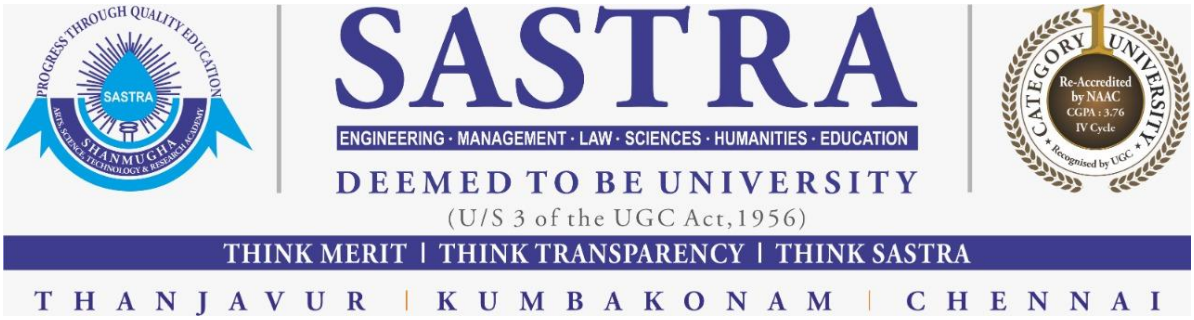


DEPARTMENT OF ELECTRICAL AND ELECTRONICS ENGINEERING

SRINIVASA RAMANUJAN CENTRE

KUMBAKONAM, TAMIL NADU, INDIA – 612 001

SMART POWER SAVING SYSTEM USING IOT

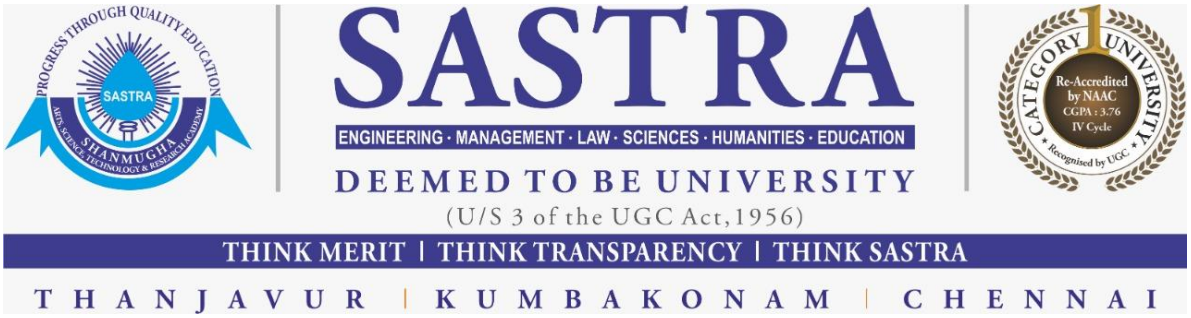
A Mini project report submitted to the SASTRA Deemed to be University
in partial fulfillment of the requirements
for the award of the degree of

B. Tech. Electrical & Electronics Engineering

Submitted by

MAKESH B
(Reg.no:223005030)
RAGUL R
(Reg.no:223005039)

December 2022



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KUMBAKONAM, TAMIL NADU, INDIA – 612 001

Bonafide Certificate

This is to certify that the project work titled "**Smart Power Saving System Using IOT**" submitted in partial fulfillment of the requirements for the award of the degree of B. Tech. Electrical & Electronics Engineering to the SASTRA Deemed to be University, it is a bona-fide record of the work done by **Mr. Makesh (223005030), Mr. Ragul (223005039)** during the seventh semester of the academic year 2022-23, in the **School of Electrical & Electronics Engineering**, under my supervision. This thesis has not formed the basis for the award of any degree, diploma, associateship, fellowship or other similar title to any candidate of any University.

Signature of Project Supervisor :

Name with Affiliation : Mr. B. Ponmudi, AP-III, EEE, SASTRA, SRC

Date :

Mini Project *Viva-voce* held on _____

Examiner 1 **Examiner 2**

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Declaration

We declare that the thesis titled "**Smart Power Saving System**" submitted by me/us is an original work done by us under the guidance of **Mr. B. Ponmudi, AP-III, Dep. of EEE, SASTRA, SRC, Department of Electrical and Electronics Engineering, SASTRA Deemed to be University** during the seventh semester of the academic year 2022-23, in the **School of Electrical and Electronics Engineering**. The work is original and wherever We have used materials from other sources, we have given due credit and cited them in the text of the thesis. This project has not formed the basis for the award of any degree, diploma, associate-ship, fellowship or other similar title to any candidate of any University.

Signature of the candidate(s) **:**

Name of the candidate(s) **: MAKESH B (223005030)**
: RAGUL R (223005039)

Date **:**

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We also convey our deep sense of gratitude and profound thanks to all Teaching and non- Teaching staff of our department who have directly and indirectly helped for the successful completion of the project.

Abstract

Optimal energy management in smart spaces requires efficient and effective contextual sensors and technologies to identify and assess energy consumption. We recommend an efficient and reliable energy management framework with automatic participation in the process. In recent times, ID cards have become part of the dress code. Identity has many features for the convenience of users, thus leading to the creation of smart ID card terminology. This card is revealed in the present patent providing a storage prepaid wallet system Track all payments through the mobile app. The system also offers parental control. Additionally, Smart ID cards provide access control, authorization, and location identification.

The main purpose of this project is to automatically control and monitor the electrical equipment in any room containing number of people. The next target is automatic attendance. Radio Frequency ID cards are appropriate for their identification, show their real-time data, this work focuses on ensure that this information is available to all with information security and authority protection. By Using IOT based system and cloud technology we can access the data from anywhere and anytime, which will provide us the better proficiency and flexibility.

Specific Contribution

- Makesh B – Data collection, Implementing and Testing the Hardware connection.
- Ragul R – Installing and Importing required MATLAB packages, developing application, and testing the result.

Technical Limitations & Ethical Challenges faced:

- Pairing the ESP8266 with the RFID tag using code is a difficult challenge.
- Finding and importing specific packages of several MATLAB libraries is also one of the difficult challenges.

Signature of the Guide Student Reg. No :

Name : Name :

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CHAPTER 1

INTRODUCTION

1.1 BASIC INTRODUCTION :

In recent days, we have seen a sudden increase in the usage of Radio Frequency Identification(RFID) systems in the fields of industrial technologies, health, agriculture, transportation, etc. Also, Internet of Things is blooming parallelly. Therefore, using these, an attempt has been made to save the electrical energy and monitoring it with the implementation of Internet of Things through ESP8266 and RFID Technology. So everything here in turn gets automated. An attempt has also been made to develop an Android application(app) to monitor the status of the power supply. Here, a smart and effective approach is used to save electricity. This energy saving approach together with a RFID and IOT system helps to control and monitor the electricity use. This optimized automatic power management device can be used in schools and colleges to reduce enormous power usage. Main concept behind Radio Frequency Identification (RFID) based system is to sense the RFID Tag using RFID Module and send the signal to ESP8266 which in turn control the power supply. RFID card has to be shown in front of the RFID reader, then the respective ID is noted down in the ESP8266 memory. This system can also be used to allow access for student in school, college, and companies. Its ability to uniquely identify each person based on their RFID tag type of ID card make the process of allowing security access easier and secure.

1.2 PURPOSE OF THE SYSTEM :

Main purpose of this System is to save power and monitor the power status, Students or workers only need to place their ID card on the RFID reader and they will be sensed and power supply will be given to the respective and then the IOT device helps to monitor the power status and store the respective data, when the person with the RFID tag leaves the room the RFID reader automatically sense the tag and turn off the power supply.

CHAPTER-2

HARDWARE COMPONENTS

2.1 REQUIRED COMPONENTS

- ATmega328 Microcontroller
- ESP8266 Wi-Fi Module
- RFID Reader
- RFID Tag
- 5V Relay
- LCD Display
- LED Bulb

2.2 ATMEGA328 MICROCONTROLLER

The microcontroller used in the basic Arduino boards, such as the Arduino UNO, Arduino Pro Mini, and Arduino Nano is called Atmega328. An Advanced Virtual RISC (AVR) microcontroller is the ATmega328. It supports the processing of 8-bit data. The ATmega-328 features inbuilt flash memory of 32 KB. 1 KB Electrically Erasable Programmable Read-Only Memory is available in the ATmega328 (EEPROM).

Figure (1): ATmega328 Microcontroller

SPECIFICATIONS AND FEATURES :

High Performance, Low Power 8-Bit Microcontroller Family :

- Advanced RISC Architecture
- Most Single Clock Cycle Execution
- 32 x 8 General Purpose Working Registers
- Fully Static Operation
- Up to 20 MIPS Throughput at 20MHz
- On-chip 2-cycle Multiplier.

High Endurance Non-volatile Memory Segments :

- 32KBytes of In-System Self-Programmable Flash program Memory
- 2KBytes Internal SRAM
- Write/Erase Cycles: 10,000 Flash/100,000 EEPROM
- Data Retention: 20 years at 85°C/100 years at 25°C(1)
- Programming Lock for Software Security.

Peripheral Features :

- Two 8-bit Timer/Counters with Separate Prescaler and Compare Mode
- One 16-bit Timer/Counter with Separate Prescaler, Compare Mode, and Capture Mode
- Real Time Counter with Separate Oscillator – Six PWM Channels.

2.3 ESP8266 WIFI MODULE

ESP8266 Systems makes the WIFI SOC (system on a chip) ESP8266. It is a tightly integrated chip meant to deliver complete internet access in a compact form factor. The ESP8266 can be used as an external Wi-Fi module by connecting it to any microcontroller via the serial UART it can directly function as a Wi-Fi enabled micro controller by writing new firmware using the provided SDK.

Figure (2): ESP8266 Module

SPECIFICATIONS AND FEATURES:

- Tensilica 32-bit RISC CPU Xtensa LX106 microcontroller
- operating voltage: 3.3V
- 7–12 volts as input
- 16 Digital I/O Pins, 1 Analog Input Pin (ADC), 1 UART, 1 SPI, and 1 I2C
- 4 MB Flash Memory
- 64 KB SRAM
- Speed of Clock: 80 MHz
- There is an inbuilt USB-TTL based on CP2102 that enables Plug n Play PCB Antenna.

2.4 RFID MODULE

Radio-frequency identification (RFID) refers to technologies that use wireless communication between an object (tag) and an interrogation device (reader) to automatically determine and track the physical location of each object. The transmission range of the tag is limited to a few meters from the reader and a clear line of sight between the tag and the reader is not required .RFID stands for radio frequency identification in its full form.
RFID module contains two parts.
They are:

1. RFID Reader
2. RFID Tag

RFID Reader:

The RFID tags are read using an RFID reader. It will scan the information on the RFID tag. The frequency of operation determines how an RFID reader operates.

Figure (3): RFID Reader

SPECIFICATION AND FEATURES:

- Low frequency: the range of frequency is 125 kHz to 134 kHz. It transmits the signal in short range that is 10cm.
- High frequency: the range is 13.56mhz.its range up to 1meter.
- Low frequency and high frequency RFID tags uses inductive coupling (near field coupling).
- Ultra-high frequency: its range is up to 860-960mhz.the range is in between the 10 to 15 m.
- Ultra-high frequency RFID tags uses electromagnetic coupling (far field coupling).

RFID TAGS:

Figure (4): RFID Tag

- RFID is an IC chip.it has unique electronic code.
- The code is varied from each person it is also called RFID key.
- Here in this system, we are using passive tags as the identity cards of the person.

2.5 5V RELAY

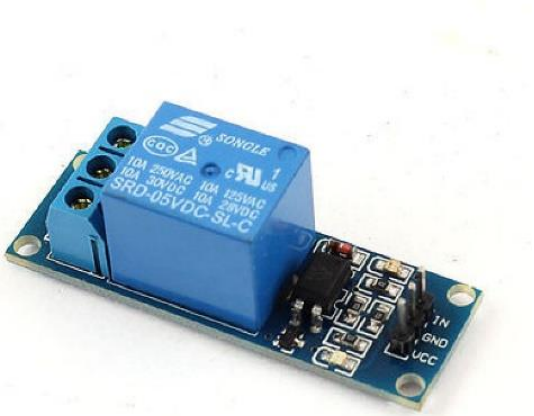


Figure (5): Relay

- Relay is nothing but a mechanical switch.
- It is electromechanically or electronically operated to control the electronic circuits.
- Relay is a switch that opens or closes the circuit in electromechanical circuits and it can be constructed with electrical, mechanical, and magnetic components.
- Relays are used in computer circuits to perform arithmetic and logic operations, automatic stabilizers.
- In this system we are managing the power for the LED bulb, so in order to control it relays is used.

There are so many types of relays such as induction type relay, solid state relay, hybrid relay, thermal relay, reed relay, etc.

2.6 LCD DISPLAY

LCD the name itself indicates that it is used to display the different strings. LCD is having two modes.

They are

1. Command mode
2. String mode.

In this system we are using RG1602A LCD

Figure (6): LCD Display

SPECIFICATION AND FEATURES:

- In this we are using LCD of 16*2 which means it has 16 columns and 2 rows.
- The maximum display of characters in the LCD is 16.
- The power supply is given at VSS pin and grounding the VDD, VEE is used change contrast of the display.
- RS is data select line, RW pin is used to read or write the data operation.

2.7 LED BULB

A light source that uses light-emitting diodes to produce light is known as an LED lamp or light bulb. When compared to equivalent incandescent lamps, LED lamps are significantly more energy-efficient. They can also be significantly more efficient than the majority of fluorescent lamps.

Figure (7): LED Bulb

SPECIFICATION AND FEATURES:

- Large Visible LED
- Power factor - 0.5
- Voltage - 220-240 V
- Wattage - 9 W
- Ultrabright Output
- RoHS Compliant

CHAPTER – 3

SOFTWARE TOOL

3.1 ARDUINO IDE SOFTWARE

Arduino Integrated Development Environment, or Arduino IDE for short, is an official software that was developed by arduino.cc and is mostly used for editing, compiling, and uploading code for Arduino devices. This software works with nearly all Arduino modules. The Arduino board comes equipped with a USB plug for connecting to your computer and a number of connection sockets for connecting to external components like motors, LEDs, and other devices. The microcontroller on the Arduino board can be programmed to do anything by simply following a set of instructions.

Features of Arduino IDE

• The project file or the sketches for a project are saved with the file extension .ino

• Features such as cut / copy / paste are supported in this IDE.

• There also is a facility for finding a particular word and replacing it with another by pressing the Ctrl + F buttons on the keyboard

There are two main parts in the programming section,

They are:

• void setup ()

This is the first routine that begins when the Arduino starts functioning. This function is executed only once throughout the entire program functioning. The setup function contains the initialization of every pin we intend use in our project for input or output

• void loop ()

This function is the next important function in the section. It consists of that part of the code that needs to be continuously executed unlike the part of the code written in the setup function.

Developing new ideas with Arduino is endless, we can use it to build new devices of our own to create and implement innovative things. Though it does have its own limitations, it is a great tool that can be used in learning.

3.2 MIT App Inventor

MIT App Inventor is a web-based tool for building Android apps. This is often referred to as visual programming, which means the user is able to perform programming tasks without entering any computer code. App Inventor is actively managed and developed by MIT's Mobile Learning Lab (the project was originally built by Google).

MIT App Inventor uses drag-and-drop style code building blocks, similar to those used by the Scratch coding language. This makes it easy to pick up from a young age and also helps take the otherwise potentially overwhelming complexity out of getting started.

Steps to use MIT app inventor:

Step 1: Open a Gmail account in case you don't have one.

Step 2: Open the link https://appinventor.mit.edu/ and log in to your Gmail account.

Step 3: You need to install the App Inventor Companion App (MIT AI2 Companion) on our mobile device that helps in live testing of our application.

Step 4: We need to connect both mobile devices & laptops/desktop should be connected to the same Wi-Fi network.

Step 5: To start the app-building click on "Start New Project".

Step 6: To connect your mobile device, choose "Connect" and "AI Companion" from the top menu.

Step 7: Now to connect the MIT AI2 App on your device and desktop/laptop scan the QR code or type the 6-digit code which is appearing on your PC screen.

Step 8: Now you can see the app you are building on your device.

Benefits of MIT app inventor:

- Everything is done through a select and drop manner. This means we can select a particular chunk of code and drop in our code. Hence, no typing.
- Easy to test your app. We can check the app developed on desktop or laptop with the app inventor application on our mobile phones.
- MIT provides the user with some basic lessons which help in building that apps and that helps in a proper understanding of how the MIT app inventor platform works for the user.
- Useful for novices.

Interface

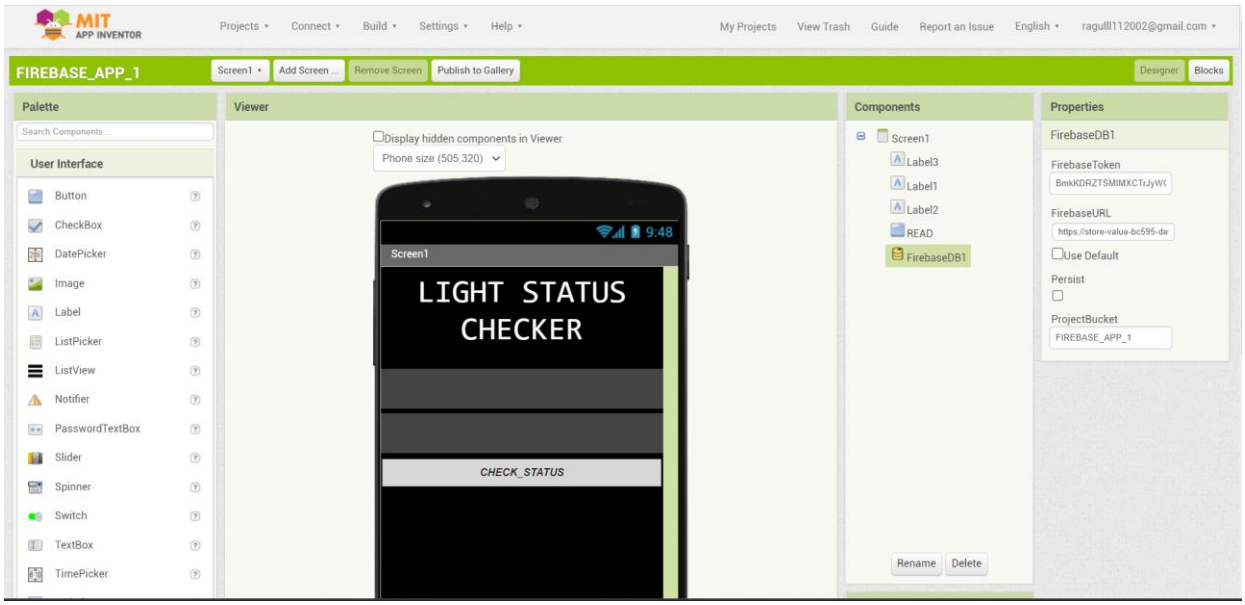


Figure (8): Home page of MIT Inventor

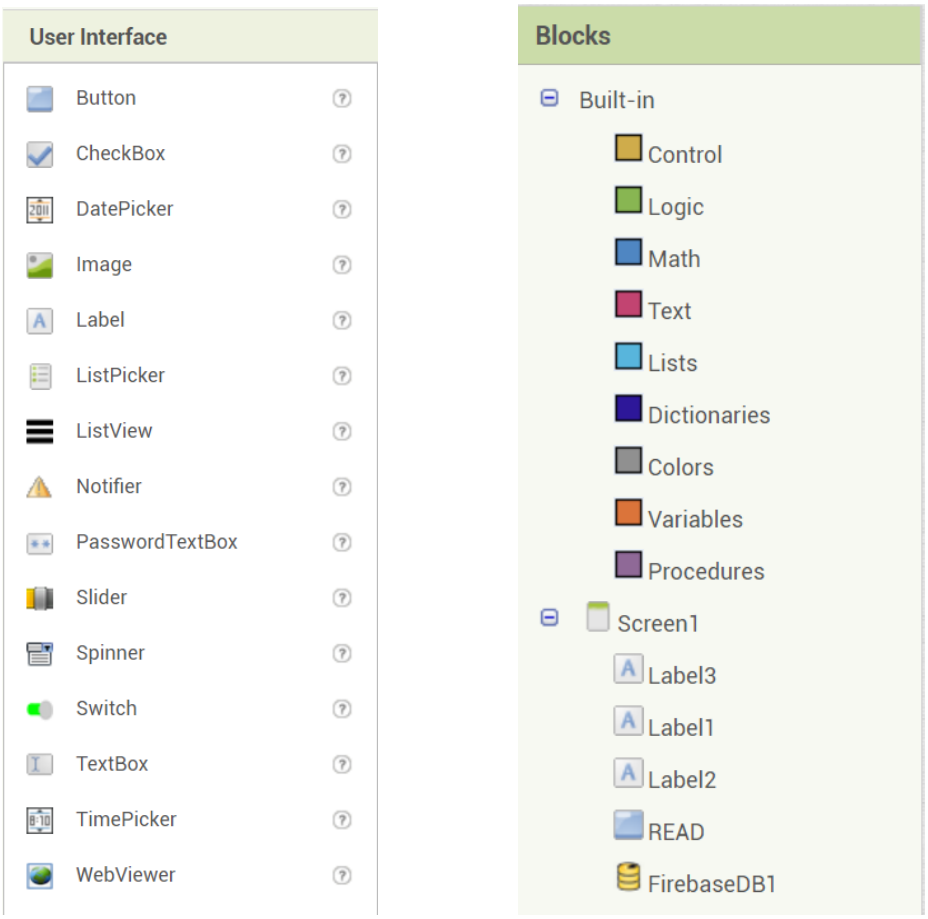


Figure (9): Tools available in MIT Inventor

CHAPTER – 4

4.1 BLOCK DIAGRAM

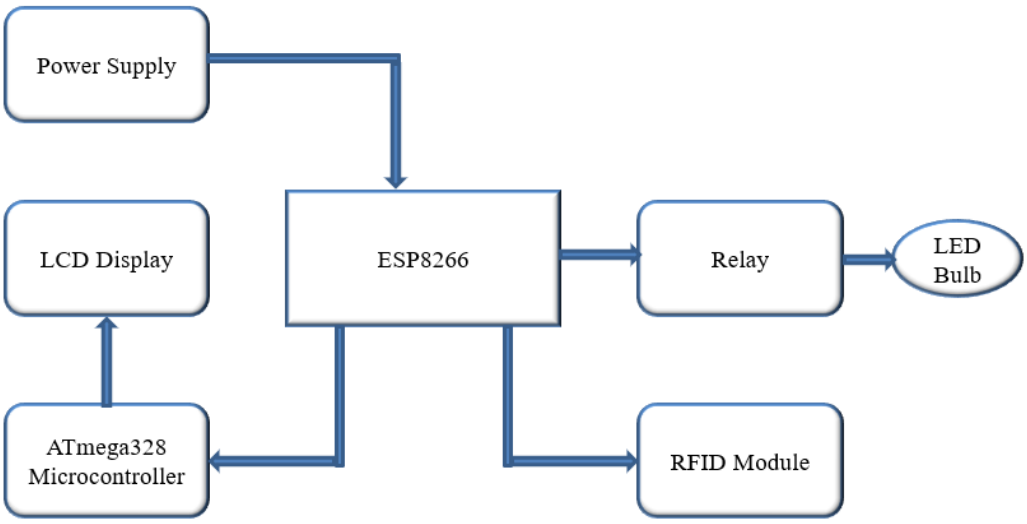


Figure (10): Block Diagram of Smart Power Saving System

The power supply is mandatory to run the electronic component, The ESP8266 WI-FI module and ATmega328 Microcontroller is programmed using Arduino IDE software. When RFID tag is sensed by the RFID Reader, the relay will turn on automatically and the power supply will be given to the load (we used LED Bulb in this project). IF the RFID Reader senses same tag again, it will turn off the relay and the electronic device connected with the relay will be turned off automatically. The status of the electronic device whether it is in on state or off state is displayed on the mobile application, which the data is from the IOT server using ESP8266 WI-FI Module.

4.2 CIRCUIT DIAGRAM

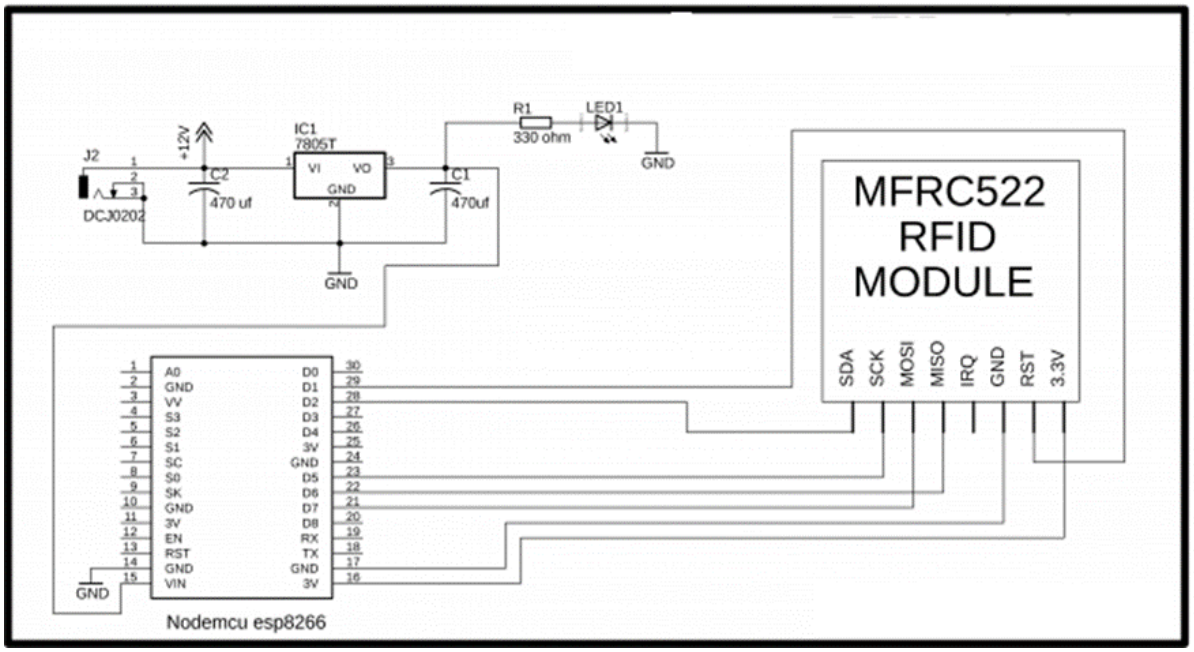


Figure (11): Circuit Diagram of Smart Power Saving System

The MFRC522 RFID module uses the SPI protocol to communicate with the ESP8266.

The SPI communication uses specific boxes on this type of microcontroller.

The pinout is as follows (left side ESP8266, right side MFRC522):

- 3V <-> 3.3V depending on the module version
- D1 <-> RST (Reset)
- GND <-> GND (Ground)
- D6 <-> MISO (Master Input Slave Output)
- D7 <-> MOSI (Master Output Slave Input)
- D5 <-> SCK (Serial Clock)
- D2 <-> SS/SDA (Slave select)

CHAPTER-5

IMPLEMENTATION

5.1 IMPLEMENTATION OF CODING:

```
#include <ESP8266WiFi.h>
#include <FirebaseArduino.h>
#include <ArduinoJson.h>
#include <SPI.h>
#include <MFRC522.h>
#define SS_PIN D2
#define RST_PIN D1
#define FIREBASE_HOST "store-value-bc595-default-rtdb.firebaseio.com"
#define FIREBASE_AUTH "BmkKDRZTSMIMXCTrJyWGXGxDJ6HYfCycrHcVR1SD"
#define WIFI_SSID "Ragul"
#define WIFI_PASSWORD "123456"
MFRC522 rfid(SS_PIN, RST_PIN);
MFRC522::MIFARE_Key key;
int count = 0;
String tag;
String myString1;
String myString2;
void setup() {
Serial.begin(9600);
SPI.begin(); // Init SPI bus
rfid.PCD_Init(); // Init MFRC522
pinMode(D0, OUTPUT);
pinMode(10, OUTPUT);
pinMode(D8, INPUT);
digitalWrite(10, LOW);
WiFi.begin(WIFI_SSID, WIFI_PASSWORD);
while (WiFi.status() != WL_CONNECTED) {
digitalWrite(D0, HIGH);
delay(500);
digitalWrite(D0, LOW);
delay(500);
} Firebase.begin(FIREBASE_HOST, FIREBASE_AUTH);
delay(1000);
myString1 = "0";
Firebase.setString("FIREBASE_APP_1/DATA", myString1);
delay(1000); }
void loop() {
if ( ! rfid.PICC_IsNewCardPresent()) {
return; }
if (rfid.PICC_ReadCardSerial()) {
for (byte i = 0; i < 4; i++) {
tag += rfid.uid.uidByte[i]; }
Serial.println(tag);
if (tag == "19721516067") {
count++;
if (count == 3) {
count = 0;
Serial.println("c"); }}
tag = "";
rfid.PICC_HaltA();
rfid.PCD_StopCrypto1(); }
if (count == 1) {
myString1 = "1";
Firebase.setString("FIREBASE_APP_1/DATA", myString1);
Serial.println("a");
digitalWrite(10, HIGH);
digitalWrite(D0, HIGH);
delay(100);
digitalWrite(D0, LOW);
delay(100);
digitalWrite(D0, HIGH);
delay(100);
digitalWrite(D0, LOW);
delay(100);
digitalWrite(D0, HIGH);
delay(100);
digitalWrite(D0, LOW);
delay(100); }
if (count == 2) {
myString1 = "0";
Serial.println("b");
Firebase.setString("FIREBASE_APP_1/DATA", myString1);
digitalWrite(10, LOW);
digitalWrite(D0, HIGH);
delay(100);
digitalWrite(D0, LOW);
delay(100);
digitalWrite(D0, HIGH);
delay(100);
digitalWrite(D0, LOW);
delay(100);
digitalWrite(D0, HIGH);
delay(100);
digitalWrite(D0, LOW);
delay(100); }
}
```

Figure (12): Arduino IDE Program

5.2 INTERFACE

Figure (13): Interface of Arduino IDE

In the left top part, there are five buttons:

Verify. Allows you to compile your sketch and check if there are any errors.

Upload. When you press this button, it first compiles, even if you pressed the “Verify” button before. Then, if there are no errors, the binary file is uploaded to the board, which is connected to the specified port.

New. Creates a new sketch.

Open. To open one of the previously created sketches or an example sketch.

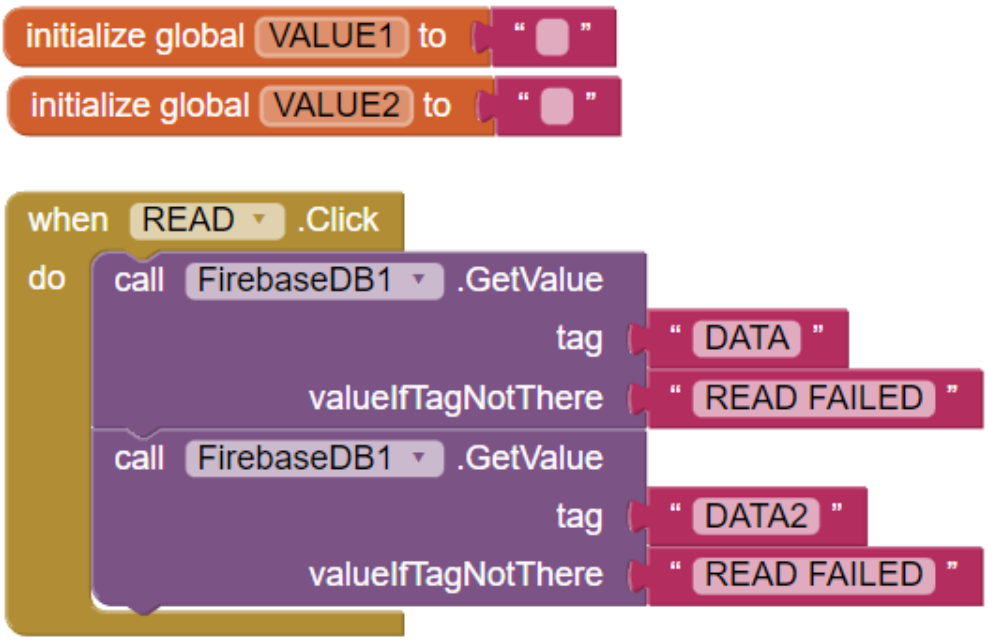
Save. This button saves the current sketch.

In the right top part, there is only one button:

Serial Monitor. Opens a window with which you can communicate with your board using the serial UART interface.

5.3 Functional Block of the Firebase Application

Blocks are the pieces you connect together to tell your app what to do.
They can be found in the Blocks Editor**.**



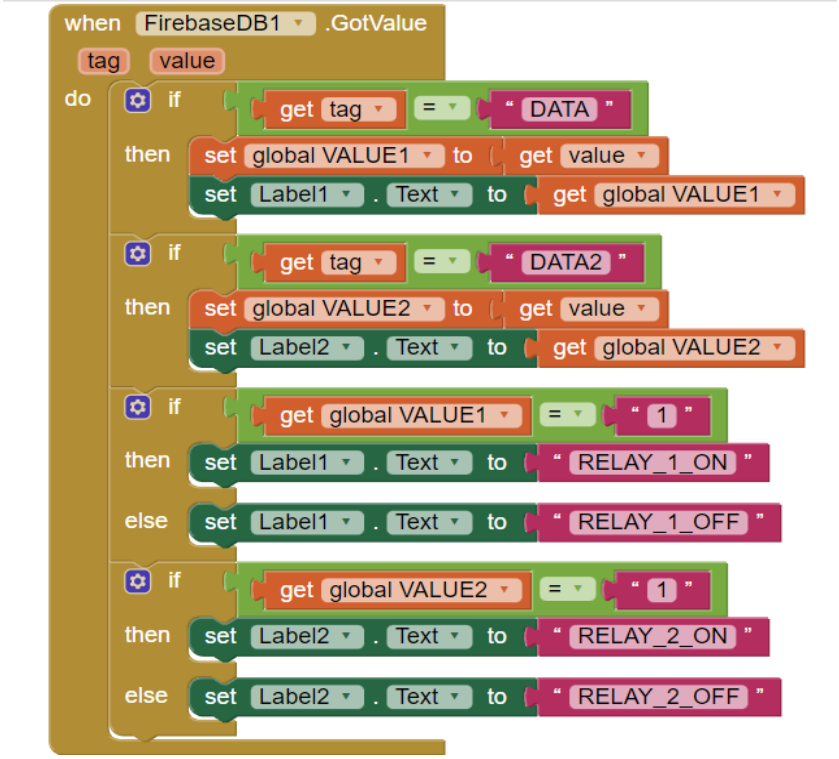


Figure (14): Code Blocks

5.3 CONNECTION PROCEDURE

Step 1

ESP8266 is interfaced with RFID reader by connecting all pins accordingly (This step is just a test process)

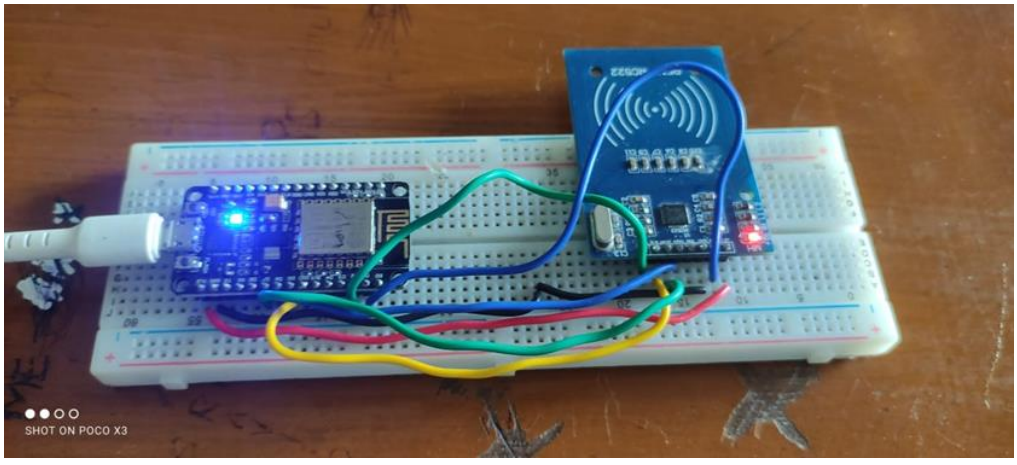


Figure (15): Testing the connection in Breadboard

Step 2

ATmega328 Microprocessor from Arduino, LCD Display, Power Supply and 5V Relay Module are placed and soldered on the PCB Board.

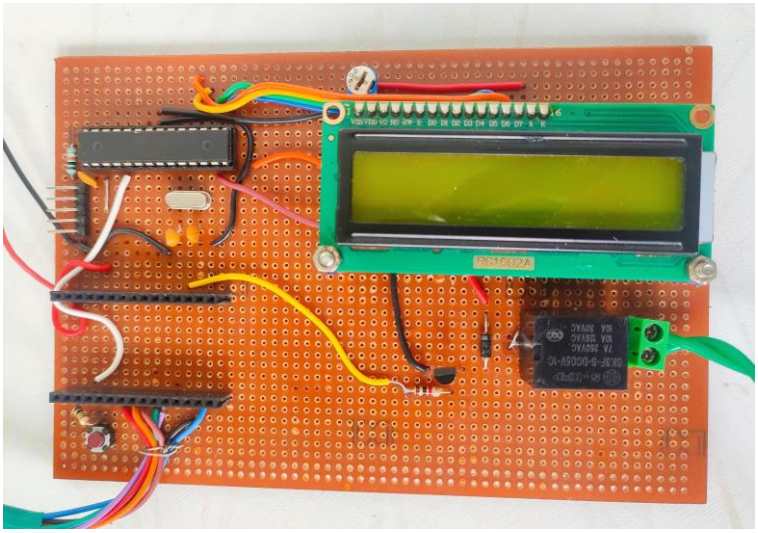


Figure (16): PCB Connection

Step 3

ESP8266 is also placed on the board, it's act as the main processor for this system by controlling the RFID Module and ATmega328. LED bulb is connected with Relay module, This process is shown below.

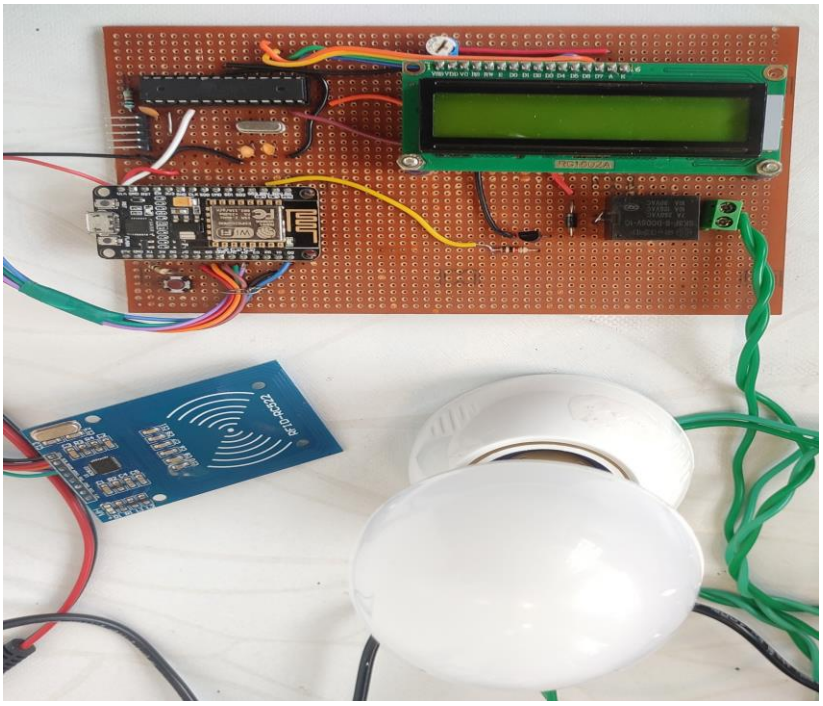


Figure (17): Smart Power Saving System

CHAPTER 6

HARDWARE IMPLEMENTATION

6.1 OUTPUT

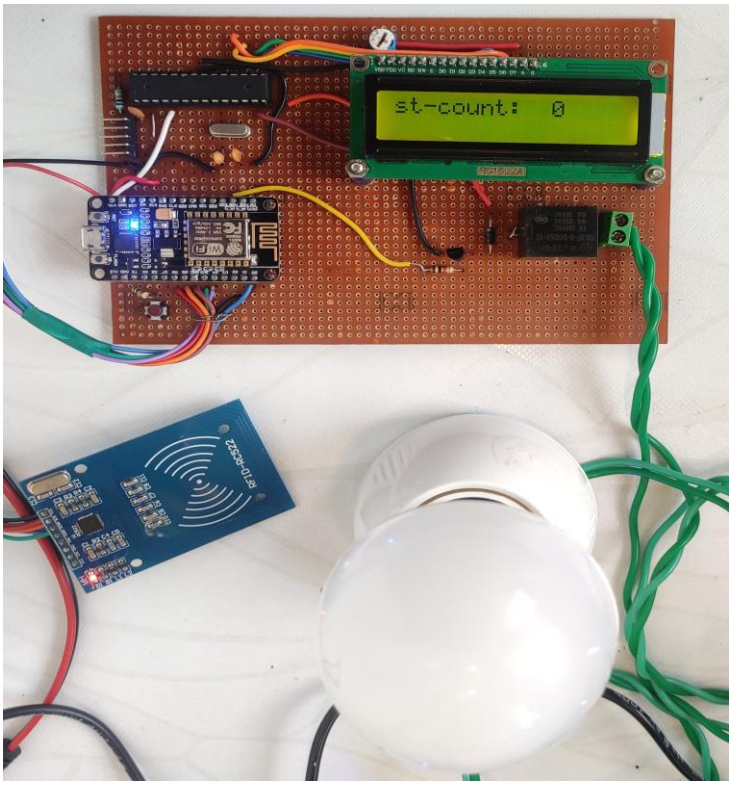


Figure (18): Smart Power Saving System during First Stage

When applying power supply to the system, the LCD Display will show count as 0 and the LED bulb will be in OFF state because Relay is in off state, just like as shown in "*Figure(17)".*

But when RFID tag is sensed by RFID reader, The relay will turn on and LED Bulb will be in ON state, and the LCD Display will show the count, just like as shown in "*Figure(18)*".

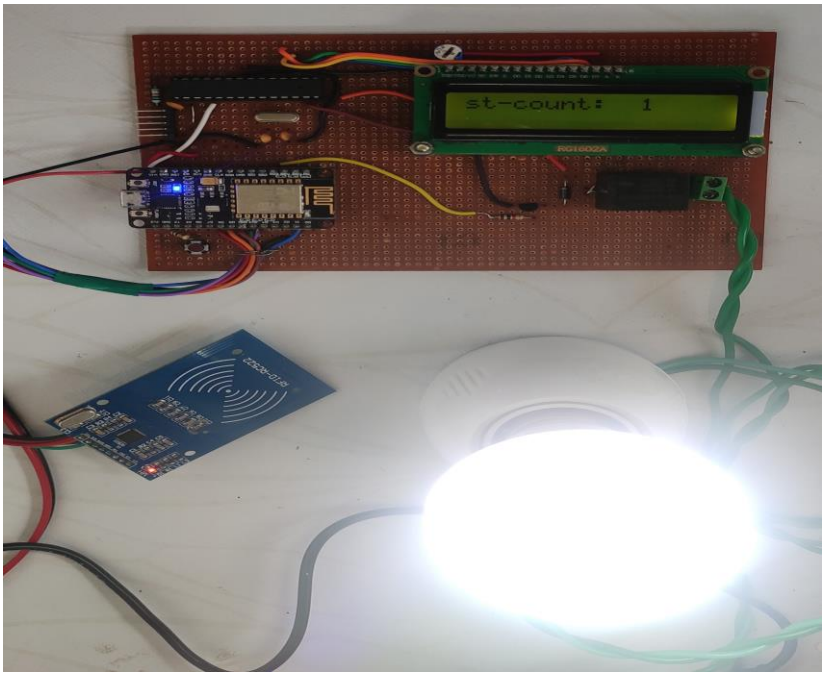


Figure (19): Smart Power Saving System during Second Stage

The "**st-count**" shown in "*Figure (19)*" is the count of the people who entered the room with Smart Card, which is sensed by RFID reader, the ATmega328 collects the data of count from ESP8266 and gives the command to LCD Display.

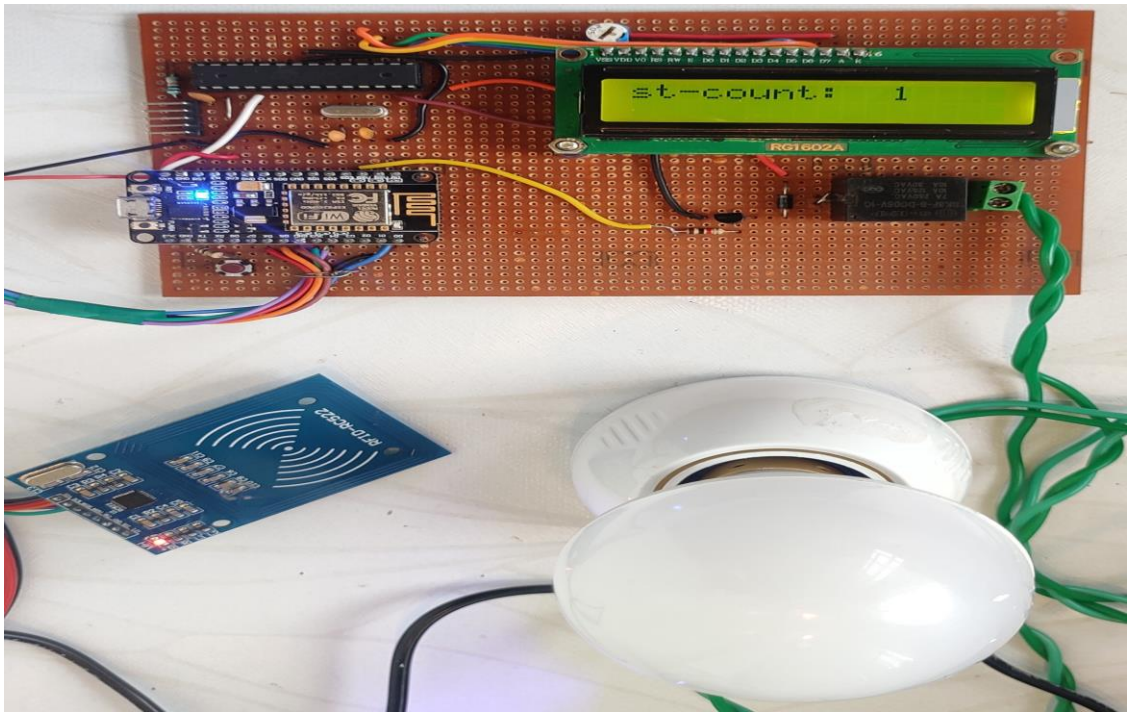


Figure (20): Smart Power Saving System during Third Stage

We also developed a mobile application to view the status of the Power supply to the LED Bulb, which will show "**RELAY_1_OFF**" when the LED Bulb is in OFF State, just like shown in "*Figure 20*"

Figure (21): Application during OFF state

Figure (22): Application during ON state

The application will show "**RELAY_1_ON**" when the LED bulb is in ON state just like shown in *figure 21*, we can view the status of the power supply from anywhere with this application.

CHAPTER-7

Conclusion

With the advancement of technology, a smart and useful approach for evaluating our environment is now available in order to decrease energy consumption in institutions and to management as well as the environment in terms of reducing electricity. The most efficient method that can be used in schools and college to reduce the enormous power consumption is by using smart power saving system. We can also create a better IOT system for Energy Management that is interfaced with Arduino Microcontrollers to control the usage of appliances such as light intensity rather than simply turning on and off and monitoring and limiting the usage of power supply to the specific load. Major advantages of the present disclosure is that it provides smart card (RFID TAG) that has multiple features that enables access control, authorization, and location identification. Although it can be helpful in many places, institution, industries, and companies can get more benefit from this smart power saving system project.

Signature of the Guide

Name :

Student Reg. No :

Name :

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