Exercise 5: Introduction to Arduino platform and programming

Aim:

To provide a comprehensive introduction to the Arduino platform and programming, offering a foundational understanding for beginners to embark on their journey in creating interactive electronic projects.

Steps to be followed using Proteus software:

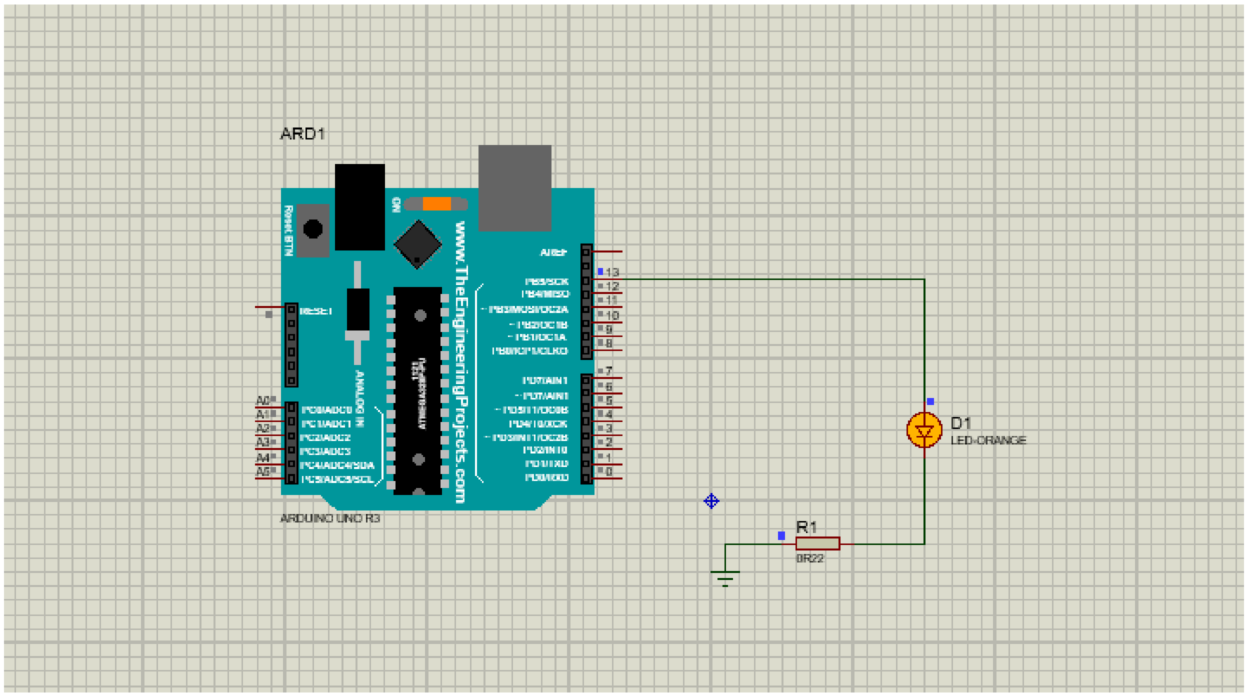
1. **Launch Proteus:** Open Proteus and create a new project.
2. Add the ArduinoUnoTEP.IDX and ArduinoUoTEP.LIB library files to the folder C:\Program Files (x86)\Labcenter Electronics\Proteus 8 Professional\DATA\LIBRARY, if they do not already exist.
3. **Add Components:** In the Proteus workspace, locate the Components tab and add the necessary components:
   - Arduino board: Search for Arduino Uno or the specific model you're using.
   - LED: Search for an LED component.
   - Resistor: Add a current-limiting resistor for the LED (usually around 220 ohms).
4. **Wiring the Circuit:** Connect the components by placing wires between them. Ensure the connections are correct:
   - Connect one leg of the LED to a digital pin on the Arduino (e.g., pin 13).
   - Connect the other leg of the LED to the resistor.
   - Connect the other end of the resistor to the ground (GND) pin on the Arduino.
5. **Writing the Arduino Sketch:**
   - Open the Arduino IDE or any text editor to write the sketch.
   - Write a simple sketch to blink the LED on and off.
   - Save the sketch with a suitable name
6. **Simulating in Proteus**:
   - In Proteus, click on the Arduino component and then click on the "Edit Properties" button.
   - In the Properties window, browse and select the .hex of Arduino sketch (.ino file) you saved earlier.
   - Click OK to close the Properties window.
   - Now, you can simulate the circuit by clicking on the Play button or pressing F5.
   - You should see the LED blinking according to the sketch.

Arduino Sketch:

```
// Define the LED pin
int ledPin = 13;
```

```
// Setup function, runs once when the sketch starts
void setup() {
  // Initialize the digital pin as an output
  pinMode(ledPin, OUTPUT);
}

// Loop function, runs repeatedly
void loop() {
  // Turn the LED on (HIGH)
  digitalWrite(ledPin, HIGH);
  // Wait for 0.1 second
  delay(100);
  // Turn the LED off (LOW)
  digitalWrite(ledPin, LOW);
  // Wait for another 0.1 second
  delay(100);
}
```

OUTPUT:



Steps to be followed using hardware:

1. Gather Components:

- Arduino UNO board
- LED
- Resistor(usually around 220 ohms)
- Jumper wires
- Breadboard
- USB Cable

2. Setup Circuit on Breadboard:
    - Place the Arduino board on the breadboard.
    - Insert the LED into the breadboard, ensuring the longer leg (anode) is connected to digital pin 13 on the Arduino.
    - Connect the shorter leg (cathode) of the LED to one leg of the resistor.
    - Connect the other leg of the resistor to the ground (GND) pin on the Arduino.
3. Upload Arduino Sketch:
    - Connect the Arduino board to your computer using a USB cable.
    - Open the Arduino IDE on your computer.
    - Write or copy the above Arduino sketch
    - Verify the sketch for any errors and then upload it to the Arduino board.
4. Test LED Blinking:
    - Once the sketch is uploaded successfully, the LED should start blinking on and off at one-second intervals.

5. Troubleshooting:

- If the LED does not blink, double-check the connections on the breadboard.
- Ensure the correct pin is specified in the sketch for the LED.
- Verify that the Arduino board is properly powered and connected to the computer.

Result:

Thus the study of Arduino platform and programming for the LED blinking project have been successfully completed.

Exercise 6: Explore different communication methods with IoT devices (Zigbee, GSM, Bluetooth)

6.1

Aim:

To explore and understand communication methods used with IoT devices, particularly focusing on GSM (Global System for Mobile Communications), to enable efficient and reliable data transmission, control, and monitoring in IoT applications.

Steps:

5. Include the GSM Module:
    - Add GSMLibraryTEP.IDX,GSMLibraryTEP.LIB,GSMLibraryTEP.hex library files to the folder C:\Program Files (x86)\Labcenter Electronics\Proteus 8 Professional\DATA\LIBRARY, if they do not already exist. Add the GSM module component SIM900 to your Proteus project.
6. Add Arduino UNO, push button, virtual terminal to the project.
7. Connect the GSM module to the microcontroller (such as Arduino) using appropriate pins for communication (usually UART). (i.e) Connect Rx pin of GSM module to Tx pin of Arduino, Tx pin of GSM to Rx pin of Virtual terminal, Tx pin of virtual terminal to Rx pin of Arduino.
8. Connect one end of the push button to Arduino pin 7 and the other end to Ground.
9. In Proteus, click on the GSM component and then click on the "Edit Properties" button.
10. In the Properties window, browse and select the GSMLibraryTEP..hex.
11. Click OK to close the Properties window.
12. Write Arduino Sketch:

- Open the Arduino IDE or any text editor to write the Arduino sketch for sending SMS.
- Include the necessary libraries for GSM communication.
- Initialize the GSM module and define necessary variables.
- Write code to set up communication with the GSM module and send the SMS.

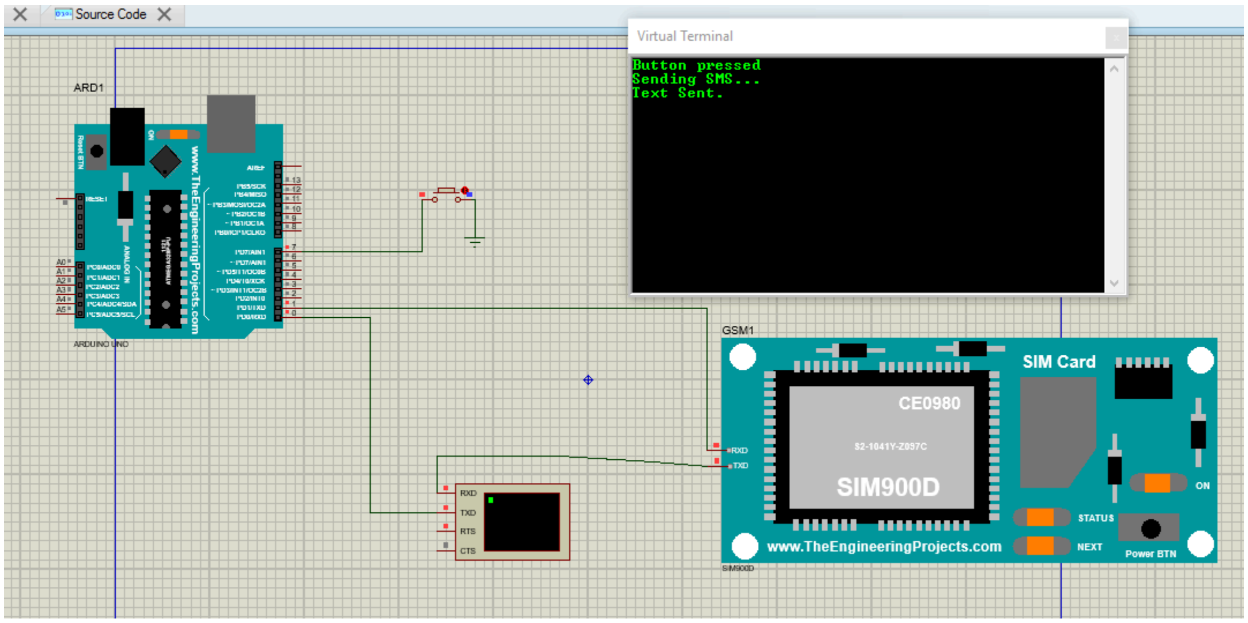
13. Upload Arduino Sketch: Upload the Arduino sketch to the microcontroller in Proteus.
14. Simulate Sending SMS: Run the simulation in Proteus. Open the serial monitor to interact with the Arduino. The GSM module in the simulation will simulate sending the SMS.
15. Verify: Check the simulation results to ensure that the SMS was sent successfully.

Arduino Sketch:

```
#include<SoftwareSerial.h>
SoftwareSerial sim8001(0,1);
#define button1 7
bool button_state;

void setup()
{
pinMode(button1,INPUT_PULLUP);
sim8001.begin(9600);
Serial.begin(9600);
delay(100);
}
void loop()
{
button_state=digitalRead(button1);
if(button_state==LOW)
{
Serial.println("Button pressed");
delay(200);

SendSMS();
}
if(sim8001.available())
Serial.write(sim8001.read());
}
```

```
void SendSMS()
{
Serial.println("Sending SMS...");
sim8001.print("AT+CMGF=1\r");
delay(100);
sim8001.print("AT+CMGS=\"+9865533668\"\r");
delay(100);
sim8001.print("SIM8001 is working");
delay(100);
sim8001.pr1awA2A34`int((char)26);
delay(100);
sim8001.println();
Serial.println("Text Sent.");
delay(400);
}
```

OUTPUT



```
Button pressed
Sending SMS...
Text Sent.
```

6.2

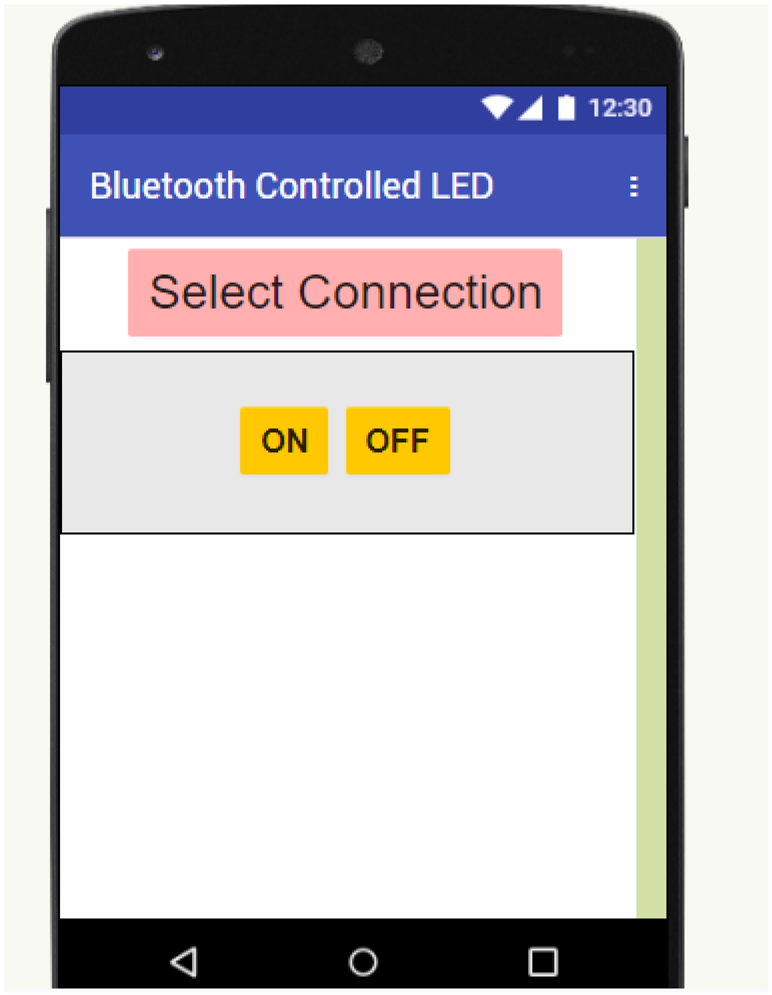
Aim:

To explore and understand communication methods used with IoT devices, particularly focusing on Bluetooth, to enable efficient and reliable data transmission, control, and monitoring in IoT applications.

Steps:

1. Include the Bluetooth Module:
    - Add BluetoothTEP.IDX,BluetoothTEP.LIB library files to the folder C:\Program Files (x86)\Labcenter Electronics\Proteus 8 Professional\DATA\LIBRARY, if they do not already exist. Add the Bluetooth module component to your Proteus project.
2. Add Arduino UNO, LED, resistor to the project.
3. Connect the Bluetooth module to the microcontroller (such as Arduino) using appropriate pins for communication (usually UART). (i.e) Connect Rx pin of Bluetooth module to Tx pin of Arduino, Tx pin of Bluetooth to Rx pin of Arduino.
4. Connect one leg of the LED to a digital pin on the Arduino (e.g., pin 13). Connect the other leg of the LED to the resistor. Connect the other end of the resistor to the ground (GND) pin on the Arduino.
5. Write Arduino Sketch:
    - Open the Arduino IDE or any text editor to write the Arduino sketch for LED Blinking.
    - Include the necessary libraries for Bluetooth communication.
    - Enable bluetooth on the computer. Configure bluetooth port is the same as Bluetooth module port.
    - Write code to set up communication with the Bluetooth module and port setting.

6. Design an App in MIT App Inventor as follows:



7. Download and install the App on the mobile phone.

8.Upload Arduino Sketch: Upload the Arduino sketch to the microcontroller in Proteus.

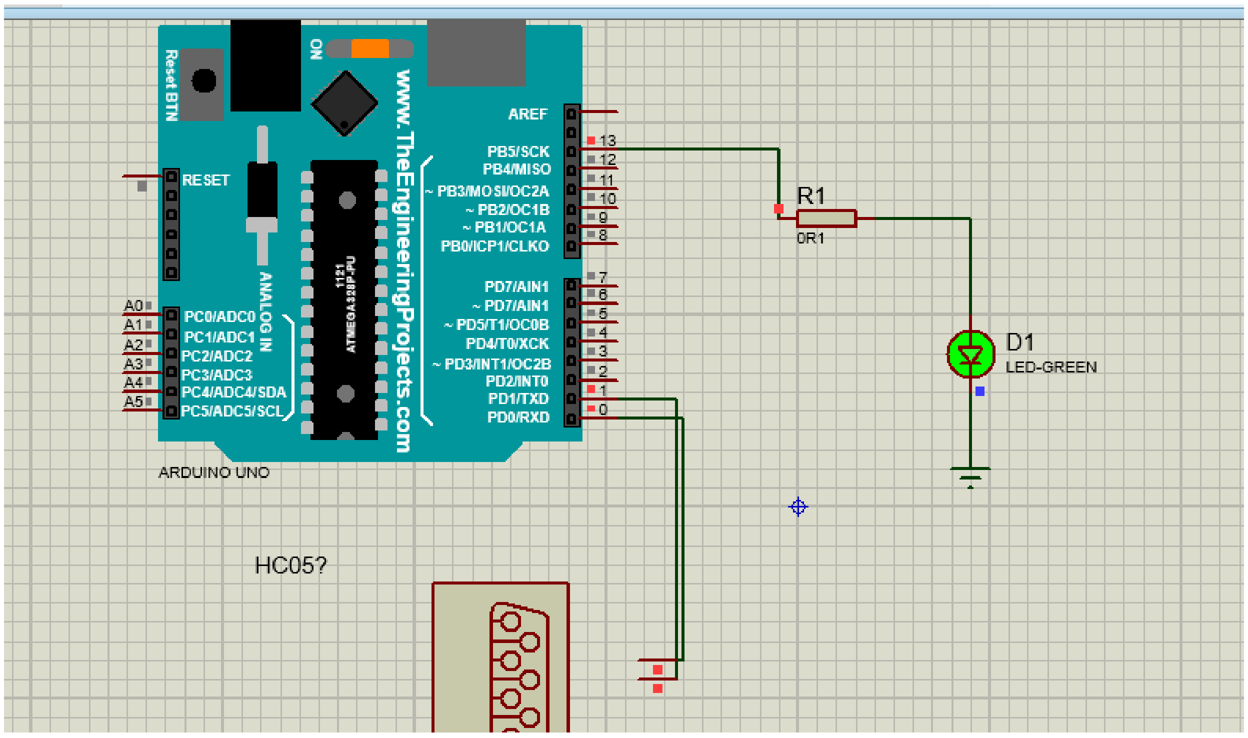
9. Run the simulation in Proteus. Open the Mobile App and establish the bluetooth connection and then click ON/OFF button to turn on or off the LED.

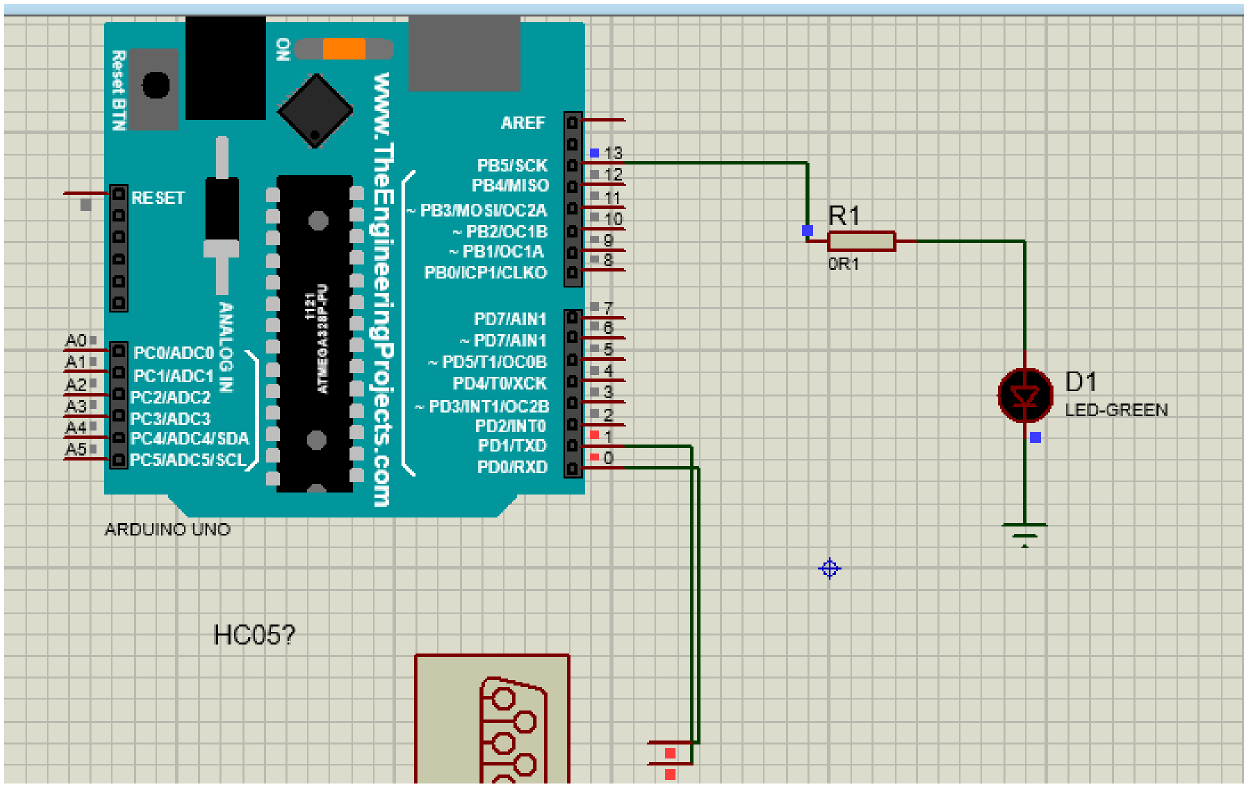
10. Verify: Check the simulation results to ensure that the LED is turning on/off successfully.

Arduino Sketch:

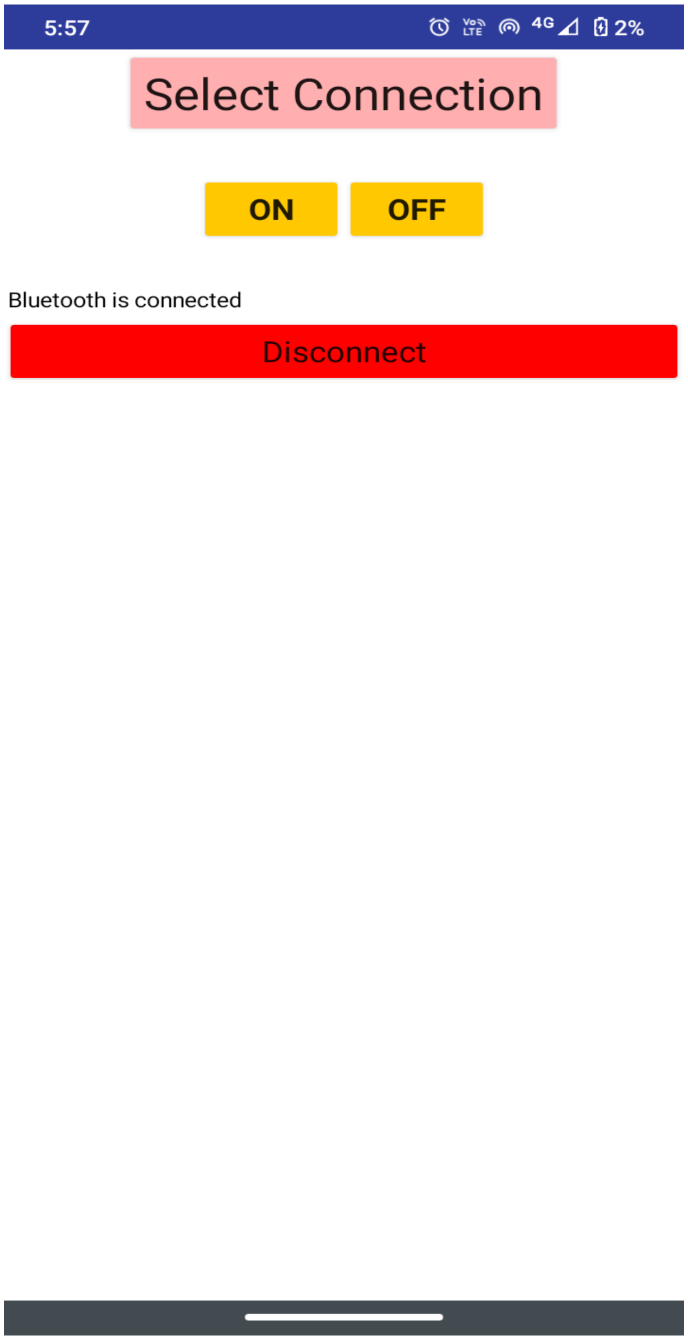
```
char inputByte;
void setup() {
 Serial.begin(9600);
 pinMode(13,OUTPUT);

}

void loop() {
while(Serial.available()>0){
  inputByte= Serial.read();
  Serial.println(inputByte);
  if (inputByte=='1'){
  digitalWrite(13,HIGH);
  }
  else if (inputByte=='0'){
  digitalWrite(13,LOW);
  }
  }
}
```

OUTPUT:





Reset BTN
ON
www.TheEngineeringProjects.com
AREF
PB5/SCK
PB4/MISO
~ PB3/MOSI/OC2A
~ PB2/OC1B
~ PB1/OC1A
PB0/ICP1/CLKO
PD7/AIN1
~ PD7/AIN1
~ PD5/T1/OC0B
PD4/T0/XCK
~ PD3/INT1/OC2B
PD2/INT0
PD1/TXD
PD0/RXD
13 12 11 10 9 8 7 6 5 4 3 2 1 0
RESET
ANALOG IN
1121 ATMEGA328P-PU
A0 A1 A2 A3 A4 A5
PC0/ADC0
PC1/ADC1
PC2/ADC2
PC3/ADC3
PC4/ADC4/SDA
PC5/ADC5/SCL
ARDUINO UNO
R1
0R1
D1
LED-GREEN
HC05?



6.3

Aim:

To explore and understand communication methods used with IoT devices, particularly focusing on Zigbee, to enable efficient and reliable data transmission, control, and monitoring in IoT applications.

Steps:

1. Open Proteus: Launch the Proteus software on your computer.
2. Create New Project: Start a new project by clicking on "File" > "New Project".
3. Add Components:
   - Search for "Arduino" in the component library and add it to your workspace.
   - Add XbeeTEP.IDX,XbeeTEP.LIB library files to the folder C:\Program Files (x86)\Labcenter Electronics\Proteus 8 Professional\DATA\LIBRARY, if they do not already exist.
   - Search for an XBee module component and add it to your workspace.
4. Wire Connections:
   - Connect the necessary pins on the Arduino board to the corresponding pins on the XBee module.
   - Typically, you'll need to connect the RX pin of the XBee module to a digital pin (e.g., pin 2) on the Arduino for receiving data, and the TX pin of the XBee module to another digital pin (e.g., pin 3) on the Arduino for transmitting data.

5. Virtual Terminal:
   - Use the Virtual Terminal component in Proteus to monitor serial communication. To add a Virtual Terminal:
   - Search for "Virtual Terminal" in the component library and add it to your workspace.
   - Connect the RX pin of the Virtual Terminal to the TX pin of the Arduino (and vice versa).
   - When you run the simulation, you should see the serial output messages displayed in the Virtual Terminal window.

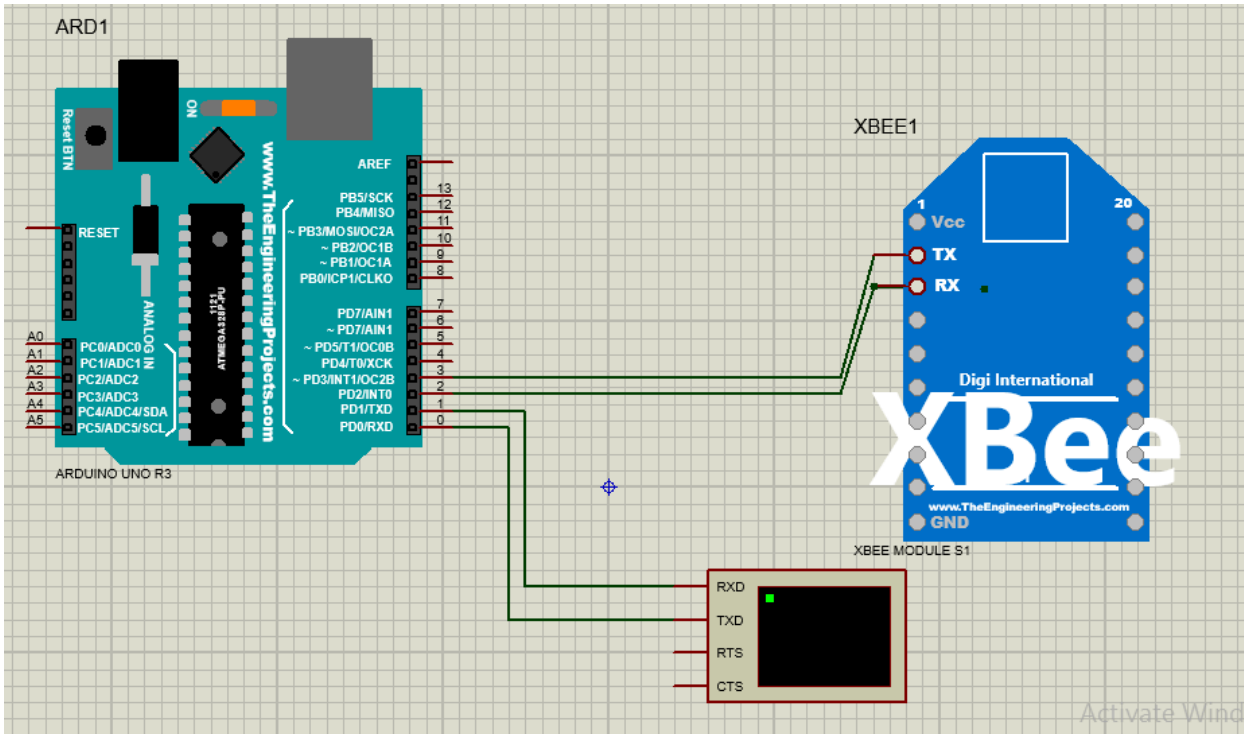
5. Write Arduino Sketch:
   - Open the Arduino IDE or any text editor and write the Arduino sketch to communicate with the XBee module.
   - Use the Serial library to communicate with the XBee module via the Arduino's serial ports.
6. Save Arduino Sketch: Save the Arduino sketch with a suitable name and with the ".ino" extension.
7. Add Arduino Sketch to Arduino Board:
   - In Proteus, double-click on the Arduino component to open its properties.
   - Navigate to the "Program File" field and browse to select the Arduino sketch you've saved.
   - Click "OK" to apply the changes.
8. Run Simulation: Run the simulation in Proteus by clicking on the "Play" button or pressing F5.

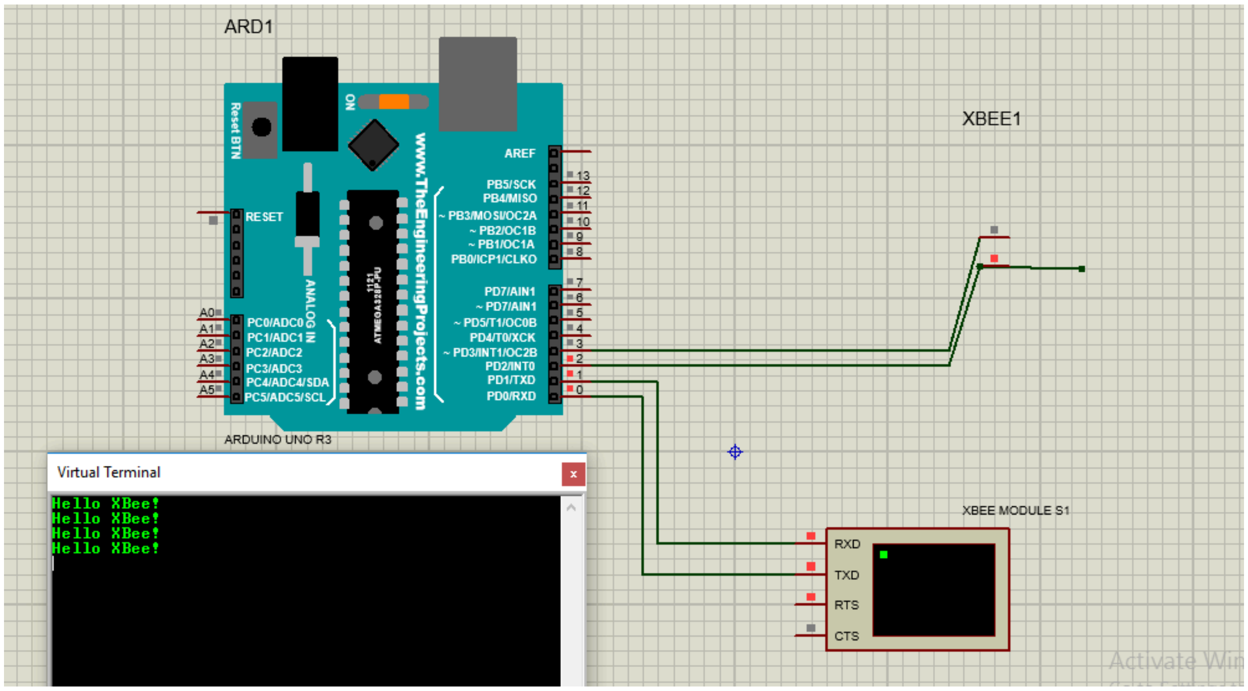
   - The Arduino sketch should execute, and you should be able to send and receive data between the Arduino and the XBee module.
9. Verify Operation: Verify that the system behaves as expected in the simulation, transmitting and receiving data between the Arduino and the XBee module.

Program

```
void setup() {
    Serial.begin(9600); // Set the baud rate to 9600
}

void loop() {
    // Send data to XBee module
    Serial.println("Hello XBee!");

    // Receive data from XBee module
    if (Serial.available() > 0) {
        String receivedData = Serial.readString();
        Serial.println("Received data: " + receivedData);
    }

    delay(1000); // Delay for 1 second
}
```

OUTPUT:





```
Hello XBee!
Hello XBee!
Hello XBee!
Hello XBee!
```

Result:
Thus the communication methods (GSM,Bluetooth,Zigbee) with IoT devices have been successfully executed and the output is verified.

Exercise 7: Introduction to Raspberry PI platform and python programming

Aim:

To provide an introductory overview of the Raspberry Pi platform and Python programming, equipping beginners with foundational knowledge to explore hardware interfacing and develop basic projects on the Raspberry Pi using Python programming language.

Steps:

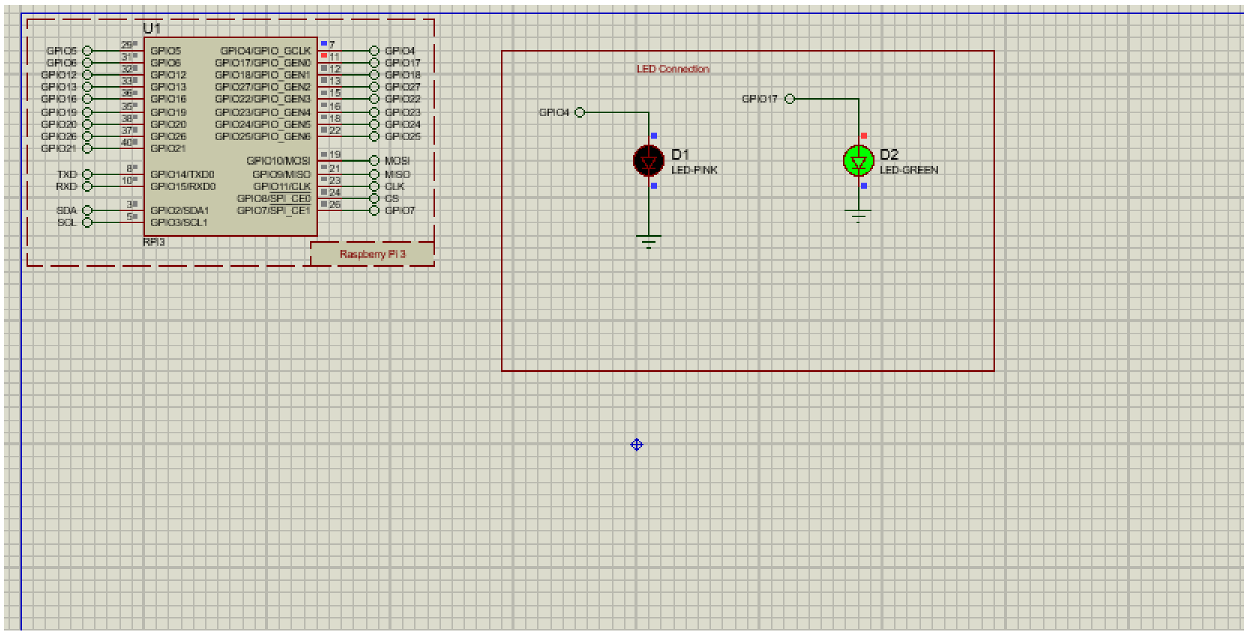
1. Open Proteus: Launch Proteus software on your computer.
2. Create New Project: Start a new project by clicking on "File" > "New Project" and choose create firmware project as Raspberry Pi..
3. Add Components:
   - Search for an LED component and add 2 LEDs to your workspace.
4. Wire Connections:
   - Connect the anode (longer leg) of the one LED to one of the GPIO pins on the Raspberry Pi (e.g., GPIO 7).
   - Connect the cathode (shorter leg) of the LED to the ground (GND) pin on the Raspberry Pi.
   - Connect the anode (longer leg) of the one LED to one of the GPIO pins on the Raspberry Pi (e.g., GPIO 11).
   - Connect the cathode (shorter leg) of the LED to the ground (GND) pin on the Raspberry Pi.
5. Write Python Script:
   - Open a text editor or Python IDE and write a Python script to control the LED.
6. Save Python Script: Save the Python script with a suitable name and with the ".py" extension.
7. Add Python Script to Raspberry Pi:
   - In Proteus, double-click on the Raspberry Pi component to open its properties.
   - Navigate to the "Program File" field and browse to select the Python script you've saved.
   - Click "OK" to apply the changes.

8. Run Simulation: Run the simulation in Proteus by clicking on the "Play" button or pressing F5.
    - The LED should start blinking according to the Python script.
9. Verify Operation: Verify that the LED is blinking as expected. You can adjust the blink rate by modifying the time.sleep() durations in the Python script.

Program:

```
import time

import RPi.GPIO as GPIO

GPIO.setmode(GPIO.BOARD)

GPIO.setwarnings(False)


LED_Red = 7

LED_Yellow= 11

 GPIO.setup(LED_Red, GPIO.OUT)

GPIO.setup(LED_Yellow, GPIO.OUT)


 while 1:

   GPIO.output(LED_Red, True)

   time.sleep(0.2)

   GPIO.output(LED_Yellow, True)

   time.sleep(.1)

   GPIO.output(LED_Red, False)

   time.sleep(.1)

   GPIO.output(LED_Yellow, False)

   time.sleep(.1)
```

OUTPUT:



Result:

Thus the LED Blinking using Raspberry Pi and python has been successfully completed and the output is verified.

Exercise 8: Interfacing sensors with Raspberry PI

8.1

Aim: To design and implement a temperature monitoring system using a temperature sensor interfaced with Raspberry Pi, aiming to collect real-time temperature data, display it on the Raspberry Pi.

Steps:

1. Open Proteus: Launch the Proteus software on your computer.
2. Create New Project: Start a new project by clicking on "File" > "New Project".

3. Add Components:
    - Search for "Raspberry Pi" in the component library and add it to your workspace.
    - Search for a temperature sensor component (such as LM35) and add it to your workspace as well.
    - Search for an ADC module component (e.g., MCP3208) and add it to your workspace.
    - Search for an LCD display component (e.g., 16x2 LCD) and add it to your workspace.
4. Wire Connections:
    - Connect the output pin of the temperature sensor to the input pin of the ADC module.
    - Connect the output pins of the ADC module to the Raspberry Pi's GPIO pins (e.g., SPI pins for MCP3208).
    - Connect the LCD display to the Raspberry Pi's GPIO pins for data and control signals.
5. Write Python Script:
    - Open a text editor or Python IDE and write a Python script to read the temperature sensor data.
    - Use the appropriate Python libraries to interface with the temperature sensor. For example, if you're using the LM35 sensor, you can use the RPi.GPIO library for GPIO access and time library for timing, and read analog values directly.
6. Save Python Script: Save the Python script with a suitable name and with the ".py" extension.
7. Add Python Script to Raspberry Pi:
    - In Proteus, double-click on the Raspberry Pi component to open its properties.
    - Navigate to the "Program File" field and browse to select the Python script you've saved.
    - Click "OK" to apply the changes.
8. Run Simulation: Run the simulation in Proteus by clicking on the "Play" button or pressing F5.
    - The Python script should execute and read the temperature sensor data.
9. Verify Operation: Verify that the temperature readings are displayed correctly in the simulation.

Program:

```
#!/usr/bin/python

import spidev

import time

import os

import RPi.GPIO as GPIO

GPIO.setmode(GPIO.BOARD)

GPIO.setwarnings(False)

# Open SPI bus

spi = spidev.SpiDev()

spi.open(0,0)

# Define GPIO to LCD mapping

LCD_RS = 15

LCD_E  = 16

LCD_D4 = 7

LCD_D5 = 11

LCD_D6 = 12

LCD_D7 = 13

# Define sensor channels

temp_channel  = 0

'''

define pin for lcd

'''
```

```
# Timing constants
E_PULSE = 0.0005
E_DELAY = 0.0005
delay = 1
GPIO.setup(LCD_E, GPIO.OUT)  # E
GPIO.setup(LCD_RS, GPIO.OUT) # RS
GPIO.setup(LCD_D4, GPIO.OUT) # DB4
GPIO.setup(LCD_D5, GPIO.OUT) # DB5
GPIO.setup(LCD_D6, GPIO.OUT) # DB6
GPIO.setup(LCD_D7, GPIO.OUT) # DB7
# Define some device constants
LCD_WIDTH = 16    # Maximum characters per line
LCD_CHR = True
LCD_CMD = False
LCD_LINE_1 = 0x80 # LCD RAM address for the 1st line
LCD_LINE_2 = 0xC0 # LCD RAM address for the 2nd line
'''
Function Name :lcd_init()
Function Description : this function is used to initialized lcd by sending the different commands
'''
```
def lcd_init():
```
  # Initialise display
  lcd_byte(0x33,LCD_CMD) # 110011 Initialise
  lcd_byte(0x32,LCD_CMD) # 110010 Initialise

  lcd_byte(0x06,LCD_CMD) # 000110 Cursor move direction

  lcd_byte(0x0C,LCD_CMD) # 001100 Display On,Cursor Off, Blink Off

  lcd_byte(0x28,LCD_CMD) # 101000 Data length, number of lines, font size

  lcd_byte(0x01,LCD_CMD) # 000001 Clear display

  time.sleep(E_DELAY)

'''

Function Name :lcd_byte(bits ,mode)

Fuction Name :the main purpose of this function to convert the byte data into bit and send to lcd
port

'''
```

def lcd_byte(bits, mode):

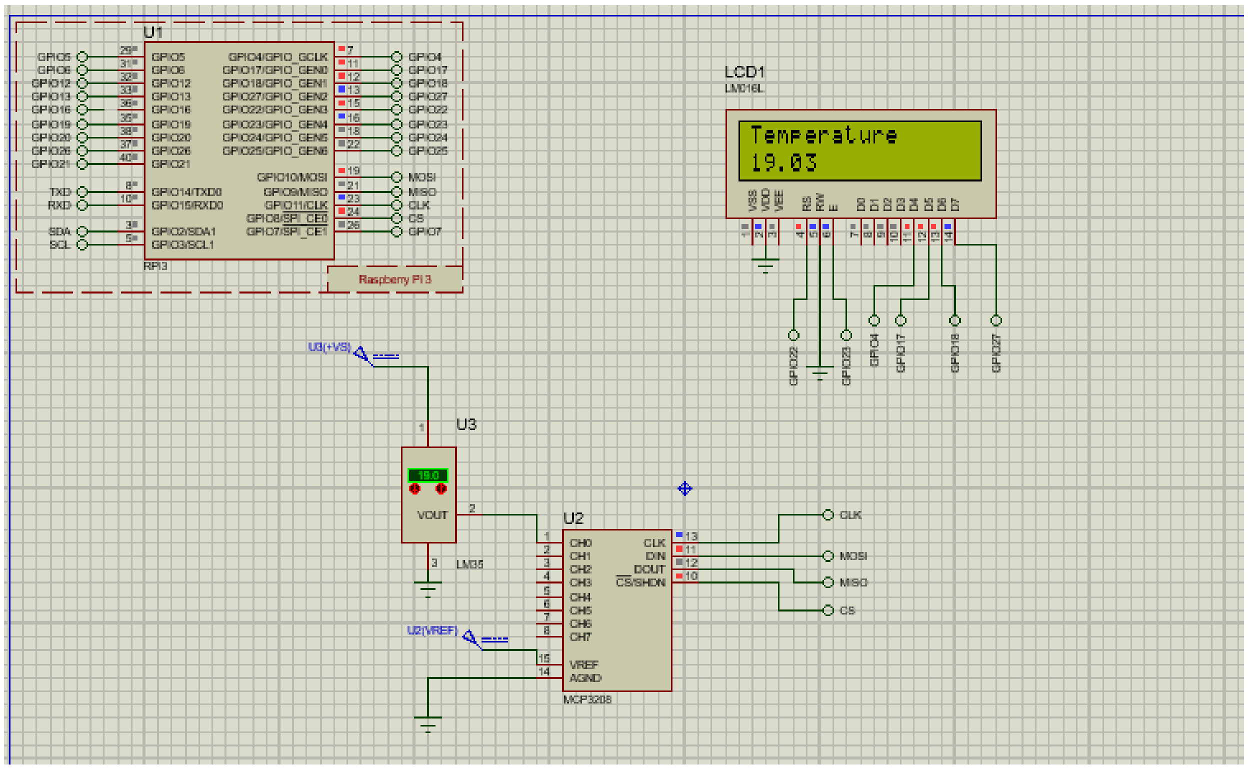
```
  # Send byte to data pins

  # bits = data

  # mode = True  for character

  #        False for command

   GPIO.output(LCD_RS, mode) # RS

   # High bits

  GPIO.output(LCD_D4, False)

  GPIO.output(LCD_D5, False)

  GPIO.output(LCD_D6, False)

  GPIO.output(LCD_D7, False)

  if bits&0x10==0x10:

    GPIO.output(LCD_D4, True)
```

```
if bits&0x20==0x20:
  GPIO.output(LCD_D5, True)
if bits&0x40==0x40:
  GPIO.output(LCD_D6, True)
if bits&0x80==0x80:
  GPIO.output(LCD_D7, True)
 # Toggle 'Enable' pin
lcd_toggle_enable()
 # Low bits
GPIO.output(LCD_D4, False)
GPIO.output(LCD_D5, False)
GPIO.output(LCD_D6, False)
GPIO.output(LCD_D7, False)
if bits&0x01==0x01:
  GPIO.output(LCD_D4, True)
if bits&0x02==0x02:
  GPIO.output(LCD_D5, True)
if bits&0x04==0x04:
  GPIO.output(LCD_D6, True)
if bits&0x08==0x08:
  GPIO.output(LCD_D7, True)


# Toggle 'Enable' pin
```

```
  lcd_toggle_enable()
'''
Function Name : lcd_toggle_enable()
Function Description:basically this is used to toggle Enable pin
'''
```
def lcd_toggle_enable():
```
  # Toggle enable
  time.sleep(E_DELAY)
  GPIO.output(LCD_E, True)
  time.sleep(E_PULSE)
  GPIO.output(LCD_E, False)
  time.sleep(E_DELAY)
'''
Function Name :lcd_string(message,line)
Function  Description :print the data on lcd
'''
```
def lcd_string(message,line):
```
  # Send string to display
  message = message.ljust(LCD_WIDTH," ")
 lcd_byte(line, LCD_CMD)
 for i in range(LCD_WIDTH):
    lcd_byte(ord(message[i]),LCD_CHR)
# Function to read SPI data from MCP3008 chip
# Channel must be an integer 0-7
def ReadChannel(channel):
  adc = spi.xfer2([1,(8+channel)<<4,0])
  data = ((adc[1]&3) << 8) + adc[2]
  return data
# Function to calculate temperature from
# TMP36 data, rounded to specified
# number of decimal places.
def ConvertTemp(data,places):
   # ADC Value
  temp = ((data * 330)/float(1023))
  temp = round(temp,places)
  return temp


 # Define delay between readings
delay = 5
lcd_init()
lcd_string("welcome ",LCD_LINE_1)
time.sleep(.2)
while 1:
  temp_level = ReadChannel(temp_channel)
  temp       = ConvertTemp(temp_level,2)
   # Print out results
```

```
lcd_string("Temperature  ",LCD_LINE_1)

lcd_string(str(temp),LCD_LINE_2)

time.sleep(.1)
```

OUTPUT:



8.2

Aim:

To construct a motion detection system utilizing an infrared (IR) sensor interfaced with Raspberry Pi, aiming to detect the presence of nearby objects or individuals, for enhanced automation or security purposes.

Steps:

10. Open Proteus: Launch the Proteus software on your computer.
11. Create New Project: Start a new project by clicking on "File" > "New Project".
12. Add Components:
    - Search for "Raspberry Pi" in the component library and add it to your workspace.
    - Add InfraredSensorsTEP.IDX,InfraredSensorsTEP.LIB, InfraredSensorsTEP.hex library files to the folder C:\Program Files (x86)\Labcenter Electronics\Proteus 8 Professional\DATA\LIBRARY ,if they do not already exist.
    - Search for an IR sensor component and add it to your workspace.
    - Search for an LCD display component (e.g., 16x2 LCD) and add it to your workspace.
13. Wire Connections:
    - Connect the output pin of the IR sensor to one of the GPIO pins on the Raspberry Pi (e.g., GPIO 24).
    - Connect the IR sensor's VCC pin to the 3.3V pin on the Raspberry Pi.
    - Connect the IR sensor's GND pin to the ground (GND) pin on the Raspberry Pi.
    - Connect the LCD display to the Raspberry Pi's GPIO pins for data and control signals.
14. Write Python Script:
    - Open a text editor or Python IDE and write a Python script to detect IR sensor input and display it on the LCD display.
    - Use the appropriate Python libraries to interface with the IR sensor and the LCD display. For example, you can use the RPi.GPIO library for GPIO access.
15. Save Python Script: Save the Python script with a suitable name and with the ".py" extension.
16. Add Python Script to Raspberry Pi:
    - In Proteus, double-click on the Raspberry Pi component to open its properties.
    - Navigate to the "Program File" field and browse to select the Python script you've saved.
    - Click "OK" to apply the changes.
17. Run Simulation: Run the simulation in Proteus by clicking on the "Play" button or pressing F5.

    - The Python script should execute, and the LCD display should show whether an object is detected by the IR sensor.

18. Verify Operation: Verify that the system behaves as expected in the simulation, detecting object presence and displaying the appropriate message on the LCD display.

PROGRAM:

```
#!/usr/bin/python

import time

import RPi.GPIO as GPIO

import time

GPIO.setmode(GPIO.BOARD)

GPIO.setwarnings(False)

'''

define pin for lcd

'''

# Timing constants

E_PULSE = 0.0005

E_DELAY = 0.0005

delay = 1

buzzer=37

GPIO.setup(buzzer, GPIO.OUT)


# Define GPIO to LCD mapping

LCD_RS = 7

LCD_E  = 11
```

```
LCD_D4 = 12

LCD_D5 = 13

LCD_D6 = 15

LCD_D7 = 16

IR_Sensor = 18

GPIO.setup(LCD_E, GPIO.OUT)  # E

GPIO.setup(LCD_RS, GPIO.OUT) # RS

GPIO.setup(LCD_D4, GPIO.OUT) # DB4

GPIO.setup(LCD_D5, GPIO.OUT) # DB5

GPIO.setup(LCD_D6, GPIO.OUT) # DB6

GPIO.setup(LCD_D7, GPIO.OUT) # DB7

GPIO.setup(IR_Sensor, GPIO.IN) # DB7

# Define some device constants

LCD_WIDTH = 16    # Maximum characters per line

LCD_CHR = True

LCD_CMD = False

LCD_LINE_1 = 0x80 # LCD RAM address for the 1st line

LCD_LINE_2 = 0xC0 # LCD RAM address for the 2nd line

'''

Function Name :lcd_init()

Function Description : this function is used to initialized lcd by sending the different commands

'''
```

def lcd_init():

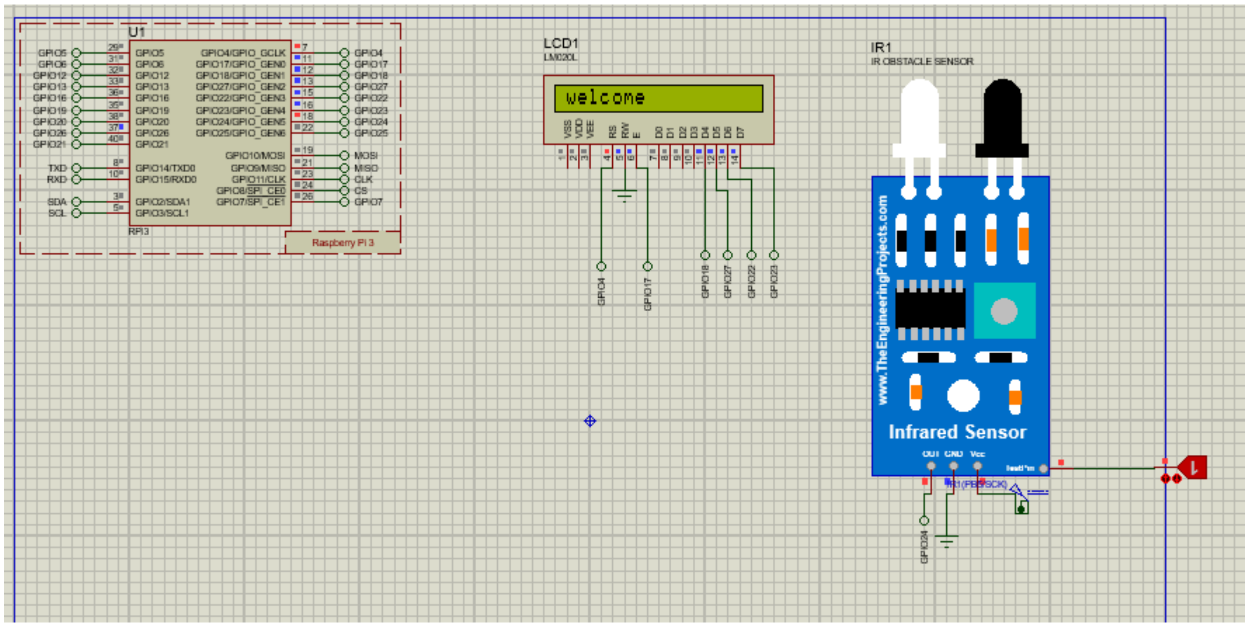
```
  # Initialise display

  lcd_byte(0x33,LCD_CMD) # 110011 Initialise

  lcd_byte(0x32,LCD_CMD) # 110010 Initialise

  lcd_byte(0x06,LCD_CMD) # 000110 Cursor move direction

  lcd_byte(0x0C,LCD_CMD) # 001100 Display On,Cursor Off, Blink Off

  lcd_byte(0x28,LCD_CMD) # 101000 Data length, number of lines, font size

  lcd_byte(0x01,LCD_CMD) # 000001 Clear display

  time.sleep(E_DELAY)

'''

Function Name :lcd_byte(bits ,mode)

Fuction Name :the main purpose of this function to convert the byte data into bit and send to lcd port

'''
```

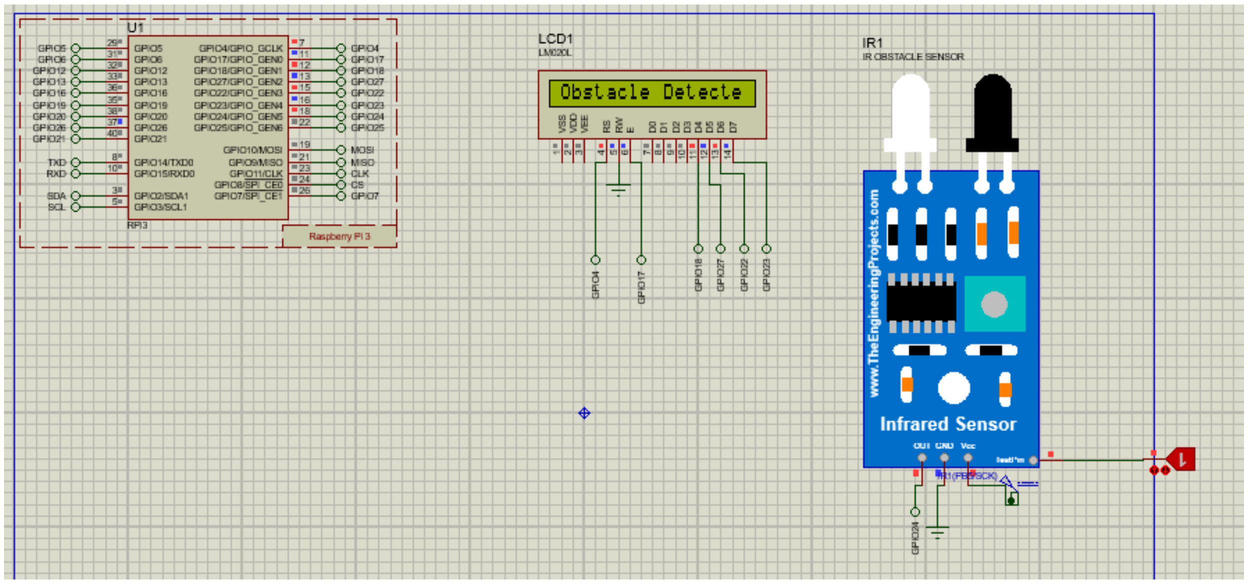
def lcd_byte(bits, mode):

```
  # Send byte to data pins

  # bits = data

  # mode = True  for character

  #        False for command


  GPIO.output(LCD_RS, mode) # RS


  # High bits

  GPIO.output(LCD_D4, False)

  GPIO.output(LCD_D5, False)
```

```
GPIO.output(LCD_D6, False)

GPIO.output(LCD_D7, False)

if bits&0x10==0x10:

  GPIO.output(LCD_D4, True)

if bits&0x20==0x20:

  GPIO.output(LCD_D5, True)

if bits&0x40==0x40:

  GPIO.output(LCD_D6, True)

if bits&0x80==0x80:

  GPIO.output(LCD_D7, True)


# Toggle 'Enable' pin

lcd_toggle_enable()


# Low bits

GPIO.output(LCD_D4, False)

GPIO.output(LCD_D5, False)

GPIO.output(LCD_D6, False)

GPIO.output(LCD_D7, False)

if bits&0x01==0x01:

  GPIO.output(LCD_D4, True)

if bits&0x02==0x02:

  GPIO.output(LCD_D5, True)
  if bits&0x04==0x04:
    GPIO.output(LCD_D6, True)
  if bits&0x08==0x08:
    GPIO.output(LCD_D7, True)


  # Toggle 'Enable' pin
  lcd_toggle_enable()
'''
Function Name : lcd_toggle_enable()
Function Description:basically this is used to toggle Enable pin
'''
def lcd_toggle_enable():
  # Toggle enable
  time.sleep(E_DELAY)
  GPIO.output(LCD_E, True)
  time.sleep(E_PULSE)
  GPIO.output(LCD_E, False)
  time.sleep(E_DELAY)
'''
Function Name :lcd_string(message,line)
Function  Description :print the data on lcd
'''
def lcd_string(message,line):
  # Send string to display
   message = message.ljust(LCD_WIDTH," ")
   lcd_byte(line, LCD_CMD)

  for i in range(LCD_WIDTH):
    lcd_byte(ord(message[i]),LCD_CHR)

lcd_init()
lcd_string("welcome ",LCD_LINE_1)
time.sleep(2)
# Define delay between readings
delay = 5
while 1:
  # Print out results
  if GPIO.input(IR_Sensor):
   lcd_string("Obstacle Detected  ",LCD_LINE_1)
   time.sleep(1)
  else:
    lcd_string("Obstacle Removed  ",LCD_LINE_1)
    time.sleep(1)
```

OUTPUT:





Result:

Thus the interfacing sensors with Raspberry PI are executed successfully and the output is verified.

Exercise 9: Setup a cloud platform to log the data

Aim

To set up a ThingSpeak cloud to log data from IoT devices and sensors, analyze it, and visualize it in real-time.

Steps:

1.Sign Up /Login to ThinkSpeak

Go to the ThingSpeak website (https://thingspeak.com/) and sign up for a new account or log in if you already have one.

2.Create a New Channel

- After logging in, click on the "Channels" tab at the top of the page.
- Click on the “New Channel” button.
- Enter the necessary information such as the name, description, and field labels for your channel.
- Configure additional settings like the number of fields, update rate, and privacy settings according to your requirements.
- Click on the "Save Channel" button to create the channel

3. Get Write API Key

- Once the channel is created, click on the "API Keys" tab.
- You will find the "Write API Key" listed there. Copy this key as you will need it to send data to your channel.

4. Configure Data Source (Device)

- Configure your IoT device or sensor to send data to ThingSpeak.
- Use the Write API Key obtained in the previous step to authenticate data transmission
    - Depending on your device and communication protocol (HTTP, MQTT, etc.), configure it to send data to ThingSpeak using the appropriate method.

5.Send Data to ThingSpeak

- Start sending data from your device to ThingSpeak using the Write API Key.
- You can send data using HTTP requests, MQTT, or other supported protocols.
- Make sure to send the data in the format expected by ThingSpeak, typically as HTTP GET or POST requests with parameters for each field.

6.View and Analyze Data:

- Once data is being sent to your ThingSpeak channel, you can view and analyze it using the ThingSpeak web interface.

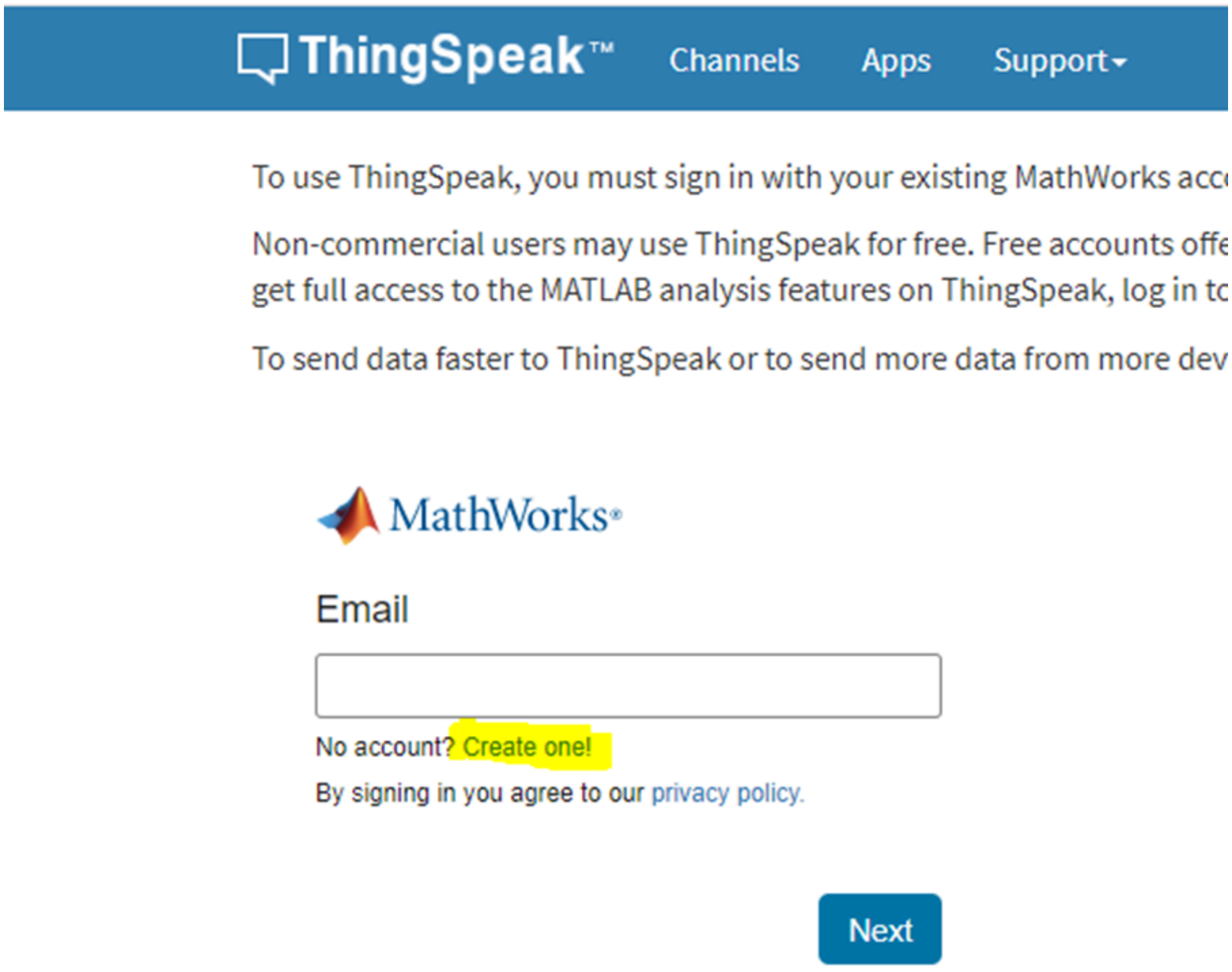
- Go to your channel's page and click on the "Charts" or "Visualizations" tab to see your data plotted on graphs.

OUTPUT:

Open thingspeak website to create account ::

https://thingspeak.com/login?skipSSOCheck=true

Step1:



To use ThingSpeak, you must sign in with your existing MathWorks acc

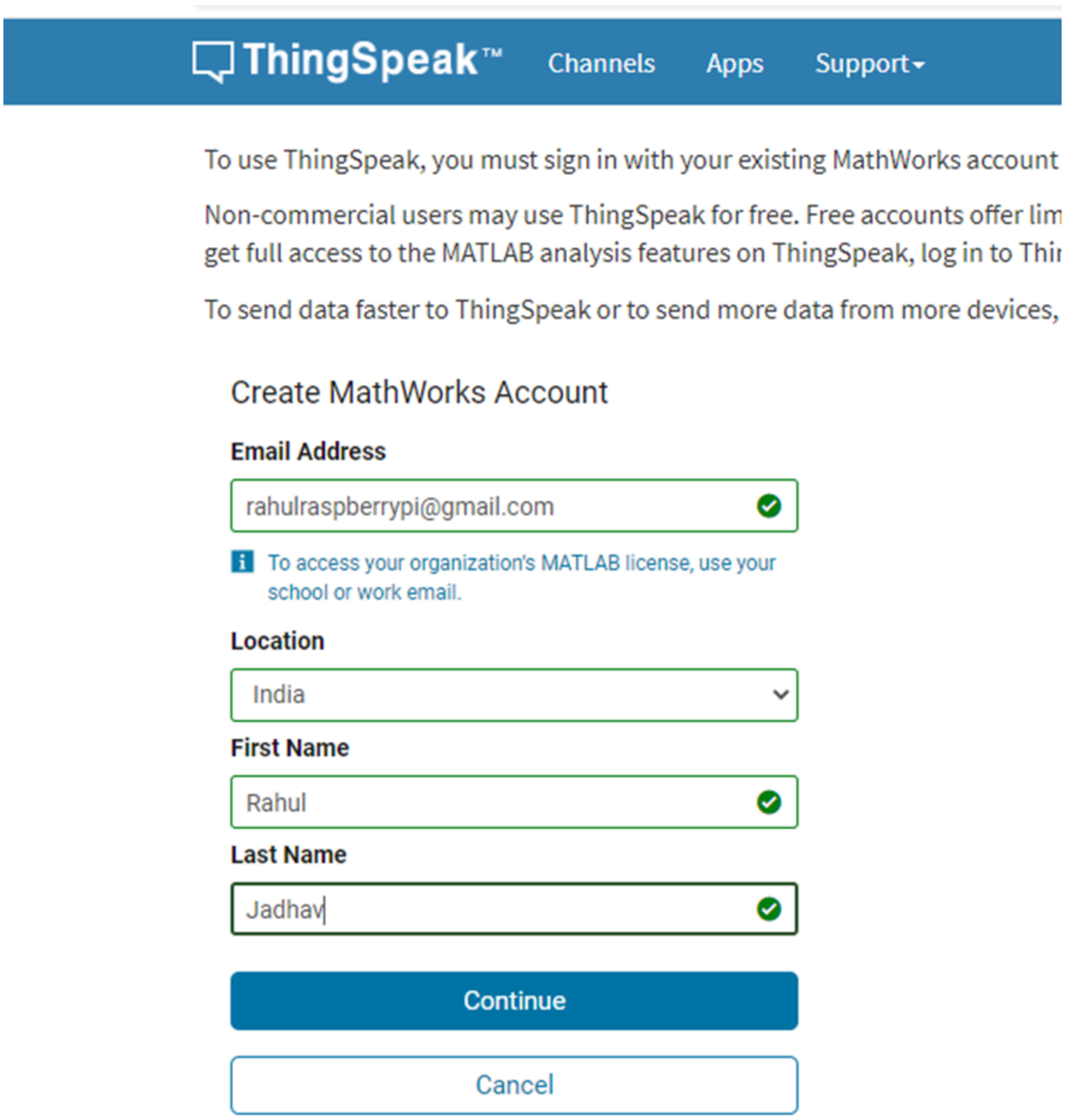
Non-commercial users may use ThingSpeak for free. Free accounts offe get full access to the MATLAB analysis features on ThingSpeak, log in tc

To send data faster to ThingSpeak or to send more data from more dev

No account? Create one!

By signing in you agree to our privacy policy.

Step 2:



To use ThingSpeak, you must sign in with your existing MathWorks account

Non-commercial users may use ThingSpeak for free. Free accounts offer lim
get full access to the MATLAB analysis features on ThingSpeak, log in to Thi

To send data faster to ThingSpeak or to send more data from more devices,

Create MathWorks Account

Email Address: rahulraspberrypi@gmail.com

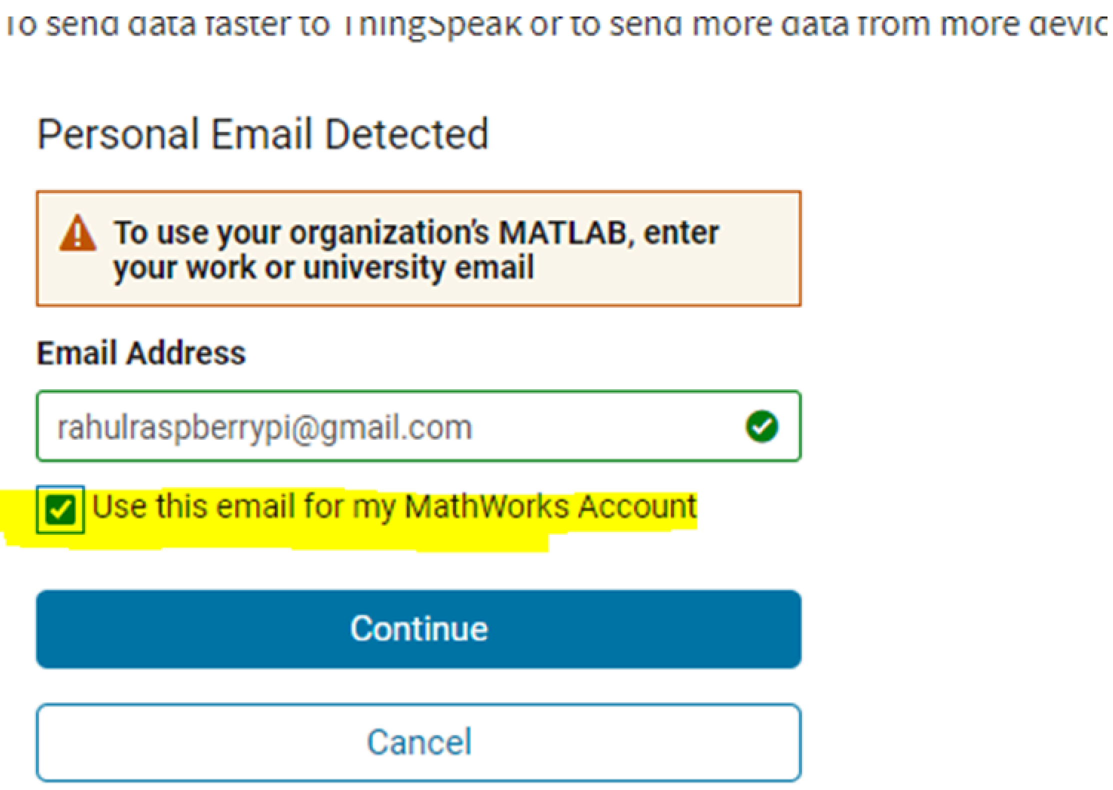
To access your organization's MATLAB license, use your school or work email.

Location: India

First Name: Rahul

Last Name: Jadhav

Step 3:



To send data faster to ThingSpeak or to send more data from more devic

Personal Email Detected

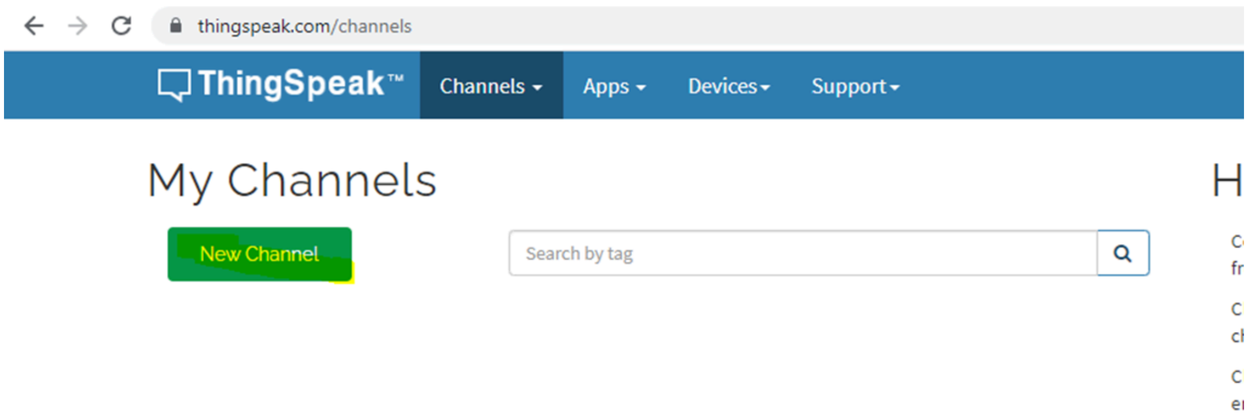
To use your organization's MATLAB, enter your work or university email

Email Address

rahulraspberrypi@gmail.com

☑ Use this email for my MathWorks Account

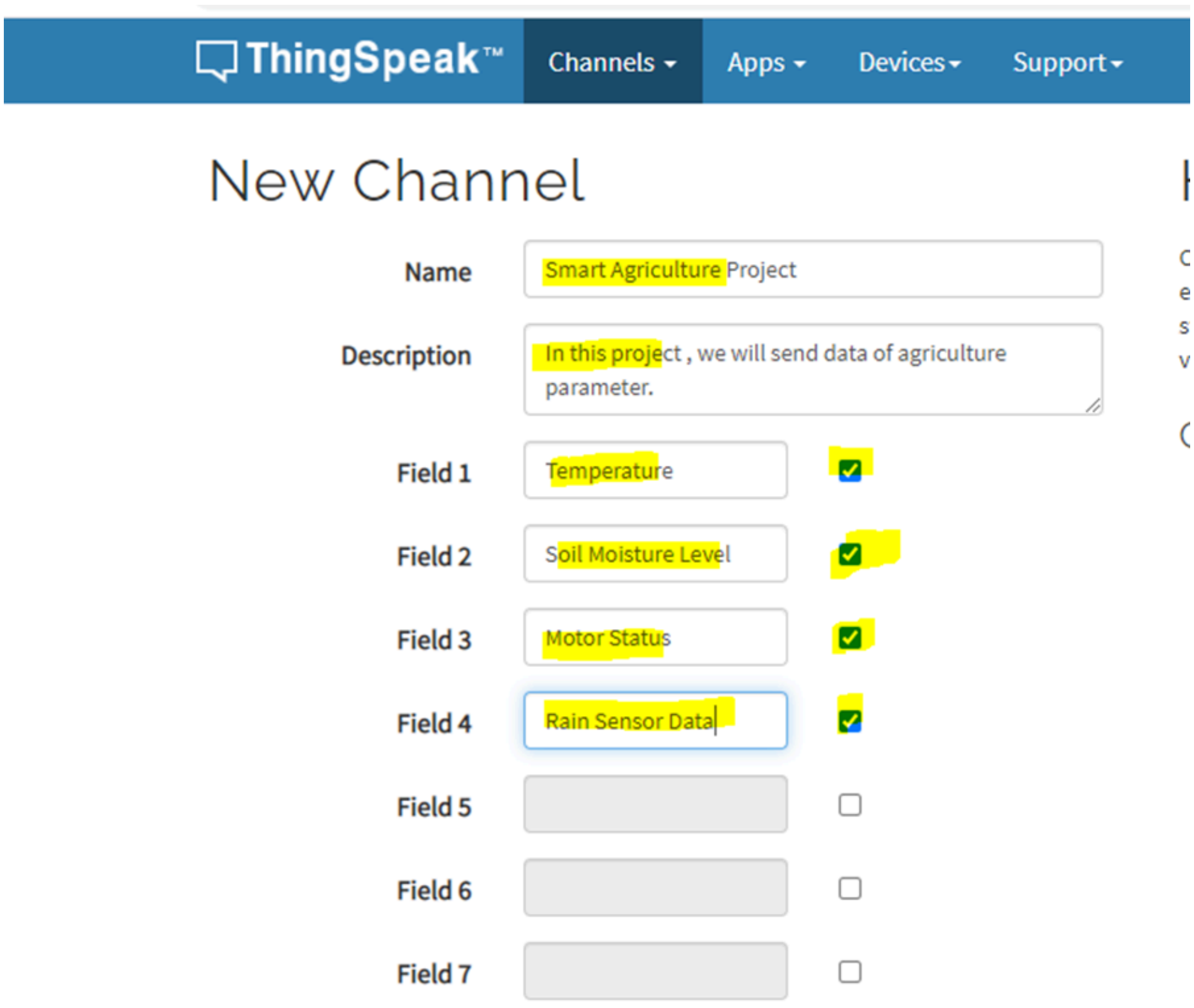
Step 4:



thingspeak.com/channels

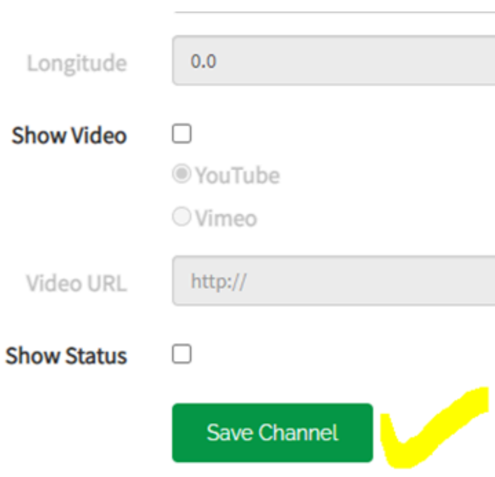
My Channels

Step 5:



New Channel

Name	Smart Agriculture Project	
Description	In this project , we will send data of agriculture parameter.	
Field 1	Temperature	✓
Field 2	Soil Moisture Level	✓
Field 3	Motor Status	✓
Field 4	Rain Sensor Data	✓
Field 5		☐
Field 6		☐
Field 7		☐



Longitude: 0.0

Show Video: ☐

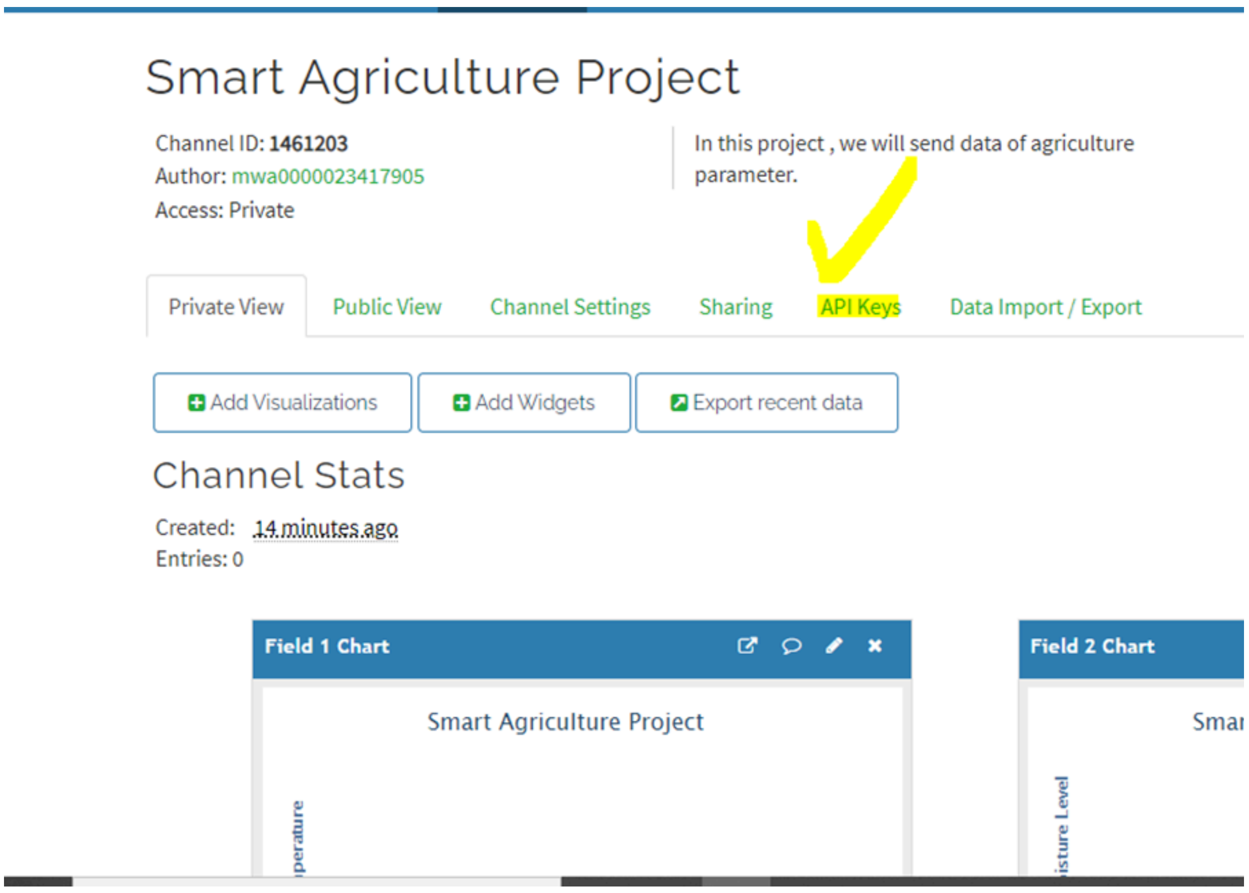
YouTube

Vimeo

Video URL: http://

Show Status: ☐

Step 6:



Smart Agriculture Project

Channel ID: **1461203**

Author: mwa0000023417905

Access: Private

In this project , we will send data of agriculture parameter.

Channel Stats

Created: 14 minutes ago

Entries: 0

Step 8:

Copy write API Key to send data on thingspeak:

HGI92BZUPPGOMWZB

Result:
Thus the setting up of ThingSpeak cloud to log data is done.

Exercise 10: Communicate between Arduino and Raspberry PI using any wireless medium

Aim:

To establish wireless communication between Arduino and Raspberry Pi using a chosen wireless medium, with the goal of facilitating data exchange and interaction between the two platforms.

Steps:

Exercise 11: Log Data using Raspberry PI and upload to the cloud platform

Aim:

Steps:

1. Open Proteus: Launch the Proteus software on your computer.

2. Create New Project: Start a new project by clicking on "File" > "New Project".
3. Add Components:
   - Search for "Raspberry Pi" in the component library and add it to your workspace.
   - Search for sensor components and add it to your workspace.
   - Search for an LCD display component (e.g., 16x2 LCD) and add it to your workspace.
4. Wire Connections:
   - Connect the components.
5. Write Python Script:
   - Open a text editor or Python IDE and write a Python script and display it on the LCD display.
   - Use the appropriate Python libraries to interface with the sensor and the LCD display. For example, you can use the RPi.GPIO library for GPIO access.
   - Write the function to send the sensor data to Thingspeak cloud.
6. Save Python Script: Save the Python script with a suitable name and with the ".py" extension.
7. Add Python Script to Raspberry Pi:
   - In Proteus, double-click on the Raspberry Pi component to open its properties.
   - Navigate to the "Program File" field and browse to select the Python script you've saved.
   - Click "OK" to apply the changes.
8. Run Simulation: Run the simulation in Proteus by clicking on the "Play" button or pressing F5.
   - The Python script should execute, and the LCD display should show whether an object is detected by the IR sensor.
9. Verify Operation: Verify that the system behaves as expected in the simulation, detecting object presence and displaying the appropriate message on the LCD display.

PROGRAM:

```
# !/usr/bin/env python3

# Modules
```

```
from goto import *

import time

import var

import pio

import resource

import spidev

import RPi.GPIO as GPIO

import urllib.request

import requests


# Peripheral Configuration Code (do not edit)

#---CONFIG_BEGIN---

import cpu

import FileStore

import VFP

import Ports


def peripheral_setup () :

# Peripheral Constructors

 pio.cpu=cpu.CPU ()

 pio.storage=FileStore.FileStore ()

 pio.server=VFP.VfpServer ()

 pio.uart=Ports.UART ()
 pio.storage.begin ()

 pio.server.begin (0)

# Install interrupt handlers


def peripheral_loop () :

 pass


#---CONFIG_END---


# Open SPI bus

spi = spidev.SpiDev()

spi.open(0,0)


# Define GPIO to LCD mapping

LCD_RS = 4

LCD_E  = 17

LCD_D4 = 18

LCD_D5 = 27

LCD_D6 = 22

LCD_D7 = 23

Relay_pin= 24

Rain_sensor = 25

# Define sensor channels
```

```
temp_channel  = 0

Moisture_channel =1


'''

define pin for lcd

'''

# Timing constants

E_PULSE = 0.0005

E_DELAY = 0.0005

delay = 1


GPIO.setup(LCD_E, GPIO.OUT)  # E

GPIO.setup(LCD_RS, GPIO.OUT) # RS

GPIO.setup(LCD_D4, GPIO.OUT) # DB4

GPIO.setup(LCD_D5, GPIO.OUT) # DB5

GPIO.setup(LCD_D6, GPIO.OUT) # DB6

GPIO.setup(LCD_D7, GPIO.OUT) # DB7

GPIO.setup(Relay_pin, GPIO.OUT) # Motor_1

GPIO.setup(Rain_sensor, GPIO.IN)

# Define some device constants

LCD_WIDTH = 16    # Maximum characters per line

LCD_CHR = True

LCD_CMD = False
```

```
LCD_LINE_1 = 0x80 # LCD RAM address for the 1st line

LCD_LINE_2 = 0xC0 # LCD RAM address for the 2nd line


'''

Function Name :lcd_init()

Function Description : this function is used to initialized lcd by sending the different commands

'''

def lcd_init():

  # Initialise display

  lcd_byte(0x33,LCD_CMD) # 110011 Initialise

  lcd_byte(0x32,LCD_CMD) # 110010 Initialise

  lcd_byte(0x06,LCD_CMD) # 000110 Cursor move direction

  lcd_byte(0x0C,LCD_CMD) # 001100 Display On,Cursor Off, Blink Off

  lcd_byte(0x28,LCD_CMD) # 101000 Data length, number of lines, font size

  lcd_byte(0x01,LCD_CMD) # 000001 Clear display

  time.sleep(E_DELAY)

'''

Function Name :lcd_byte(bits ,mode)

Fuction Name :the main purpose of this function to convert the byte data into bit and send to lcd
port

'''

def lcd_byte(bits, mode):

  # Send byte to data pins

  # bits = data
  # mode = True  for character

  #        False for command


  GPIO.output(LCD_RS, mode) # RS


  # High bits

  GPIO.output(LCD_D4, False)

  GPIO.output(LCD_D5, False)

  GPIO.output(LCD_D6, False)

  GPIO.output(LCD_D7, False)

  if bits&0x10==0x10:

    GPIO.output(LCD_D4, True)

  if bits&0x20==0x20:

    GPIO.output(LCD_D5, True)

  if bits&0x40==0x40:

    GPIO.output(LCD_D6, True)

  if bits&0x80==0x80:

    GPIO.output(LCD_D7, True)


  # Toggle 'Enable' pin

  lcd_toggle_enable()


  # Low bits
```

```
  GPIO.output(LCD_D4, False)
  GPIO.output(LCD_D5, False)
  GPIO.output(LCD_D6, False)
  GPIO.output(LCD_D7, False)
  if bits&0x01==0x01:
    GPIO.output(LCD_D4, True)
  if bits&0x02==0x02:
    GPIO.output(LCD_D5, True)
  if bits&0x04==0x04:
    GPIO.output(LCD_D6, True)
  if bits&0x08==0x08:
    GPIO.output(LCD_D7, True)

  # Toggle 'Enable' pin
  lcd_toggle_enable()
'''
Function Name : lcd_toggle_enable()
Function Description:basically this is used to toggle Enable pin
'''
def lcd_toggle_enable():
  # Toggle enable
  time.sleep(E_DELAY)
  GPIO.output(LCD_E, True)
  time.sleep(E_PULSE)

  GPIO.output(LCD_E, False)

  time.sleep(E_DELAY)

'''

Function Name :lcd_string(message,line)

Function  Description :print the data on lcd

'''

def lcd_string(message,line):

  # Send string to display



  message = message.ljust(LCD_WIDTH," ")



  lcd_byte(line, LCD_CMD)



  for i in range(LCD_WIDTH):

    lcd_byte(ord(message[i]),LCD_CHR)



# Function to read SPI data from MCP3008 chip

# Channel must be an integer 0-7

def ReadChannel(channel):

  adc = spi.xfer2([1,(8+channel)<<4,0])

  data = ((adc[1]&3) << 8) + adc[2]

  return data
```

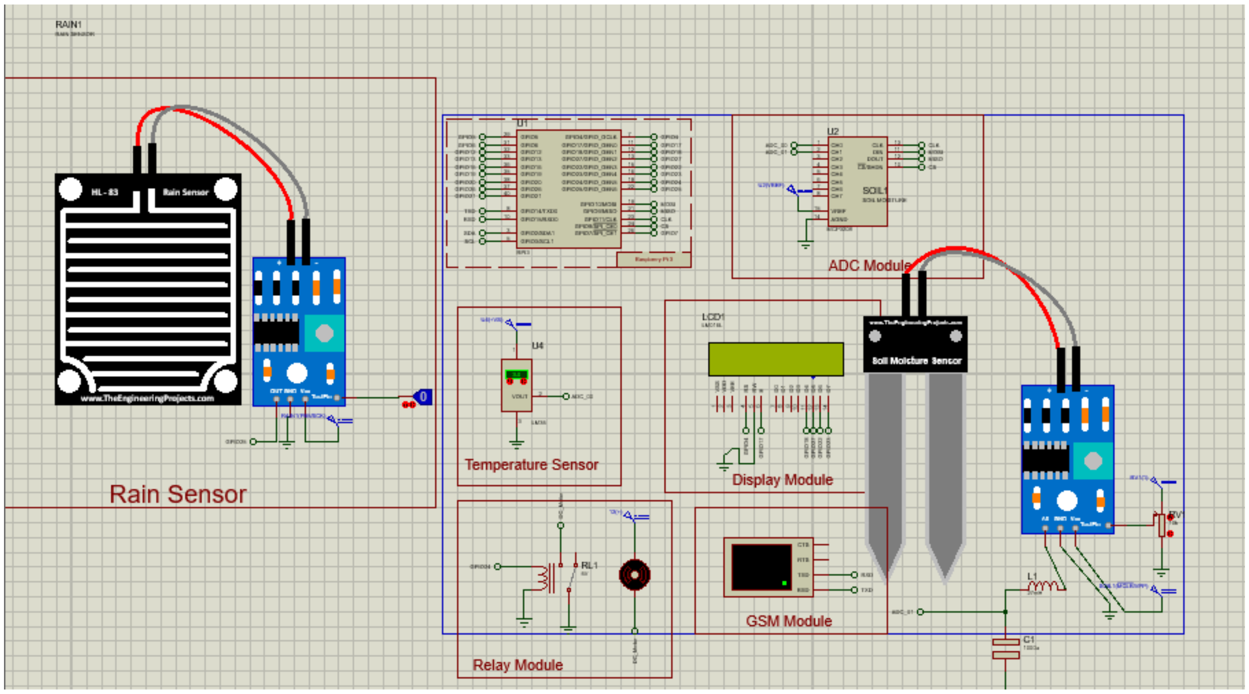
```
# Function to calculate temperature from

# TMP36 data, rounded to specified

# number of decimal places.

def ConvertTemp(data,places):

  temp = ((data * 330)/float(1023))

  temp = round(temp,places)

  return temp


def thingspeak_post(temp,moisture_level,motor_status,rain_data):

    URl='https://api.thingspeak.com/update?api_key='

    #Enter Your Private Key here

    KEY='24AOZ5TLM9UHE5BO'

HEADER='&field1={}&field2={}&field3={}&field4={}'.format(temp,moisture_level,motor_st
atus,rain_data)

    NEW_URL=URl+KEY+HEADER

    print(NEW_URL)

    data=urllib.request.urlopen(NEW_URL)

    print(data)


# Define delay between readings

delay = 5
```

```
lcd_init()

lcd_string("welcome ",LCD_LINE_1)

time.sleep(1)

lcd_byte(0x01,LCD_CMD) # 000001 Clear display

lcd_string("Smart Irrigation",LCD_LINE_1)

lcd_string("System ",LCD_LINE_2)

time.sleep(1)

lcd_byte(0x01,LCD_CMD) # 000001 Clear display

# Main function

def main () :

# Setup

 peripheral_setup()

 peripheral_loop()

 #Motor Status

 motor_status = 0

# Infinite loop

 while 1 :


  temp_level = ReadChannel(temp_channel)

  temp       = ConvertTemp(temp_level,2)


  # Print out results

  lcd_byte(0x01,LCD_CMD) # 000001 Clear display
```

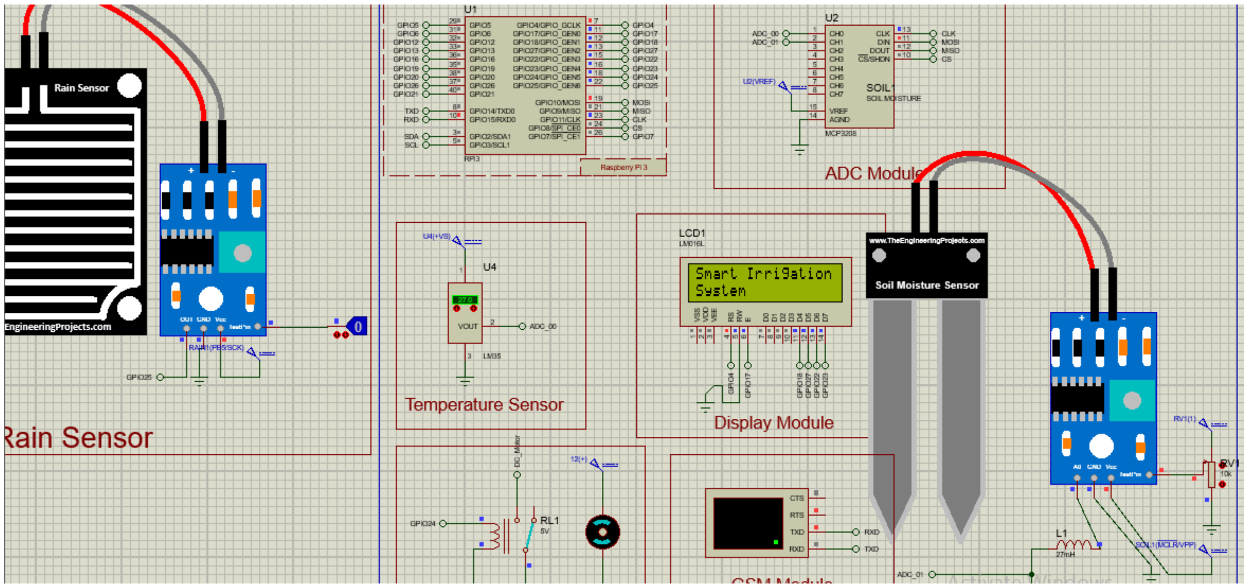
```
lcd_string("Temperature  ",LCD_LINE_1)
lcd_string(str(temp),LCD_LINE_2)
time.sleep(0.5)

moisture_level = ReadChannel(Moisture_channel)
# Print out results
lcd_byte(0x01,LCD_CMD) # 000001 Clear display
lcd_string("Moisture Level  ",LCD_LINE_1)
lcd_string(str(moisture_level),LCD_LINE_2)
time.sleep(0.5)
rain_data = GPIO.input(Rain_sensor)
#Send data on thing speak server
thingspeak_post(temp,moisture_level,motor_status,rain_data)
if((temp > 25)  and  (moisture_level < 100) and (rain_data != True)) :
 GPIO.output(Relay_pin, True)
 lcd_byte(0x01,LCD_CMD) # 000001 Clear display
 lcd_string("Motor Start ",LCD_LINE_1)
 pio.uart.println("AT")
 pio.uart.println("AT+CMGF=1")
 pio.uart.println("AT+CMGS=\"+919865533668\"\r")
 pio.uart.println("Motor Started")
 motor_status = 1
 time.sleep(0.5)
```

```
  else:
   GPIO.output(Relay_pin, False)
   lcd_byte(0x01,LCD_CMD) # 000001 Clear display
   lcd_string("Motor Stop ",LCD_LINE_1)
   if(rain_data == True):
      lcd_string("Rain Detected ",LCD_LINE_2)
   pio.uart.println("AT")
   pio.uart.println("AT+CMGF=1")
   pio.uart.println("AT+CMGS=\"+919865533668\"\r")
   pio.uart.println("Motor Stop")
   motor_status = 0
   time.sleep(0.5)

  pass
# Command line execution
if __name__ == '__main__' :
   main()
```

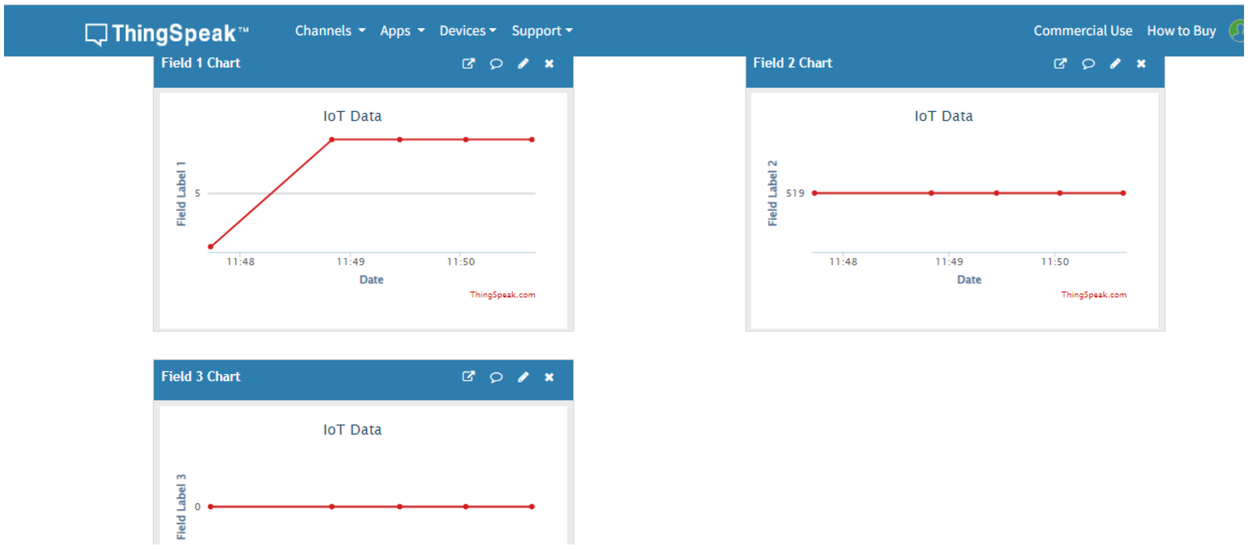
OUTPUT:



RAIN1
HL - 83
Rain Sensor
www.TheEngineeringProjects.com
Rain Sensor
U1
Raspberry Pi 3
U2
ADC Module
U4
Temperature Sensor
LCD1
Display Module
Soil Moisture Sensor
RL1
Relay Module
GSM Module
L1
C1
RV1



Rain Sensor
EngineeringProjects.com
Rain Sensor
U1
RP3
Raspberry Pi 3
U2
MCP3208
ADC Module
U4
LM35
Temperature Sensor
LCD1
LM016L
Smart Irrigation
System
Display Module
www.TheEngineeringProjects.com
Soil Moisture Sensor
RL1
5V
GSM Module
L1
27mH
RV1
10k



Exercise 12:Design an IOT based system