and many more. Depending on the degree of the infection the patient would be advised to take the medication many times a day and for a prolonged period of time. But either due to the day to day life or due to some other factor the patient sometimes fail to take their medication which in turn worsens their situation and affects their quality of living . For instance in the case of young child they wouldn't remember to take their medication as they tend to get distracted easily as such it's up to the child's parents to give the medication and in some cases even they do tend to forget due to their work, stress etc.

The smart med box can thus be used by the parents to set the time and alarm so as to remind their child to take their medication on time even when they aren't around. The same can be said even for the adults, teenagers who have to study, work to earn a living, this device can help them as it serves as a reminder to take their medication. It is possible for them to set an alarm using their phone to take their medication but there is still a chance to ignore that reminder as they just simply have to slide it off it does serve its purpose to remind the person but there is no guarantee they would do it at that time maybe they would take it at a later time as they are busy at the moment and as a result they tend to forget to take. As this medicine box is portable they can carry it around with them and as the alarm buzzes they have to switch it off with the button placed on the device and since the medication is also present they would just take it then and there as there work would be done and in the case they don't a message will be sent to the guardian in such cases. This box is especially useful for the elderly who tend to forget things as they age. The problem is either due to their old age or due to diseases like Alzheimer which mostly tends to appear in people aged 50 above.

1.2 Aim of the project

The aim of the project is to create an reasonable, simple, and portable medicine box that can be used by patient and user to carry in case of going on trips and for day to day use. The primary goal is to address the challenge of medication non-adherence by providing a user-friendly platform that automates medication scheduling and dispensing. This aims to reduce the risk of missed or doubled doses, promoting a more consistent and effective treatment regimen. The device facilitates remote monitoring of medication adherence by healthcare providers and caregivers. This real-time data access allows for timely interventions and adjustments to treatment plans, leading to more personalized and responsive healthcare. Adapt to Evolving Healthcare Needs: The Smart Medicine Box is designed to adapt to changes in a patient's health condition or treatment plan. This flexibility ensures that the device remains relevant and effective in managing evolving healthcare requirements.

1.3 Project Domain

IoT technology can be applied to improve medication adherence and management. Develop a system that connects the smart medicine box to a central platform, allowing healthcare providers or family members to monitor medication usage remote. Creating a system that promotes better adherence to prescribed medication schedules. Investigate the use of reminders, notifications, and alarms to alert users when it's time to take their medication. Design an intuitive and user-friendly interface for the smart medicine box, catering to users of all ages and varying levels of technological proficiency. Address concerns related to the storage and transmission of sensitive healthcare data. Implement robust security measures to protect user information and maintain compliance with healthcare privacy regulations.

To integrate the smart medicine box with Electronic Health Record(EHR) or other healthcare management systems to provide a comprehensive health monitoring solution. Research and implement advanced sensor technologies to detect medication usage, refill status, and environmental conditions that may affect the medication's efficacy. Develop features that help users track their medication inventory, including expiration dates and automatic reordering of medications when supplies are low. Consider the needs of users with disabilities, ensuring that the smart medicine box is accessible to a diverse range of individuals. Implement a reporting system that allows healthcare providers or family members to receive updates on medication adherence and any issues related to the user's health.

1.4 Scope of the Project

As number of people are being diagnosed with disease irrespective of their age factor. There is also a growing need for them to take their medication as advised by the doctors. As these medication tend to alleviate their symptoms, failure of taking the medication can cause the symptoms to aggravate. Though the patient has been warned about the consequence of not taking the medication they do tend to forget to take it which might be due to stress, work or disease busy life and tend to forget it So here is where the smart medicine box can be put to use. These can be used to store the medication and set the alarm for when the medication is to be taken and as such serves as a reminder for the patient to take their medication on time as the buzzer will sound for a minute or two depending on the brand that has made the smart medicine box. There are presently smart medicine box that can are in the market but they are tedious to use as in some device you would have to continuously push the button to set the time, to understand and difficult to use.

The present investigations can be used as a prototype for other research going on in this device as it's a simple, cheap and easy to use device. GPRS module has been used to provide information to the guardian and patient whether the medication has been consumed. This is done by using a button which controls the drawer. The Smart Medicine Box can be employed in public health programs to address specific medication adherence challenges in large populations. It offers a scalable solution for improving healthcare outcomes on a broader scale.The data generated by the Smart Medicine Box, including medication adherence patterns and health tracking information, can be utilized for health data analytics. This data-driven approach provides insights into patient behavior, trends, and potential areas for intervention.

Chapter 2

LITERATURE REVIEW

[1].Akshaya. C et al., (2019) made a medicine kit that has individual compartments that can be filled with medicines and designed in a way to fill medicines when the compartments are empty. When it is time for medication the medicine box drops the pills and sounds an alarm with notification until we take the pills . The setup is interfaced with servo motor and a GSM module to provide notification. A speaker module is connected to the ATMEGA 328. Then the LED on the pillbox glows and an alarm is also generated indicating which pill should be taken.

[2].Anandhapadmanaban .S et al., (2020) used Peltier module which is imported into one of the compartments made for cold storage and other compartments left without Peltier for room temperature storage. According to medical adherence, box is splitted to store drugs to be taken thrice times in a day.

[3].Deepak Bhatt et al., (2018) made an automated medicine box, operated by the ESP8266 microcontroller. This controller has an in-built Wi-Fi module which can connect to a smart phone. The microcontroller is programed such that whenever it is powered ON, it will connect to the smart phone through Wi-Fi. The microcontroller will attempt MQTT connection with smartphone's android application. Once the MQTT connection is established, the user can update the schedule of medicines.

[4].Diaa SalamaAbdul et al., (2018) their device was able to logs the pill name, number of pills and hours at which each pill is actually taken versus the time it should have been taken. Emitting warnings to the owner's relatives or nurses if needed. The pills box contains nine separate sub-boxes so can have 9 distinct pills. Has 3 parts The pill refilling mechanism, the pill dispensing mechanism and the electronic module. Also has a pill tray where each one of the pills will exit the pillbox. Pill is dispensed.

[5].Divya Sai. K et al., (2021) had designed a medicine box where the schedule data/configuration

data is sent to the pill box through IoT. The smart pill box contains Arduino MCU, LED display, LEDs, buzzer, buttons, Pulse Sensor and Temperature Sensor. The LED are used to display the commands in pill box by MCU. The Wi-Fi module is configured with IoT.

[6].Ekbal Rosli et al., (2018) created a robotic device that can assist patient to take medicine alone by implementing an IOT apps system for controlling the Smart Medicine Box. There are four sensors. The purpose of PIR sensor is to detect hand movement near the device, while IR sensor is to detect the line follower on the floor. The LM 35 acts as the detection of the temperature inside the box and the ultrasonic acts as the detection of the obstacle in front of the device. The servo motor will be used in the box to drop the medicine, DC motor will move from one place to another.

[7].Nausheen Fatima et al., (2019) designed a device which had visual indicator which would light up along with the speaker. Also had a buzzer which will give a loud auditory indication that the medicine needs to be taken. A mobile app will give details about whether the patient has taken medicine or not for that time. It also has Heart beat sensor and temperature sensor. The Real time clock inside the LPC2148 will update the registers. The registers are then loaded to the RAM of the LCD and hence displayed on the Screen. When the box is opened, a delay timer is set for 1 minutes. The buzzer and LED will remain ON until the patient has taken the pill.

[8].Nur Zulaikhah Nadzri et al., (2020) designed the device in such a way that the user will set the time according to the medicine scheduled by the doctor by using the Blynk apps. Then, if the time is correct it will notify by 2 notification, LED and buzzer is on. Magnetic switch is used to detect the action of opening and closing the iBox cover.

[9].Roy Abi Zeid Daou et al., (2018) designed one in which the weight of the pill is monitored using a safety weight sensor system. The Processor does the calculations to check if the patient has taken the medication on time or not. For this a safety-related 1oo2 architecture is targeted (one out of two) channels are connected in such a way that one of them is sufficient for triggering the safety function.

[10].Sanjay Bhati et al., (2017) made a device where setting up time table of prescribed medicines through push buttons as given in prescription. Present time will be saved in RTC module and notification time will be saved in EEPROM. Therefore at the time of taking medicine system generate Notification sound and display the Bright light in certain pill boxes.

Chapter 3

PROJECT DESCRIPTION

3.1 Existing System

An electronic pill dispenser realized using pic microcontroller with keyboard and an LCD that lets the user schedule his/her pills manually on a plate. It dispenses the pills and generates an audio alarm to alert thepatient.Also, an SMS is sent to the caregiver phone number in case the pill wasn't taken. A pill dispenser was created using a combination of infrared sensors and Arduino microcontroller with alarmsystem to help the patients take their pills at the correct time. The alarm system was implemented using a popup notification on smartphone. Another pill dispenser that is created using Arduino microcontroller that dispenses only one pill at a time to prevent overdose. Then it notifies the user via SMS that the pill is ready to be taken. Also, it was connected toan android application that is used by the caretaker to edit the dates and times of the pills to be dispensed.

Disadvantages: It cannot display the images of the patient.

3.2 Proposed System

The proposed SMB system takes the idea of automated dispenser to the next level as it has some functionalities that are not included in any other automated dispensers. An account is provided for each patient and no one else can access it except the patient and the caregiver if the credentials were provided to him/her. Also, some statistics are provided about the pills taken with their alarms and the already existing ones. Online database of the users, pills and their alarms are also a great feature that helped in the design of the project. The pills can be edited and created using an android application remotely through smartphones.

Advantages: The robot itself move to the certain place. If the click on the button automatically the box will be open and they can easily take the medicine.

3.3 Feasibility Study

3.3.1 Economic Feasibility

Initial costs for designing the smart medicine box, including technology research, prototype development, and testing. Costs related to the development of physical components, embedded systems, sensors, and software application. If the smart medicine box involves cloud connectivity for data storage and remote monitoring, consider the costs associated with cloud services. Costs associated with obtaining necessary certifications and regulatory approvals for healthcare devices. If the smart medicine box relies on a centralized server or platform, consider the associated operational costs.

Determine the pricing strategy that considers production costs, market demand, and perceived value by customers. Develop financial models to project revenue, expenses, and profitability over time. Evaluate existing competitors and potential market saturation. Assess the value proposition for users, including improved health outcomes and quality of life.

3.3.2 Technical Feasibility

The availability and suitability of sensors for tracking medication usage, environmental conditions, and other relevant data. The feasibility of incorporating wireless technologies such as Wi-Fi, Bluetooth, or cellular connectivity for communication with other devices or cloud platforms. Assess the technical requirements for displaying medication information, reminders, and notifications.Storage options for storing user data, medication schedules, and historical information. Assess the feasibility of implementing robust security measures to protect sensitive health data.

The costs associated with the hardware components, sensors, and other technology used in the smart medicine box.The feasibility of scaling the smart medicine box solution to accommodate different user needs and potential future expansions.

3.3.3 Social Feasibility

The feasibility of educating users about the benefits of the smart medicine box and addressing potential concerns. The diverse demographics of potential users and ensure that the design is accessible to individuals of different ages, abilities, and technological literacy. Cultural practices and norms related to healthcare and medication management to ensure the smart medicine box aligns with cultural values.

The feasibility of implementing robust privacy measures to address concerns related to the storage and transmission of personal health information. The feasibility of designing the smart medicine box in a way that minimizes any potential social stigma associated with medication use or health conditions. Assess the feasibility of providing user-friendly educational materials and training programs to enhance health literacy and promote effective use of the smart medicine box.

3.4 System Specification

3.4.1 Hardware Specification

- Arduino
- RTC module
- 12C LCD interface
- Power supply and breadboard power supply
- SIM800L GPRS module

3.4.2 Software Specification

- PYCHARM
- DJANGO
- HTML
- CSS
- JAVASCRIPT

3.4.3 Standards and Policies

IEC 1348: This international standard specifies requirements for a quality management system for the design and manufacturing of medical devices.
IEC 60601-1-2: This standard addresses electromagnetic compatibility for medical electrical equipment, ensuring that the device functions properly in the presence of other electronic devices.
IEC 62366-1: Focuses on the application of usability engineering to medical devices, ensuring that the user interface is designed with user needs and safety in mind.
IEC 9001: Although not specific to medical devices, ISO 9001 provides a general framework for quality management systems, which can be beneficial for ensuring overall quality in the design and manufacturing process. Sample attached
Anaconda Prompt

Anaconda prompt is a type of command line interface which explicitly deals with the ML(Machine-Learning) modules.And navigator is available in all the Windows,Linux and MacOS.The anaconda prompt has many number of IDE's which make the coding easier. The UI can also be implemented in python.

Standard Used: ISO/IEC 27001

Jupyter

It's like an open source web application that allows us to share and create the documents which contains the live code, equations, visualizations and narrative text. It can be used for data cleaning and transformation, numerical simulation, statistical modeling, data visualization, machine learning.

Chapter 4

METHODOLOGY

4.1 Architecture diagram for smart medicine box

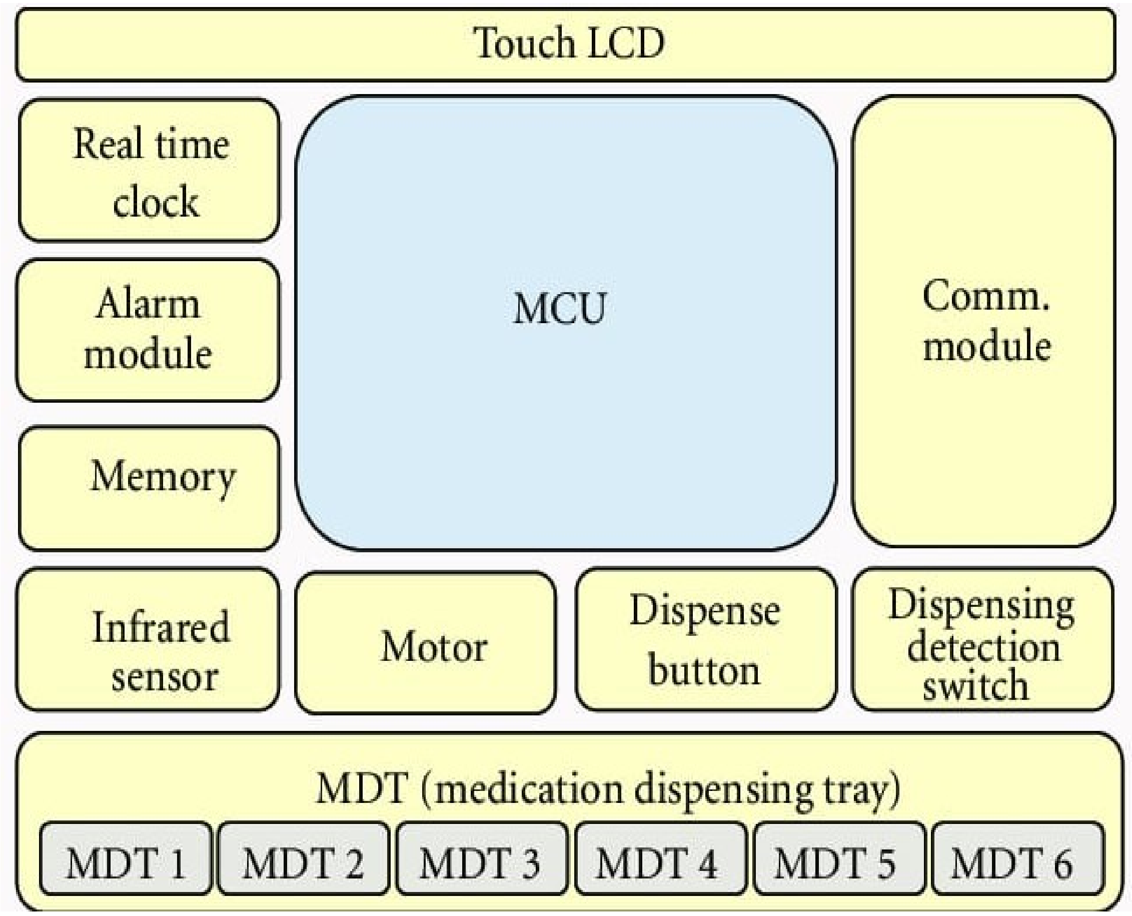

Figure 4.1: **Architecture diagram for smart medicine box**

Figure 4.1 shows the architecture diagram of a smart medicine box. It includes components such as a touch le, memory, infrared sensorLCD, real-time clock, alarm, microcontroller unit, communication modu, dispensing motors, detection switches, and medication dispensing trays.

4.2 Design Phase

4.2.1 Data flow diagram for smart medicine box

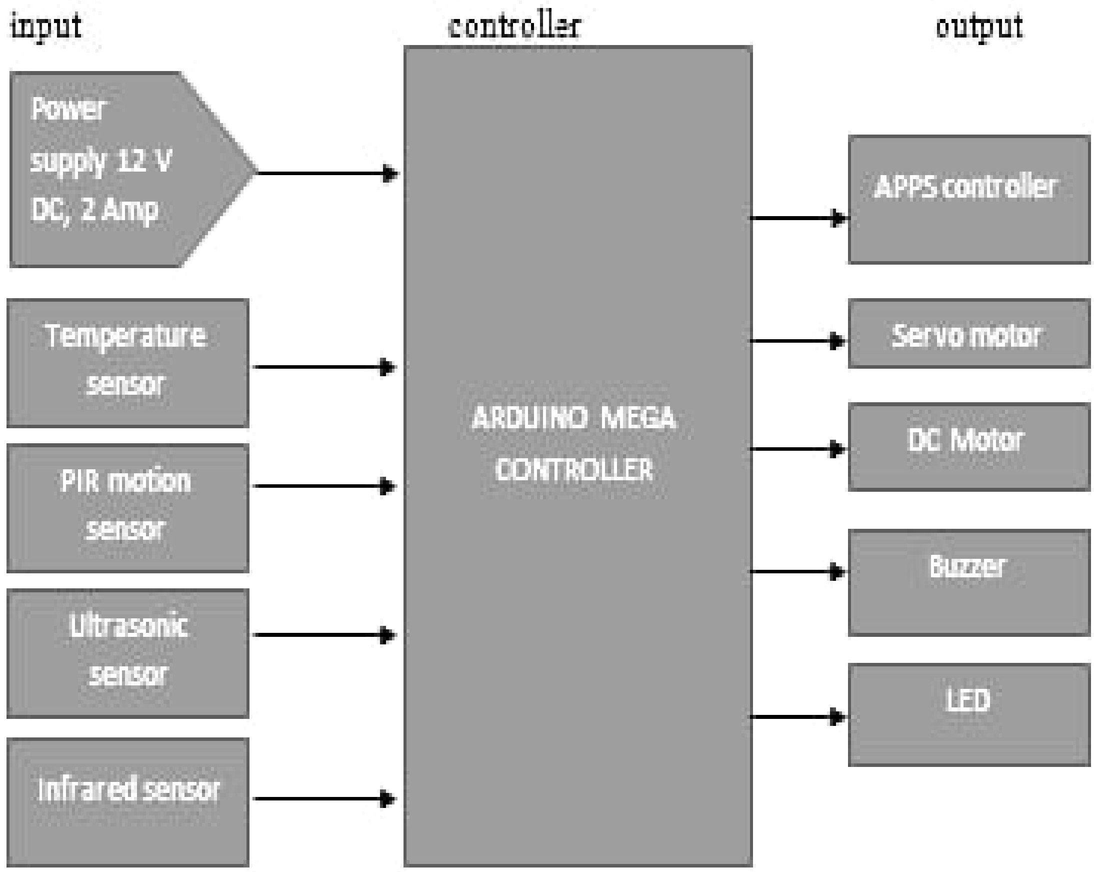

Figure 4.2: **Data flow diagram for smart medicine box**

Figure 4.2 shows the dataflow diagram of a smart medicine box. The image is a diagram depicting a system with various components such as a power supply, temperature sensor, servo motor, Arduino Mega controller, DC motor, PIR motion sensor, buzzer, ultrasonic sensor, LED, and infrared sensor. The components are interconnected in a specific configuration to achieve a certain funcamtionality.

4.2.2 Usecase diagram for smart medicine box

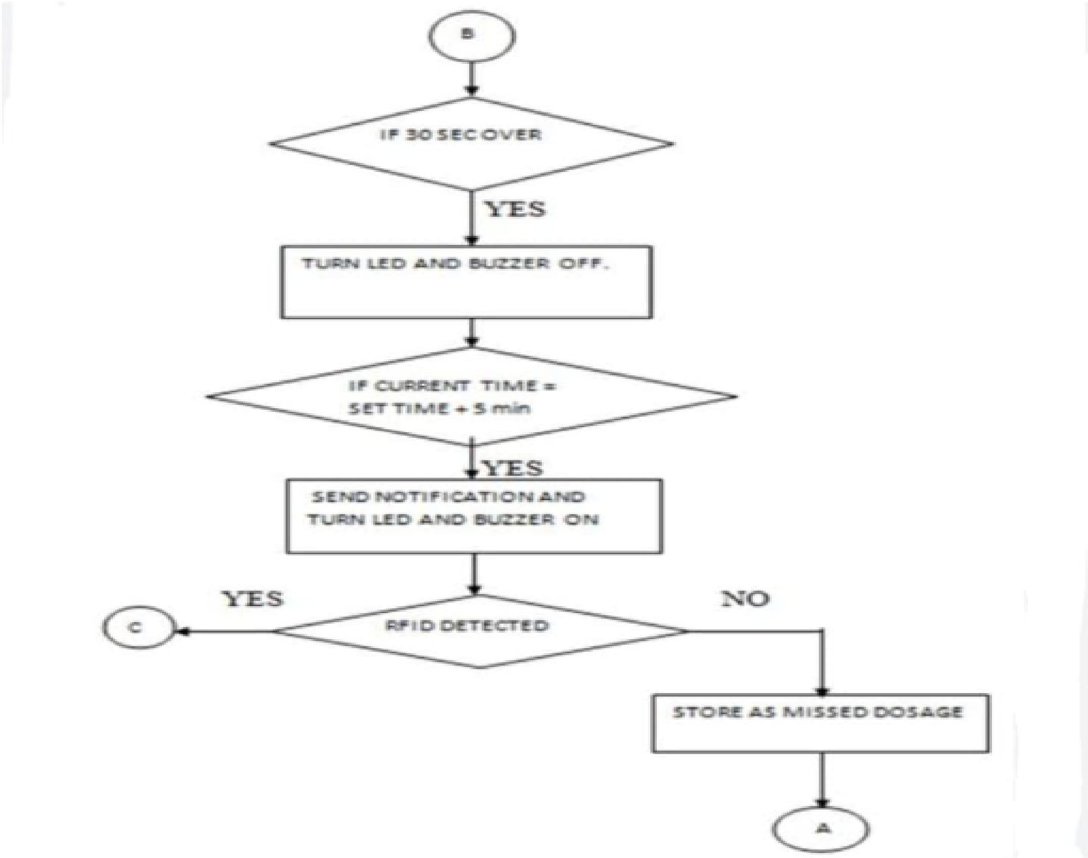

Figure 4.3: **Usecase diagram for smart medicine box**

Figure 4.3 shows the usecase diagram of a smart medicine box. It involves actions such as turning LED and buzzer on or off based on certain conditions, sending notifications, and storing data related to the detection. It defines the formal functional requirements that a use case must supply to the end user.

4.2.3 Class diagram for smart medicine box

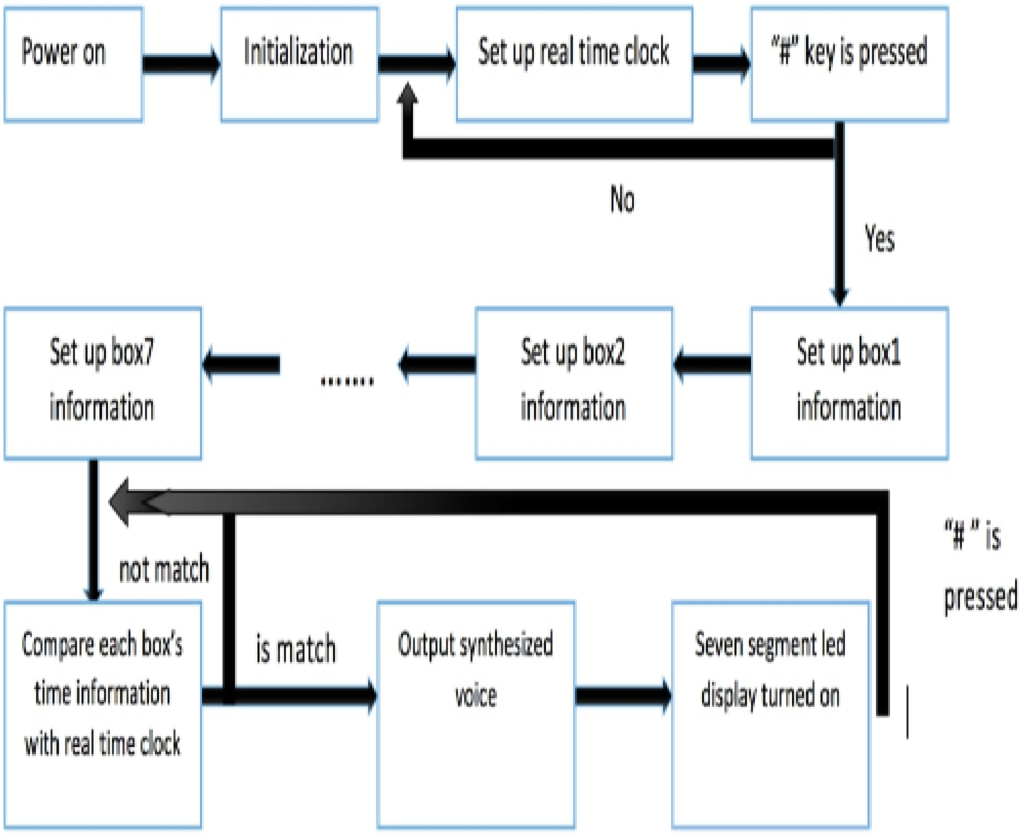

Figure 4.4: **Class diagram for smart medicine box**

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4.2.4 Sequence diagram for smart medicine box

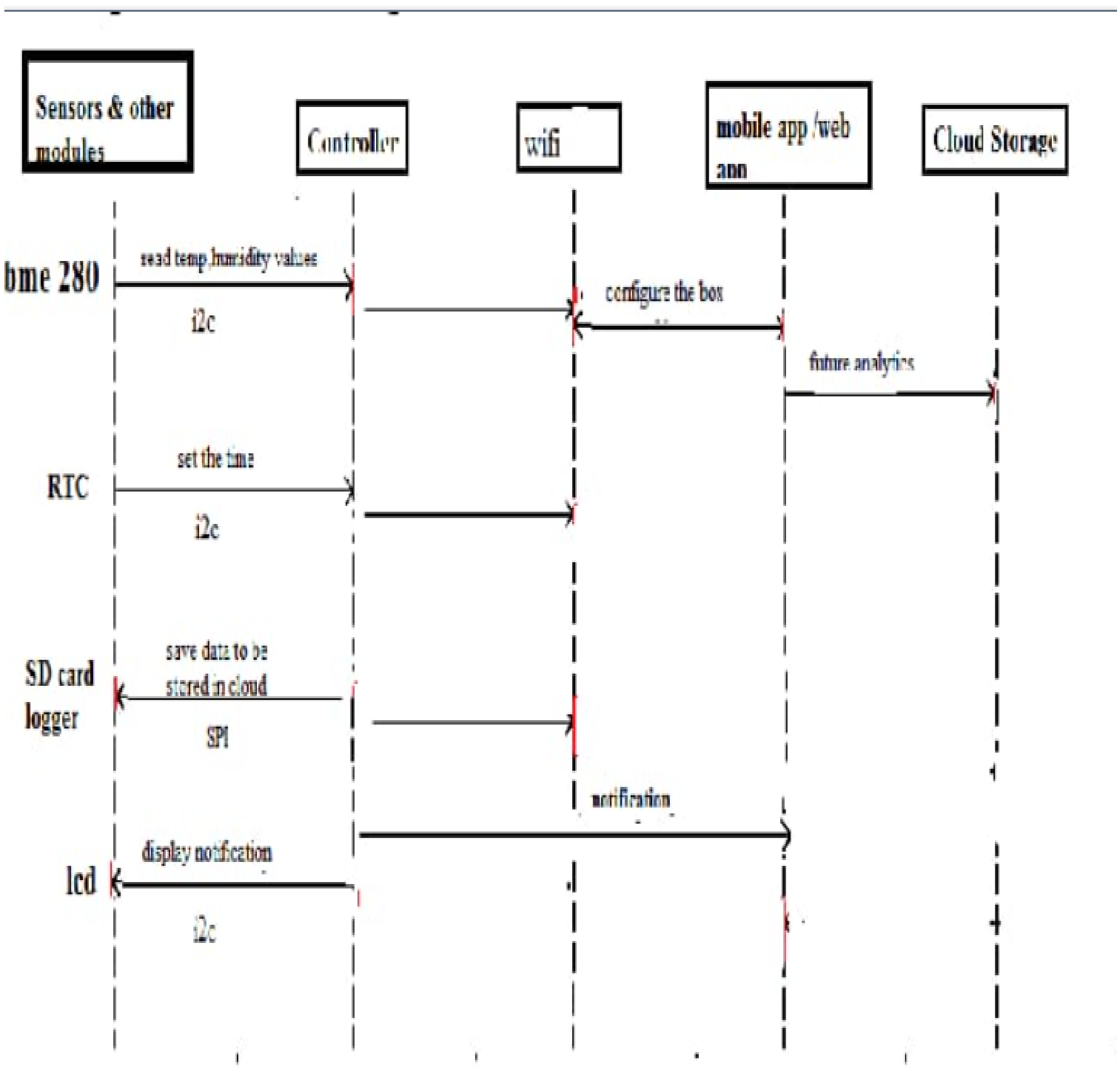

Figure 4.5: **Sequence diagram for smart medicine box**

Figure 4.5 shows the sequence diagram of a smart medicine box. The image appears to be a technical diagram or plan showing various components and modules such as sensors, controller, wifi, mobile app, cloud storage, and others. The diagram also includes specific details about the functions and connections of these components, such as reading temperature and humidity values, configuring the box, saving data to an SD card, and displaying notifications on an LCD screen. Overall, it seems to be a schematic for a system involving data collection, storage, and display.

4.2.5 Colloboration diagram for smart medicine box

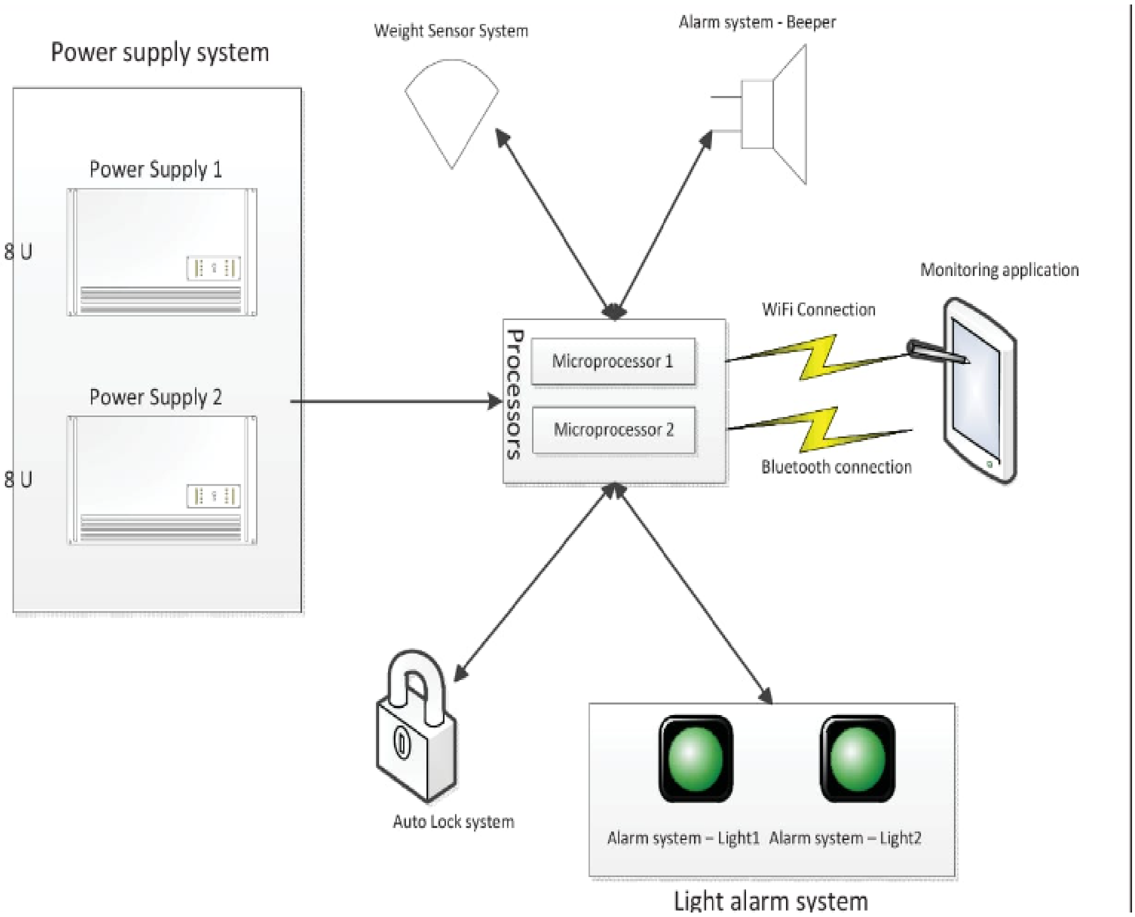

Figure 4.6: **Colloboration diagram for smart medicine box**

Figure 4.6 shows the colloboration diagram of a smart medicine box. It includes components such as power supply systems, weight sensor systems, microprocessors, alarm systems, auto lock system, and monitoring applications. The diagram also shows connections like WiFi and Bluetooth.The diagram also includes specific details about the functions and connections of these components, such as reading temperature and humidity values, configuring the box, saving data to an SD card, and displaying notifications on an LCD screen.

4.2.6 Activity diagram for smart medicine box

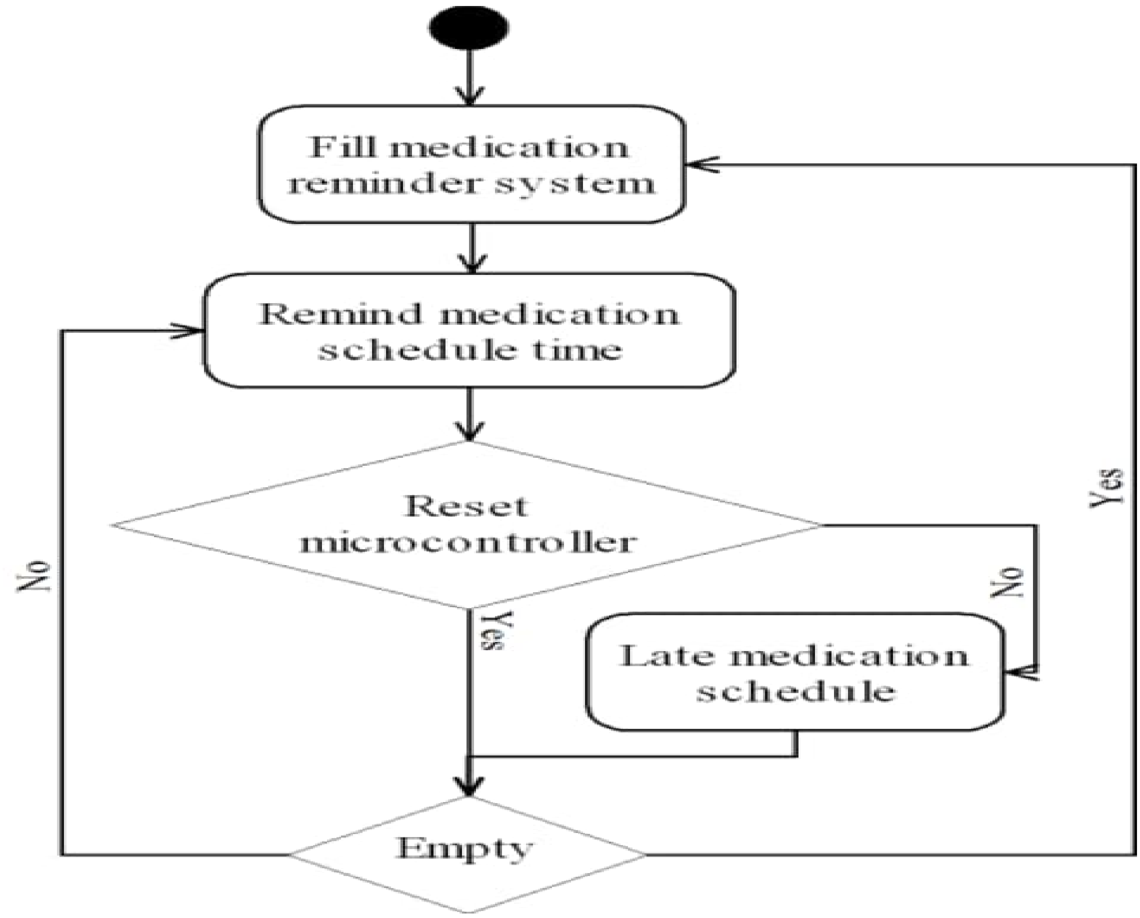

Figure 4.7: **Activity diagram for smart medicine box**

Figure 4.7 The image is a diagram depicting a fill medication reminder system. It includes options for reminding medication schedule time, resetting, late medication schedule, and empty status.

4.3 Algorithm & Pseudo Code

4.3.1 Algorithm For smart medicine box

Step1:When the arduino is powered on. It shows the starting screen.

Step2:It then moves to the main menu selection and on turning the knob the user can scroll through the options present.

Step3:On choosing alarm we can then select the compartment for which we want to select the time. We can choose the time for three compartment namely Med1, Med2 , Med3.

Step4:After choosing the compartment we will be prompted to choose the hours and time for the medication to be taken.

Step5:The selected time will be displayed on the LCD for the user.

Step6:Both LED and buzzer sounds at the time specified by the user. On pushing the button (Red) the buzzer and LED turns off.

Step7:The LCD also displays a message to indicate which medication has to be.

Step8:Then the second button (white) is pressed to push the container with the medication forward and also a message is sent in this situation to indicate that the medication has been taken as the box is now open.

Step9:Failure of pressing this button also results in a message to be sent to indicate the failure of taking said medication.

4.3.2 Pseudo Code

```
#include <stdio.h>
#include <inttypes.h>
#include <avr/io.h>
#include <avr/interrupt.h>
#include <avr/pgmspace.h>
#include <stdlib.h>
#include <string.h>
#include <util/delay.h> // needed for lcd_lib
#include "lcd_lib.h"
#include <math.h>
#define F_CPU 16000000UL
#define begin {
#define end }
#define t1 20 //statemachine repeattime
#define t2 100//
#define t3 1000 // 1s base for the RTC
#define t4 1 // 4ms for led
#define t5 1000 //1 min for CompareF
#define TableSize 2920 //refers to the following incl file
```

```
//Contains the packed 2-bit codes for syntehsis
//Generated by the program Make2code476.m
#include "DPCMAllDigits.h"
//reconstruction differentials
// PCMvalue[4] = {-78, -16, 16, 78};
volatile signed char PCMvalue[4] = {-20, -4, 4, 20};
volatile unsigned int outI, tableI; //indexes
volatile unsigned char cycle ; //decode phase counter
volatile signed char out, lastout; //output values
volatile unsigned char p1, p2, p3, p4;//hold 4 differentials
volatile unsigned char packed ; //byte containing 4 2-bit values
int firstenter=1; // for the sound
//=====================================================
int countdisplay=0;
//Box information
struct box
{
int dayofweek[7];
int times2eat;
int amount2eat;
int flag;
};
struct box box[7];
int boxnum=0;
// RTC PARAMETERS
int second1,second2,minute1,minute2,hour,weekdays;
second1=0;
second2=0;
minute1=9;
minute2=5;
hour=7;
weekdays=1;//1 represents Monday and so on
//fake time====
second11=0;
second22=0;
minute11=0;
minute22=0;
hour1=0

 case 1:
 outI = 0;
 tableI = 0;
 //init the ouptut value
 lastout = 0;
// turn on PWM
TCCR0B = 1;
 firstenter=2;
 break;
 case 2:
 //wait until the speech is done then
```

```
//time delay the next utterance.
if(TCCR0B==0)
{_delay_ms(1000);
firstenter=1;
}
break;
#define PORTDATA PORTD
#define PORTIN PIND
// The raw keyscan
unsigned char key;
// The decoded button number
unsigned int butnum,position,i,value,multi;
// the last key pushed
unsigned char lastbutnum;
//key pad scan table
unsigned char keytbl[16]=
{0xee, 0xde,0xbe,0xed, //{1 2 3 4
0xdd, 0xbd,0xeb, 0xdb, // 5 6 7 8
0xbb, 0xe7, 0xd7, 0xb7, //9 * 0 #
};
//==========================================================
//LED display library
unsigned char number[10]=
{
0b1111110,const int8_t LCD_p16[] PROGMEM = "BOX5 Date: ";
const int8_t LCD_p17[] PROGMEM = "BOX5 Time: ";
const int8_t LCD_p18[] PROGMEM = "BOX5 Amount: ";
const int8_t LCD_p19[] PROGMEM = "BOX6 Date: ";
const int8_t LCD_p20[] PROGMEM = "BOX6 Time: ";
const int8_t LCD_p21[] PROGMEM = "BOX6 Amount: ";
const int8_t LCD_p22[] PROGMEM = "BOX7 Date: ";
const int8_t LCD_p23[] PROGMEM = "BOX7 Time: ";
const int8_t LCD_p24[] PROGMEM = "BOX7 Amount: ";
const int8_t LCD_p25[] PROGMEM = "Time to eat";
const int8_t LCD_space[] PROGMEM = " ";
const int8_t Monday[] PROGMEM = "MON";
const int8_t Tuesday[] PROGMEM = "TUS";const int8_t Wednesday[] PROGMEM = "WED";
const int8_t Thursday[] PROGMEM = "THU";
const int8_t Friday[] PROGMEM = "FRI";
const int8_t Saturday[] PROGMEM = "SAT";
const int8_t Sunday[] PROGMEM = "SUN";
unsigned int paranum=0; //For parameter input and LCD showing staff
unsigned int lock=0;
//keypad scanf function==================================
void scanfkeypad()
begin
//get lower nibble
PORTDIR = 0x0f;
PORTDATA = 0xf0;
_delay_us(5);
```

```
key = PORTIN;
//get upper nibble
PORTDIR = 0xf0;
PORTDATA = 0x0f;
_delay_us(5);
key = key | PORTIN;
butnum=0;
//find matching keycode in keytbl
if (key != 0xff)
begin
for (butnum=0; butnum<maxkeys; butnum++)
begin
if (keytbl[butnum]==key)
break; // break when keyscan finds the pressed key
end
if (butnum==maxkeys)
butnum=0; // detect more than one key is pushed
else butnum++; // adjust to 1-16
end // end the search
else butnum=0;
end //end keyscan
//==============real time clock =================
void rtc()
{
trtc=t3; //reset t3
second1++;

 case 1:
 outI = 0;
 tableI = 0;
 //init the ouptut value
 lastout = 0;
// turn on PWM
TCCR0B = 1;
 firstenter=2;
 break;
 case 2:
 //wait until the speech is done then
 //time delay the next utterance.
 if(TCCR0B==0)
 {_delay_ms(1000);
 firstenter=1;
 }
 break;
 }// switch
} // if
else
{
if(timedisplay==0) led();
}
```

```
  scanfkeypad();
  if(butnum==11)
{
  responseb=1;
}
}
end
end


\
```

4.4 Module Description

4.4.1 Sensor integration

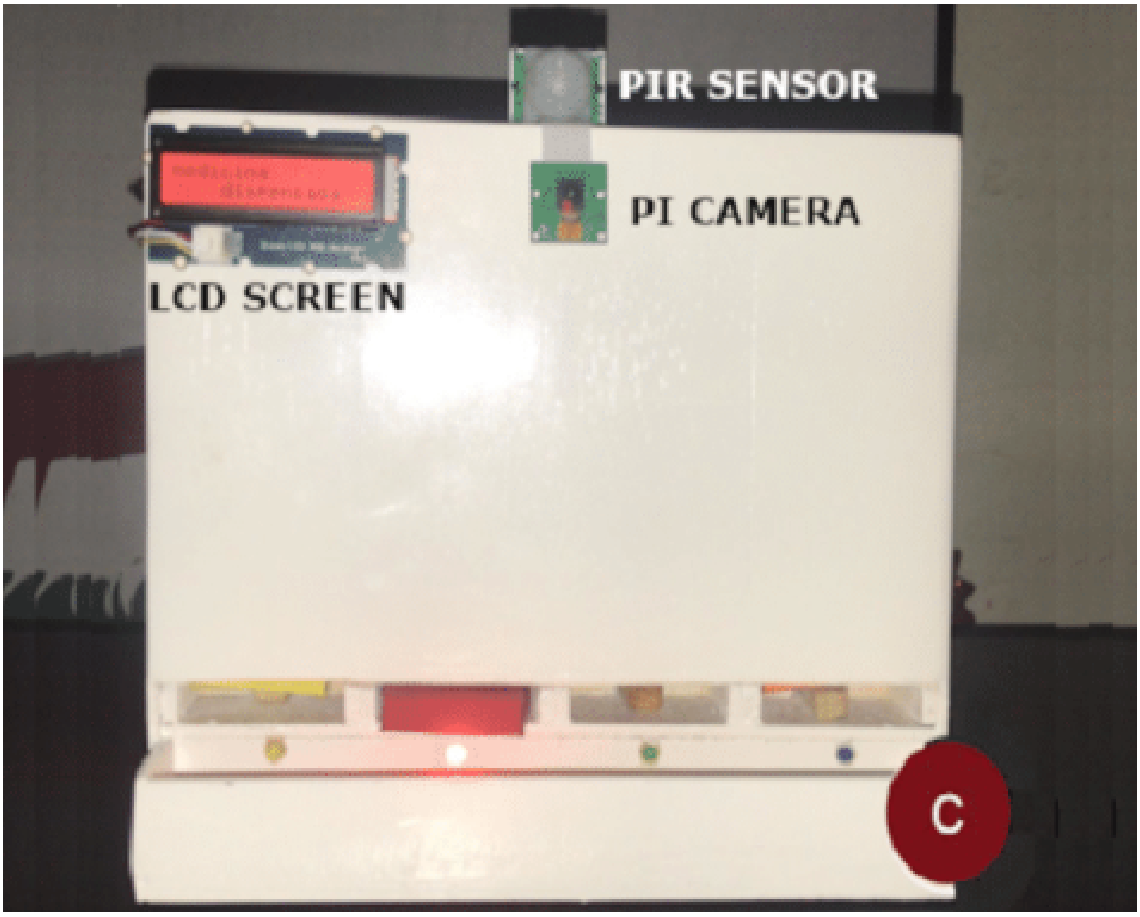

Figure 4.8: **Sensor integration**

Figure 4.8 The sensor integration module in a smart medicine box employs RFID, NFC, weight sensors, and cameras to identify medications, monitor dosage, and track usage. It alerts users of missed doses, logs medication data, and integrates with smartphone apps for real-time monitoring and customization. Security features safeguard patient information, while remote monitoring enables caregivers to track adherence. This module enhances medication management, promotes adherence, and improves healthcare outcomes by providing seamless communication between patients and healthcare providers.

4.4.2 Data Acquisition and Preprocessing:

The Data Acquisition and Preprocessing module in a smart medicine box collects sensor data from RFID, NFC, weight sensors, and cameras. It gathers information on medication identification, dosage, and usage patterns. Preprocessing algorithms clean and organize the data, removing noise and outliers. The module logs this refined data, including timestamps of medication intake and refill events. It integrates with smartphone apps for user access and healthcare provider monitoring. By ensuring data accuracy and reliability, this module enables precise medication management and adherence tracking, ultimately enhancing patient care and health outcomes through actionable insights and personalized interventions.Upon data acquisition, preprocessing algorithms come into play, ensuring the raw data is cleaned, organized, and standardized for further analysis. Noise reduction, normalization, and feature extraction are some common preprocessing techniques applied to the collected data. This step is essential for removing outliers, dealing with sensor inaccuracies, and converting the raw data into a usable format.

The preprocessed data serves as the foundation for various functionalities within the smart medicine box system. It enables the generation of timely alerts for low medication levels, missed doses, or potential medication interactions. Moreover, it facilitates the provision of personalized recommendations and adherence reminders based on individual user profiles and historical data

4.4.3 Decision-Making Logic:

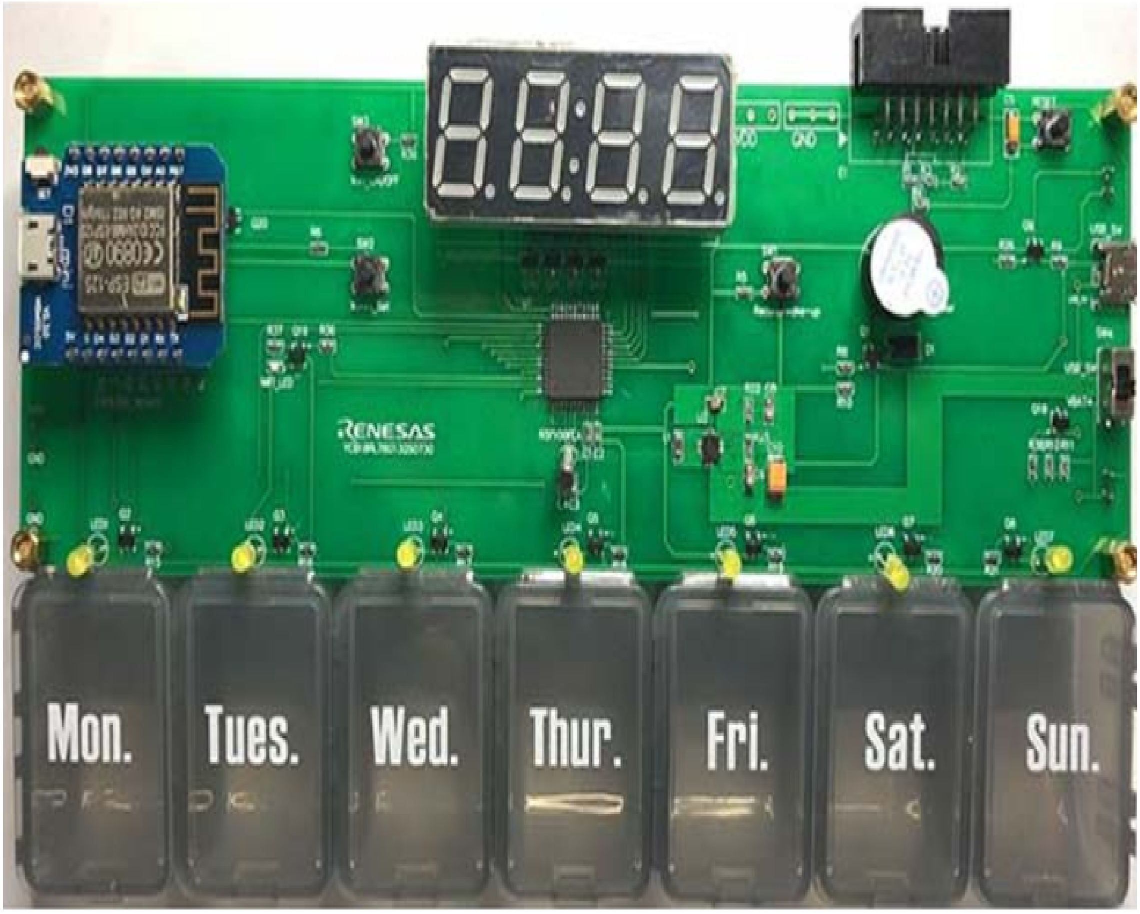

Figure 4.9: **Decision-Making Logic**

Figure 4.9 The Decision-Making Logic module in a smart medicine box analyzes preprocessed sensor data to make informed decisions regarding medication management. Using machine learning algorithms, it predicts adherence patterns, identifies potential medication interactions, and suggests personalized dosage adjustments. The module considers individual health profiles, medication schedules, and historical usage data to optimize treatment regimens. It dynamically adjusts reminders, alerts, and refill notifications based on real-time feedback. Additionally, it can trigger alerts for healthcare providers in case of irregularities or emergencies. By integrating decision-making capabilities, this module enhances medication adherence, minimizes risks, and improves patient outcomes through proactive and personalized interventions.

4.4.4 Automation and Control:

The Automation and Control module in a smart medicine box orchestrates the operation of various components to streamline medication management. It automates tasks such as dispensing medications at scheduled times, refilling pill compartments, and adjusting dosage levels. Using preset user preferences and real-time data from sensors, it ensures accurate and timely medication administration. The module integrates with smartphone apps to enable remote control and monitoring, allowing users to manage medication schedules from anywhere. It employs safety protocols to prevent overdoses or errors and provides alerts for low medication levels or missed doses. This module enhances convenience, adherence, and overall healthcare management efficiency.

4.5 Steps to execute/run/implement the project

4.5.1 Hardware Setup:

- Utilize an Arduino microcontroller board as the core component for managing the smart medicine box's functions and interactions.
- Integrate an RFID or NFC reader to enable easy identification of medication packages. Elderly users can simply tap their RFID/NFC-enabled ID cards or tags to access their prescribed medications without needing to operate complex interfaces.

4.5.2 Software Configuration :

- **RFID/NFC Authenticatio**n: Implement code to authenticate users based on RFID/NFC tags.
- **Dispensing Logic**: Write logic to control the servo motor for dispensing medication based on the authenticated user and their prescribed schedule.
- **Navigation**: Create intuitive menu navigation for selecting medication schedules or confirming dispensing actions.
- **Status Display**: Show medication reminders, dosage instructions, and system status to keep users informed.

4.5.3 Output Monitoring

- **Medication Schedule**: Display the current schedule and upcoming doses to keep users informed.
- **Dispensing Confirmation**: Show confirmation messages when medication is successfully dispensed to reassure users.

Chapter 5

IMPLEMENTATION AND TESTING

5.1 Input and Output

5.1.1 Input Design

Figure 5.1: **Input Design for smart medicine box**

The diagram above illustrates the data set related to design of smart medicine box for the smart medicine box designed for elderly people using Arduino includes RFID/NFC authentication for user identification and a keypad or buttons for manual input. This enables simple and secure access to medication, ensuring ease of use and promoting medication adherence among elderly users.

5.1.2 Output Design

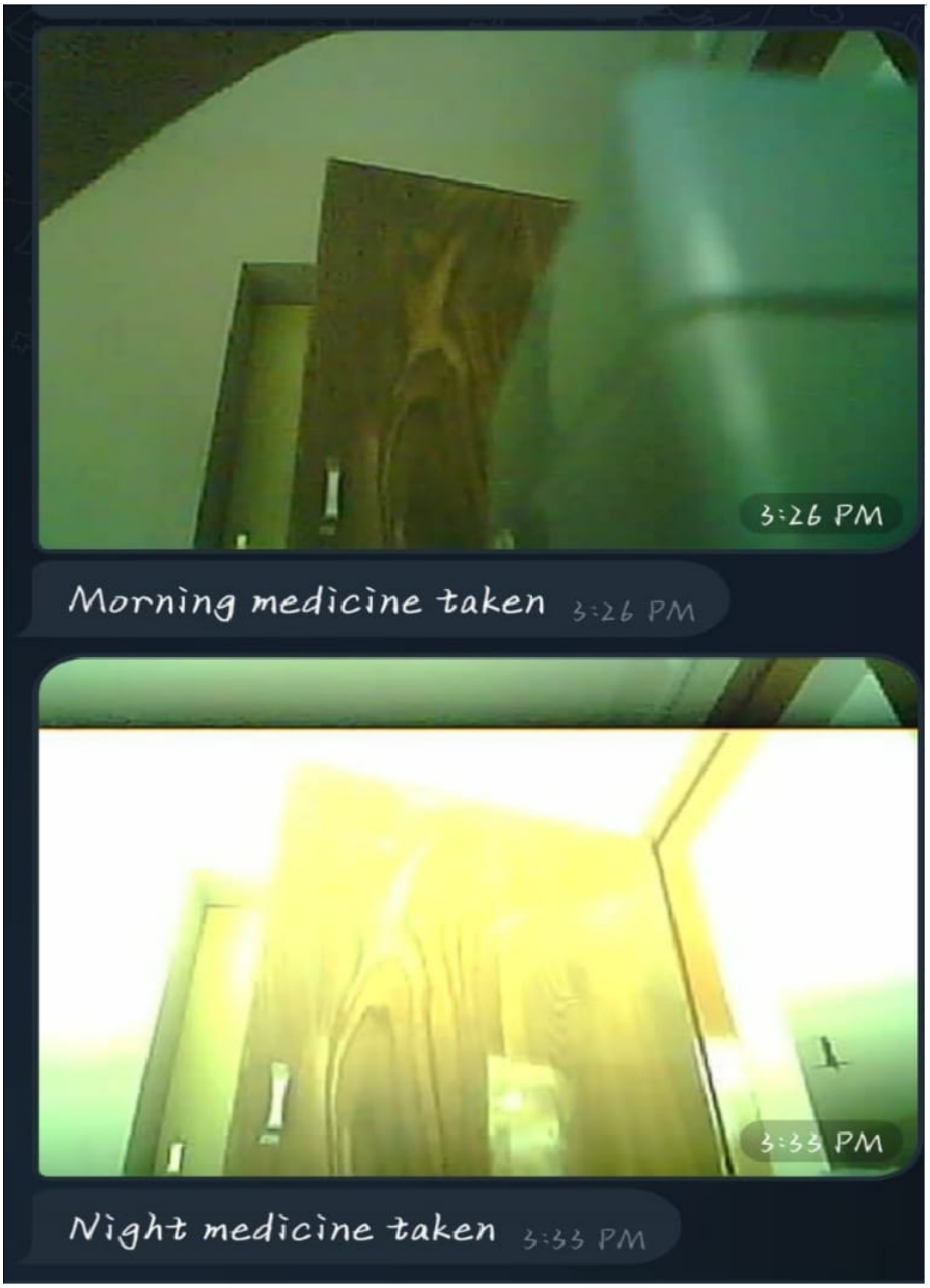

Figure 5.2: **Output Design for smart medicine box**

Figure5.2 shows the total outcome of the project.If the patient clicks on the button it captures the image and sends to the user and they will receive the message that the patient have taken the medicine.

5.2 Testing

5.3 Types of Testing

5.3.1 System testing

System testing is that the stage of implementation that's aimed to- ward ensuring that the system works accurately and efficiently for live operation commences. Testing is significant to the success of the system. System testing makes a logical assumption that if all the parts of the system are correct, then goal are going to be successfully achieved as shown in Fig4.9.

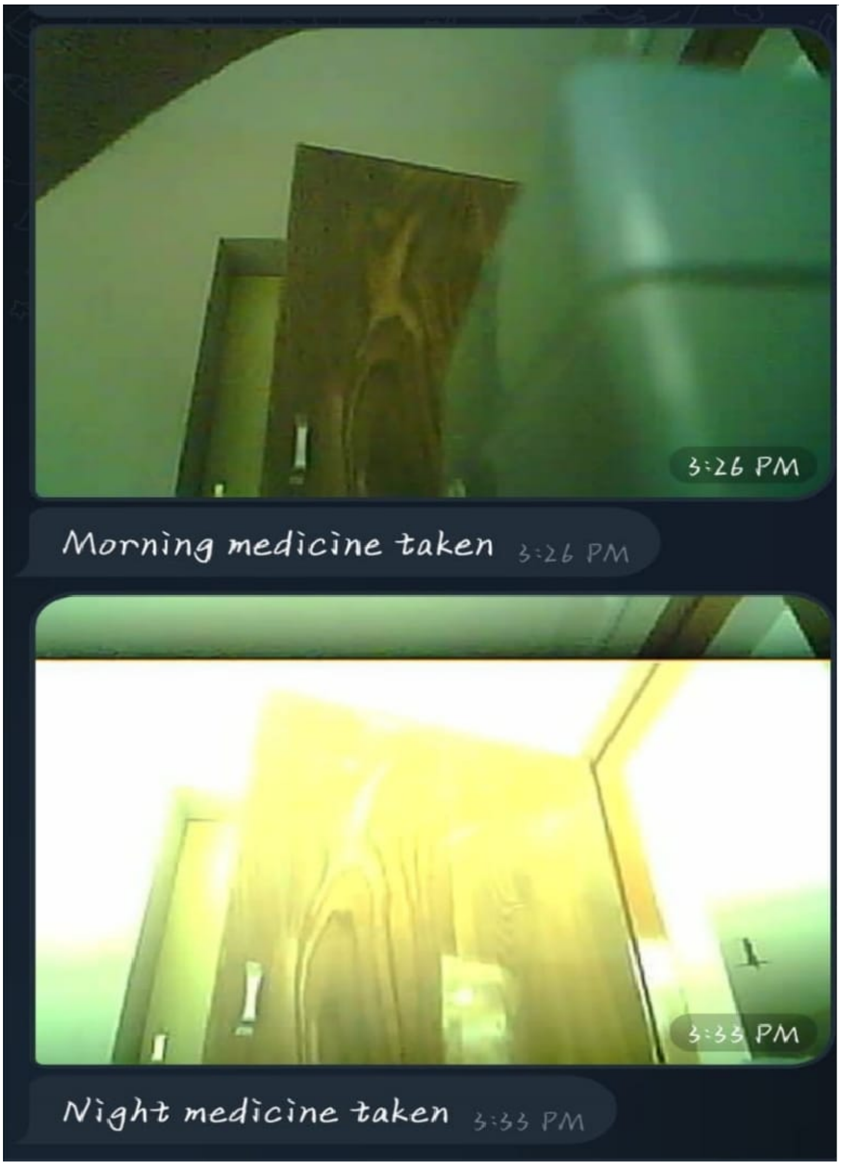

Figure 5.3: **Unit Testing Input for smart medicine box**

5.3.2 Integration testing

Integration testing is systematic testing for construction the program structure while at an equivalent time conducting tests to uncover errors related to within the interface. The objective is to require unit tested modules and build a program structure. All the modules are combined and tested as an entire is shown in Fig4.8.

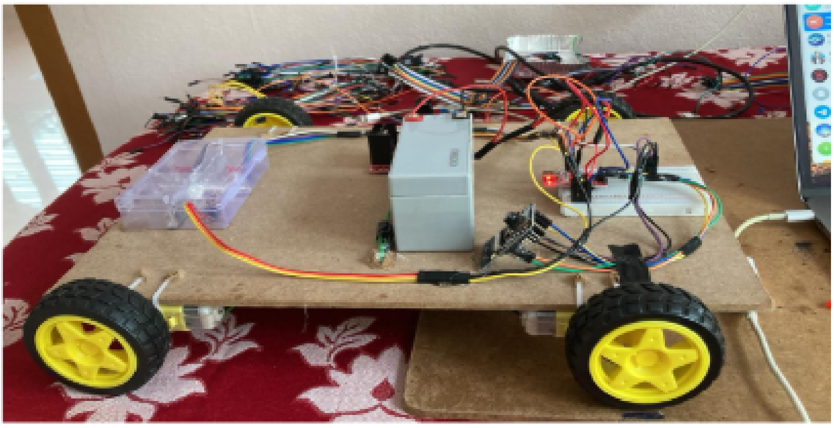

Figure 5.4: **Integration Test Input for smart medicine box**

5.3.3 Test Result

Figure 5.5: **Test Image for smart medicine box**

Chapter 6

RESULTS AND DISCUSSIONS

6.1 Efficiency of the Proposed System

The proposed system is based on the medicine Algorithm that creates many decision trees. Accuracy of proposed system is done by using random patients gives the ouput approximately 76 to 78 percent.This system can also be monitored by the patient parents as it will be linked to a phone application. This application will be used to configure the medical box by calculating the weight of each pill, setting the schedule of medical intake, alarming the user of the number of remaining pills, generating alarms whenever the patient does not take the required number of pills or doesn't take them at all, and so on. This system was implemented and tested by more than 50 patients who were taking several medication types (each one of them takes one medication only) and were using different mobile phone.

6.2 Comparison of Existing and Proposed System

Existing system:(Decision tree)

In the Existing system,An electronic pill dispenser realized using pic microcontroller with keyboard and an LCD that lets the user schedule his/her pills manually on a plate. It dispenses the pills and generates an audio alarm to alert thepatient.Also, an SMS is sent to the caregiver phone number in case the pill wasn't taken. A pill dispenser was created using a combination of infrared sensors and Arduino microcontroller with alarm- system to help the patients take their pills at the correct time. The alarm system was implemented using a popup notification on smartphone. Another pill dispenser that is created using Arduino microcontroller that dispenses only one pill at a time to prevent overdose. Then it notifies the user via SMS that the pill is ready to be taken. Also, it was connected toan android application that is used by the caretaker to edit the dates and times of the pills to be dispensed

Proposed system:(Random forest algorithm)

The proposed SMB system takes the idea of automated dispenser to the next level as it has some functionalities that are not included in any other automated dispensers. An account is provided for each patient and no one else can access it except the pa- tient and the caregiver if the credentials were provided to him/her. Also, some statis- tics are provided about the pills taken with their alarms and the already existing ones. Online database of the users, pills and their alarms are also a great feature that helped in the design of the project. The pills can be edited and created using an an- droid application remotely through smartphones. The robot itself move to the certain place. If the click on the button automatically the box will be open and they can easily take the medicine.

6.3 Sample Code

```
#include <stdio.h>
#include <inttypes.h>
#include <avr/io.h>
#include <avr/interrupt.h>
#include <avr/pgmspace.h>
#include <stdlib.h>
#include <string.h>
#include <util/delay.h> // needed for lcd_lib
#include "lcd_lib.h"
#include <math.h>
#define F_CPU 16000000UL
#define begin {
#define end }
#define t1 20 //statemachine repeattime
#define t2 100//
#define t3 1000 // 1s base for the RTC
#define t4 1 // 4ms for led
#define t5 1000 //1 min for CompareF
#define TableSize 2920 //refers to the following incl file
//Contains the packed 2-bit codes for syntehsis
//Generated by the program Make2code476.m
#include "DPCMAllDigits.h"
//reconstruction differentials
// PCMvalue[4] = {-78, -16, 16, 78};
volatile signed char PCMvalue[4] = {-20, -4, 4, 20};
volatile unsigned int outI, tableI; //indexes
volatile unsigned char cycle ; //decode phase counter
volatile signed char out, lastout; //output values
volatile unsigned char p1, p2, p3, p4;//hold 4 differentials
volatile unsigned char packed ; //byte containing 4 2-bit values
int firstenter=1; // for the sound
//======================================================
int countdisplay=0;
//Box information
```

```
struct box
{
int dayofweek[7];
int times2eat;
int amount2eat;
int flag;
};
struct box box[7];
int boxnum=0;
// RTC PARAMETERS
int second1,second2,minute1,minute2,hour,weekdays;
second1=0;
second2=0;
minute1=9;
minute2=5;
hour=7;
weekdays=1;//1 represents Monday and so on
//fake time====
second11=0;
second22=0;
minute11=0;
minute22=0;
hour1=0

 case 1:
 outI = 0;
 tableI = 0;
 //init the ouptut value
 lastout = 0;
// turn on PWM
TCCR0B = 1;
 firstenter=2;
 break;
 case 2:
 //wait until the speech is done then
 //time delay the next utterance.
 if(TCCR0B==0)
 {_delay_ms(1000);
 firstenter=1;
 }
 break;
 #define PORTDATA PORTD
#define PORTIN PIND
// The raw keyscan
unsigned char key;
// The decoded button number
unsigned int butnum,position,i,value,multi;
// the last key pushed
unsigned char lastbutnum;
//key pad scan table
```

```
unsigned char keytbl[16]=
{0xee, 0xde,0xbe,0xed, //{1 2 3 4
0xdd, 0xbd,0xeb, 0xdb, // 5 6 7 8
0xbb, 0xe7, 0xd7, 0xb7, //9 * 0 #
};
//============================================================
//LED display library
unsigned char number[10]=
{
0b1111110,const int8_t LCD_p16[] PROGMEM = "BOX5 Date: ";
const int8_t LCD_p17[] PROGMEM = "BOX5 Time: ";
const int8_t LCD_p18[] PROGMEM = "BOX5 Amount: ";
const int8_t LCD_p19[] PROGMEM = "BOX6 Date: ";
const int8_t LCD_p20[] PROGMEM = "BOX6 Time: ";
const int8_t LCD_p21[] PROGMEM = "BOX6 Amount: ";
const int8_t LCD_p22[] PROGMEM = "BOX7 Date: ";
const int8_t LCD_p23[] PROGMEM = "BOX7 Time: ";
const int8_t LCD_p24[] PROGMEM = "BOX7 Amount: ";
const int8_t LCD_p25[] PROGMEM = "Time to eat";
const int8_t LCD_space[] PROGMEM = " ";
const int8_t Monday[] PROGMEM = "MON";
const int8_t Tuesday[] PROGMEM = "TUS";const int8_t Wednesday[] PROGMEM = "WED";
const int8_t Thursday[] PROGMEM = "THU";
const int8_t Friday[] PROGMEM = "FRI";
const int8_t Saturday[] PROGMEM = "SAT";
const int8_t Sunday[] PROGMEM = "SUN";
unsigned int paranum=0; //For parameter input and LCD showing staff
unsigned int lock=0;
//keypad scanf function==================================
void scanfkeypad()
begin
//get lower nibble
PORTDIR = 0x0f;
PORTDATA = 0xf0;
_delay_us(5);
key = PORTIN;
//get upper nibble
PORTDIR = 0xf0;
PORTDATA = 0x0f;
_delay_us(5);
key = key | PORTIN;
butnum=0;
//find matching keycode in keytbl
if (key != 0xff)
begin
for (butnum=0; butnum<maxkeys; butnum++)
begin
if (keytbl[butnum]==key)
break; // break when keyscan finds the pressed key
end
```

```
if (butnum==maxkeys)
butnum=0; // detect more than one key is pushed
else butnum++; // adjust to 1-16
end // end the search
else butnum=0;
end //end keyscan
//==============real time clock =================
void rtc()
{
trtc=t3; //reset t3
second1++;

 case 1:
 outI = 0;
 tableI = 0;
 //init the ouptut value
 lastout = 0;
// turn on PWM
TCCR0B = 1;
 firstenter=2;
 break;
 case 2:
 //wait until the speech is done then
 //time delay the next utterance.
 if(TCCR0B==0)
 {_delay_ms(1000);
 firstenter=1;
 }
 break;
 }// switch
} // if
else
{
if(timedisplay==0) led();
}
 scanfkeypad();
 if(butnum==11)
{
 responseb=1;
}
}
end
```

Output

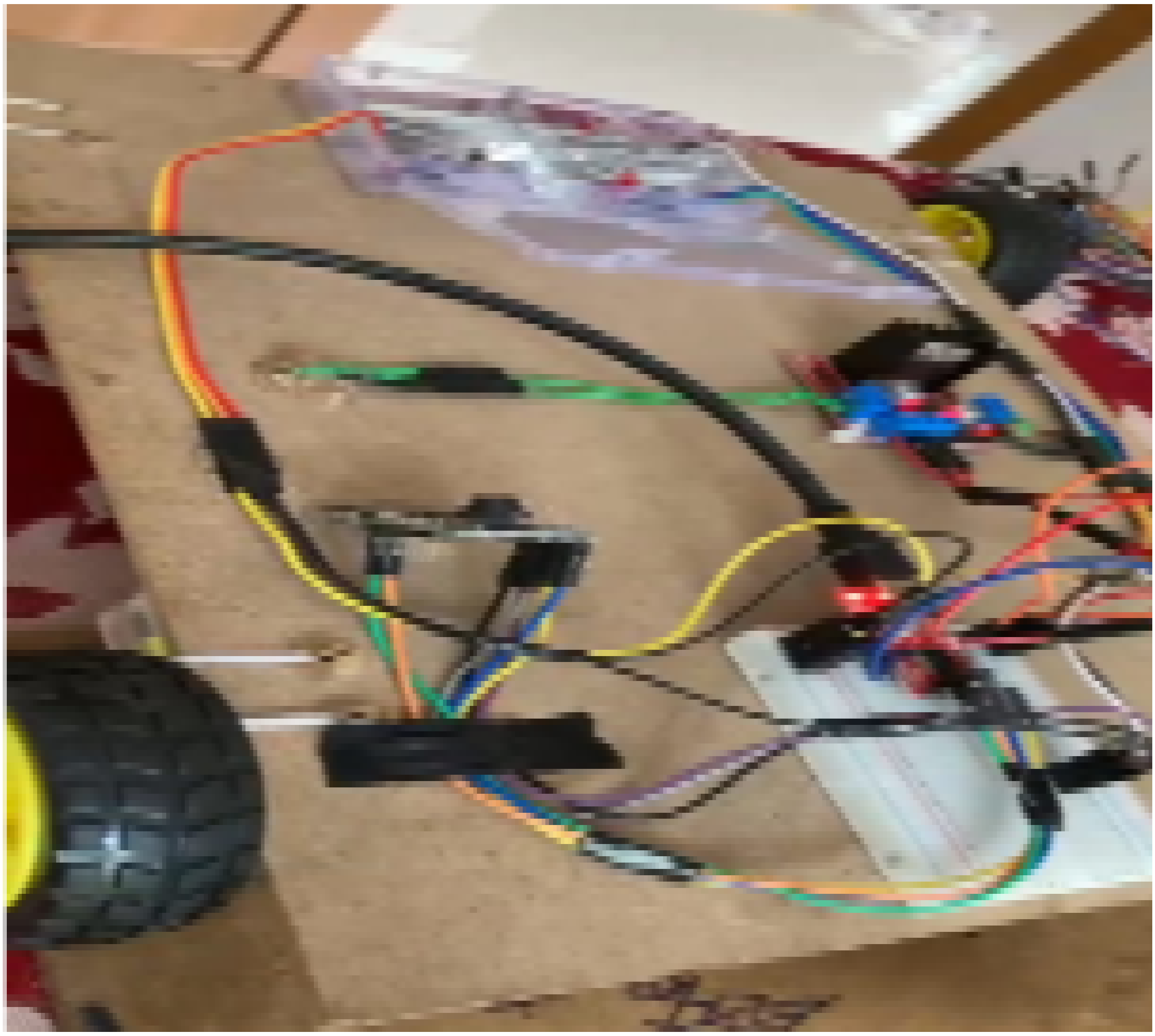

Figure 6.1: **Output 1 for smart medicine box**

Figure5.1 shows the output of a smart medicine box which contains arduino,buttons,medicine boxes,arduino,LCD,Camera.If we connect the device to the phone automatically the system turns on.It works only in the network areas.The user and patient should connect to the wi-fi then they can receive the messages.

Figure 6.2: **Output 2 for smart medicine box**

Chapter 7

CONCLUSION AND FUTURE ENHANCEMENTS

7.1 Conclusion

Now it's common to see people young and old take medication maybe be for health purpose etc. The medication may be required to be taken many times per day and people do tend to forget as they have many other things going on with their lives. The project was done with the aim of trying to find a good measure for this problem. This project can potentially help caretakers, guardians and patient as it reduces their burden of having to constantly remember the fact that they or the patient under the guidance have to take their medication and a specific time. The project is inexpensive, easy and portable for use. More work can be done like adding more options to the menu system, sensors for tracking pills weight, adding more compartment, and security. The proposed project is, in its general purpose, aiming to control medication adherence. In this way, this smart pill box will help to increase life expectancy for those of older as well as younger aged adults. Additionally, the proposed device is low cost, user friendly, and above all, a safe system.

The suggested system is able to measure the weight of the pills, monitor the medicine intake, and remind the patient to take their medication during the allotted time. Furthermore, as a device that is connected to a smart phone, it does not disrupt the fast paced pattern of the patient's daily life, but rather accommodates to it. There are several aspects we need to work on our device in the future to meet the user needs. Firstly, we should develop strategies and modify the device based on the user evaluation results. This includes creating a user manual; choosing a larger lcd display; using a metal or plastic box to cover the entire circuitry; placing the switch and led displays on the surface of the box and using larger pill boxes. We should also follow the risk analysis structure to analyze the potential risks and hazards as well as develop strategies to mitigate the risks. The device is controlled by using GSM system, so the nurse does not need go to the personal ward to give the medicine. This system is a very good to apply in the hospital because it can make the nurse job easier besides making the patients more comfortable to stay at the hospital. The goal of this system is to provide healthy and tension free life to those users who are taking regularly pills and to provide this product at affordable cost also. This system is also reusable by exchanging those other medicine box that has only alerting system and are non-usable or unaffordable compare to our product

7.2 Future Enhancements

Although this system was well operating, several adjustments can be made in order to increase its use and ameliorate its behavior. A major drawback of this system is that cannot take to the travel places. This can be solved in future versions of this system. Also, the system can be designed using a smaller surface which may lead to a reduce box size. As a device that only unlocks through the application, it is safe to keep it anywhere as it is out of the reach of children. Indeed, this system was designed with a safety first approach in order to eliminate any additional risk to the patient. As for some future works, we see this system as the beginning of a larger project for improving health care. Adding more alarm systems and sensors as the ones listed in safety system section as the detection of the size of the pills to make sure of the taken medication. Compression of the size of the box to be compatible and more flexible for usage. Addition of more slides for the application to be used for multiple medications. There are several aspects we need to work on our device in the future to meet the user needs. Firstly, we should develop strategies and modify the device based on the user evaluation results. This includes creating a user manual; choosing a larger lcd display; using a metal or plastic box to cover the entire circuitry; placing the switch and led displays on the surface of the box and using larger pill boxes.

Chapter 8

PLAGIARISM REPORT

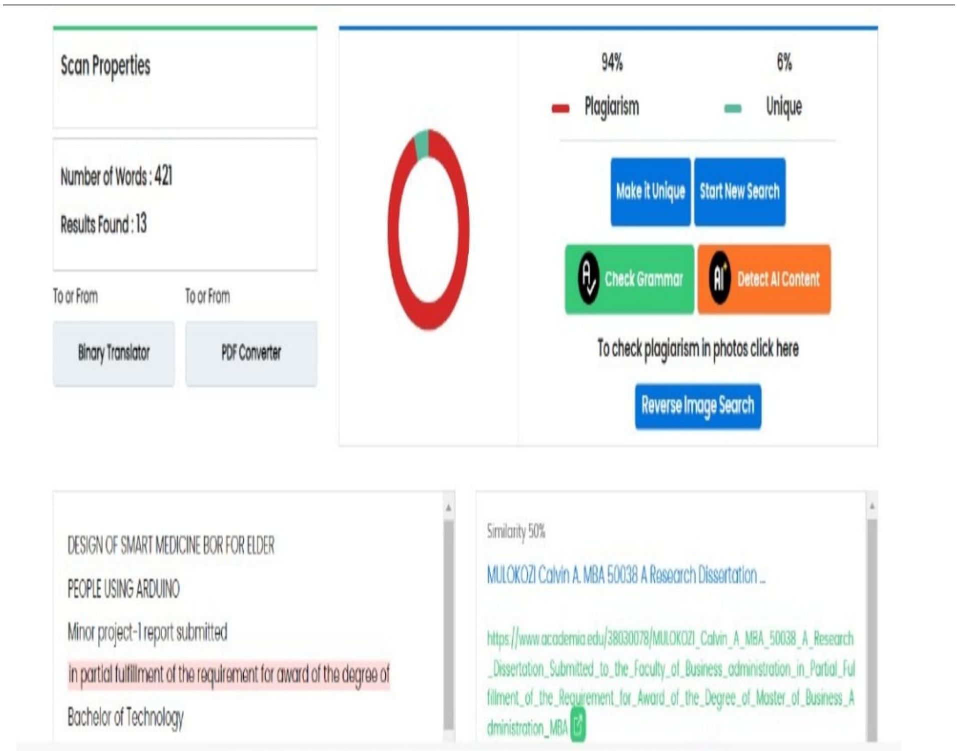

Figure 8.1: **Plagiarism Report**

Chapter 9

SOURCE CODE & POSTER PRESENTATION

9.1 Source Code

```
int main(void)
begin
initialize();
LCDclr();
while(1)
begin
if(trtc==0) rtc();

StaticString();
 if(runflag==0)
 {
if(timeofbuttonRes==0) buttonResponse();// excute buttonResonse every 100 ms
if(timeofstatemachine==0) statemachine();
 }
 else
{
 if(timeCompareF==0) CompareF();
}
if(hitflag==1)
{
 //init the output indexes
 if(responseb==0)
 {
 switch (firstenter)
40
 {
 case 1:
 outI = 0;
 tableI = 0;
 //init the ouptut value
 lastout = 0;
// turn on PWM
TCCR0B = 1;
 firstenter=2;
```

```
 break;
 case 2:
 //wait until the speech is done then
 //time delay the next utterance.
 if(TCCR0B==0)
 {_delay_ms(1000);
 firstenter=1;
 }
 break;
 }// switch
} // if
else
{
if(timedisplay==0) led();
}
 scanfkeypad();
 if(butnum==11)
{
 responseb=1;
}
}
switch (sw)
 {
 case 1:
for(i = 0;i < position ;i++)
 box[boxnum].dayofweek[i]=InputString[i]-'0';
 break;
 case 2:
 box[boxnum].times2eat=value;
 break;
 case 3:
 box[boxnum].amount2eat=value;
 boxnum++;
 break;
 }end
for (i = 0;i < position ;i++)
begin
value = value+((int)(InputString[i] - '0') * multi);
multi = multi / 10;
for(int i=0;i<position;i++)//clear the buffer for the input string
InputString[i]=' ';
 position=0;//clear variables for the next parameter input
 multi=1;
 value=0
end
end
```

9.2 Poster Presentation

9.3 Poster Presentation

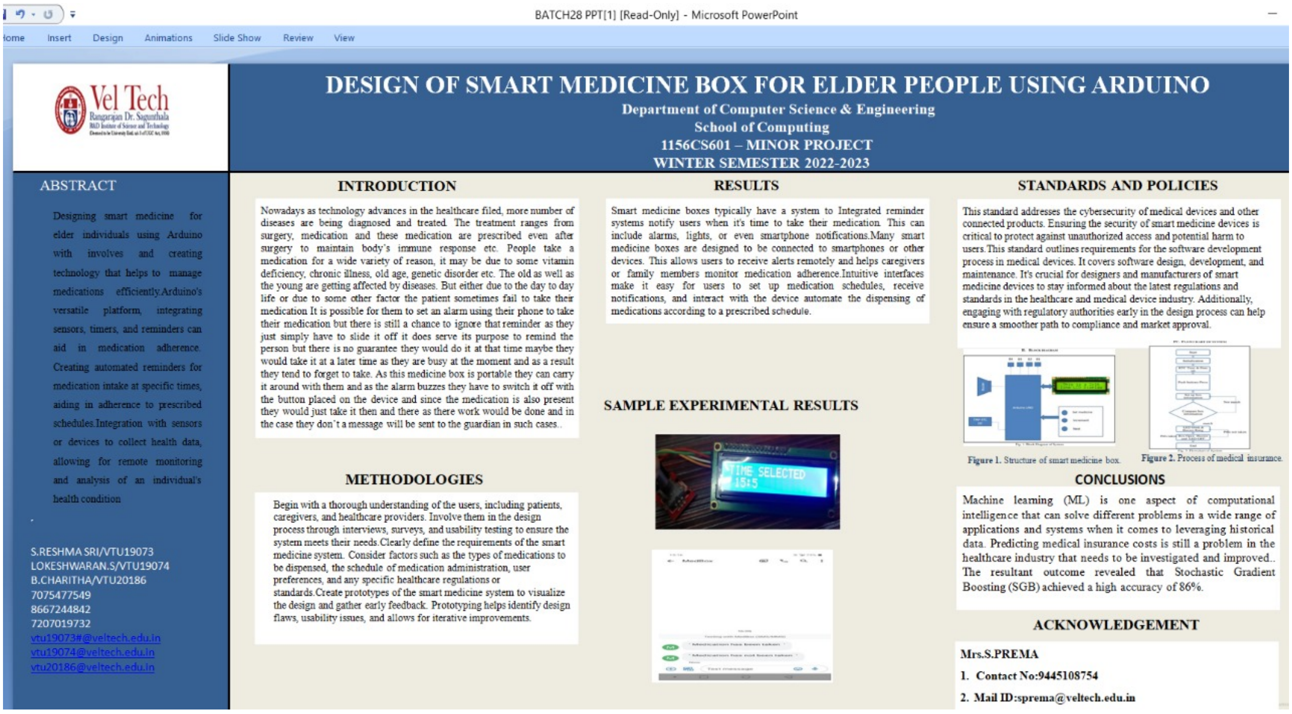

Figure 9.1: **Poster Presentation**

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