University of Moratuwa

Department of Electronic and Telecommunication Engineering

ENGINEERING DESIGN PROJECT

SMART MULTIPLUG

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This is the final report of the project fulfilment of the module EN1190

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Abstract

Smart Bluetooth multiplug controls electrical devices around someone, providing them the ease of the use of such devices. Our product takes the aid of an app which is controlled by a mobile phone according to the user. The circuit consists of an ATmega328p and a PCB containing several components. Crystal oscillator, capacitors, resistors 3-way relay module are included in the circuit. In the enclosure there are three sockets with an AC wire which is used to plug the multiplug into the home power supply. Also, there is an ADC in the PCB board which is used to power up the microcontroller. Mobile app used to get the inputs of user has an interface with clear indications. In the multiplug there three unique LEDs used as unique identifiers so the user can identify the devices connected to the multiplug and working easily and separately. The enclosure of the product was designed using SolidWorks software and the PCB design was done by Altium software.

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1. Introduction

Our project of smart Bluetooth multiplug allows users to control electrical devices by just a fingertip. They can switch on and off any device with this using Bluetooth technology. This would be a great relief to differently abled people and busy people who work in office. Main components we are using here are as below.

- ATmega328p microcontroller
- Analog to Digital Converter
- Bluetooth Module
- 3-way 3 channel relay module

There are unique identifiers implemented as three unique LEDs to identify which devices are connected and which one is not connected. This can be simply used by plugging into the home power supply and the mobile which is using to switch on and off the desired devices can easily be downloaded into the phone.

2. Problem Description

2.1. Problem

With the advancement of technology, most people who works in office or university students have to spend a lot of time in front of their computers or engage in other activities from their seats. Not only that Disabled people with difficult to walk are in a same place most of the day. It is very difficult to constantly go near the plug point to turn on or off electrical devices in that situation without calling someone.

2.2. Project Idea Validation

We conducted a survey among randomly selected people and based on that results it's proven that this problem has been on many people's minds. So, It had better to have a clear solution to this particular problem.

3. Solution

To solve this problem, we decided to transform manual controlling electrical equipment into smart controlling equipment through controlling the power supply remotely. Also, we can monitor the certain appliances whether it is switched ON or OFF through a software(app) when the user is near by 10- 15 m. So, our solution is introducing a smart controlling multiplug with 3 sockets. It is based on Bluetooth technology.

4. Justifications

Bluetooth technology is very familiar and versatile technology among most of the people since every smart phone has been integrated this technology. It's easy to use. No need any prerequisite knowledge or device to use this technology. Although we are able use much advanced technology having relatively higher controlling range Wi-Fi to develop our product, we identified an issue of it. Most probably user may have connected to a Wi-Fi network from his mobile phone and when he/she wants to control the power supply of the equipment, he/she will have to disconnect from that network and connect to the multiplug. So, we can suppress that issue by using Bluetooth technology. We selected to include 3 sockets to our multiplug. According to the survey results which we had done, 3 electric devices are usually being used at the same time. And it will cause to reduce the project budget as well. Although there are existing products as such already in the market which can be used to solve the problem those prices are not affordable. Majority expect to spend around Rs.2000 for such product at a bulk rate.

5. Technical Feasibility

In our design of Bluetooth multiplug essential requirements and availability of them can be listed as below.

Item	Quantity
AtMega328p Microcontroller	1
22pf Capacitor	2
16 MHz Crystal Oscillator	1
MD0688 – 5VDC 3-way 3-channel Relay Module	1
Bluetooth Module	1
AC 240V to DC 5V Convertor	1
10kOhm Resistor	1
LED Red	1
Terminal Block	1
330Ohm Resistor	3
Male Headers	12
Switches	4
Normal LEDs	3

According to the above table it's obvious that almost everything is available and affordable I the local market currently. Other than the availability of components as a well based product we have to check in order to see if this is working properly and if the required performances are reachable. In that case it can be described as below. This product is designed to reach several main goals. Among them the main goal is to ease the handling of several electronic devices at the same time just by a fingertip on the phone. So, on the way to reach that goal we use an app that can handle Bluetooth technology. Therefore, by that app we can simply handle every device which is connected to the multiplug. There we reach the second main goal of our product, which is to help the disabled people to use electronic devices without moving an inch. So, these two goals are the ones we can easily accomplish. Any user who uses our product have the ability to control many electronic devices and carry out multiple tasks easily at the same time rather than pasted onto a one task for a long time. At that point we have achieved the third goal we hope to achieve by our product. This Bluetooth multiplug can be powered by plugging into the home electricity system. No worries on giving power to this application. Other than the group of disabled people we target our product can be used vastly by the daily office workers who works in a single office room. They have to work with several electronic devices simultaneously at the same time. For an example an officer has to work with the printer, computer at the same time. With a product like ours he can simply connect them both into a one multiplug and easily control both of them by his/her mobile

phone. By that support of the Bluetooth technology, he/she can do another work without waiting till one work ends. Our product of Bluetooth multiplug have three main goals to accomplish as mentioned above. 1. Controlling several electronic devices at the same time simultaneously. 2. Help the disabled people to control such devices without moving an inch. 3. Provide the ease of working for a person who has to work with several devices at the same moment. As mentioned above our product- Bluetooth multiplug has the ability to perform well in order to fulfill these goals. Also, its components are reachable in the local market.

6. Product Life Cycle

After fully manufactured in the industrial field and when it is done with the testing stuff, it would be released to the market at an affordable price. Then after the buying and affording and the trade is done, it will be given to the user directly with a literal manual guidance, which would be helpful with using this product. From the time at which a user begins to use it, it will provide a continuous service for the user for a long enough time. We approximate that our Bluetooth multiplug will work properly for 4/5 years without being damaged at a minimum cause of occurrence of a malfunctional error in the system. After the usage, when the multiplug exceeds its lifetime, the user can simply put it into a recycling process. Since this is made of plastic and many more materials which are not decaying naturally, it has to be recyclable, otherwise it will be considered as an e-waste pollution and will not be healthy for the environment. Therefore, we deeply emphasize that after the usage this product has to be put into a recycling process.

7. Product Architecture

In smart multi plug the phase wire is connected through three relay modules in each socket which is controlled by the microcontroller Atmega328p IC. If user need to switch ON/OFF a particular device, user can use the software to access the control through an android mobile phone. After connecting the mobile phone and Smart multiplug though Bluetooth. Microcontroller will receive the command form user through Bluetooth signal then it will activate or deactivate relay module. Also, user can see whether the devices are turned ON of OFF in an office with multiple devices. In the software platform initially, we need to install and assign the keys. For particular multi plug. There are two keys per socket out of three sockets in the smart multiplug. Assigning simple ASCII codes ‘1’, ‘2’, ‘3’, ‘4’, ‘5’, ‘6’ for remote control.

1, 2 - Switching ON, OFF 1st socket

3, 4 - Switching ON, OFF 2nd socket

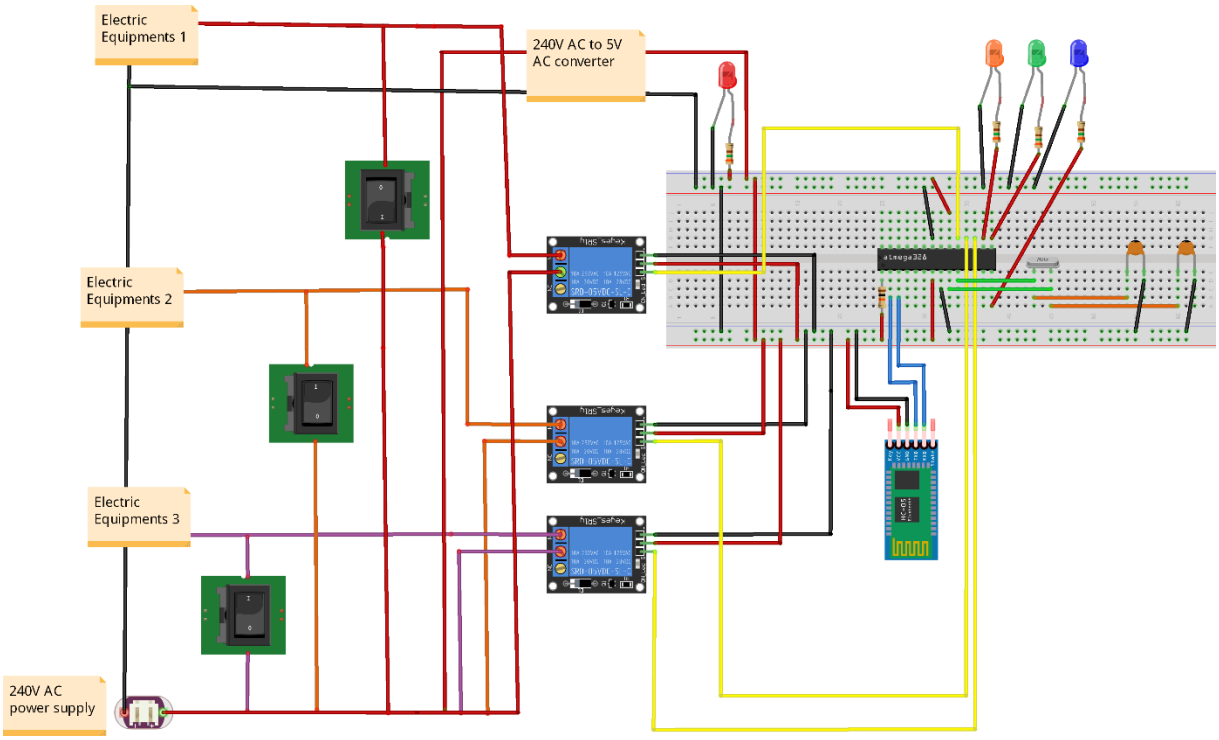
5, 6 - Switching ON, OFF 3rd socket

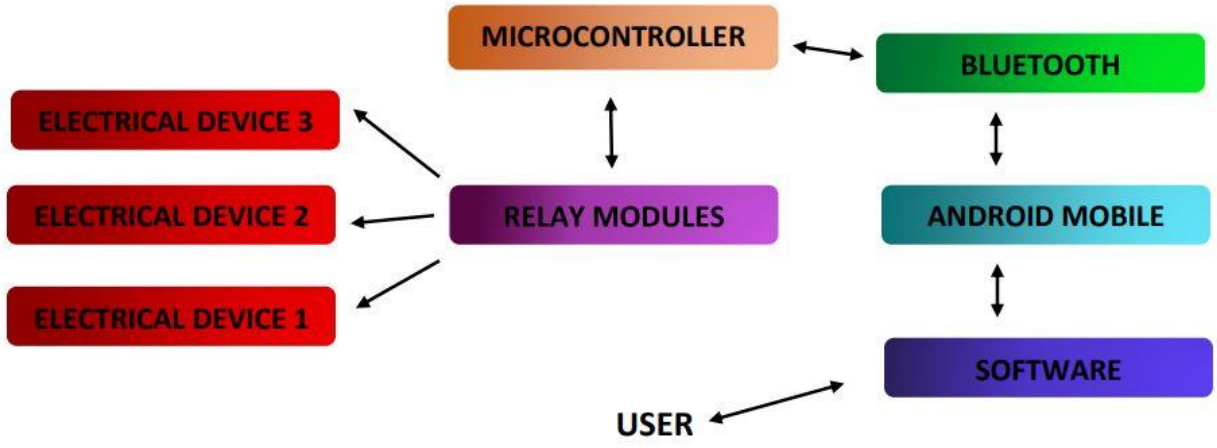
8. Specifications

- ✓ Rated Voltage : 100V- 250V AC (50Hz)
- ✓ Rated Current : 5A
- ✓ Color : Grey
- ✓ Size : length 20cm , width 7.6cm
- ✓ Weight : Up to 250g
- ✓ Wire Length : 3.5m
- ✓ Material : ABS Plastic
- ✓ Triple Socket with Bluetooth Switch (For dual purpose)
- ✓ 1 Year Warranty
- ✓ Indoor use

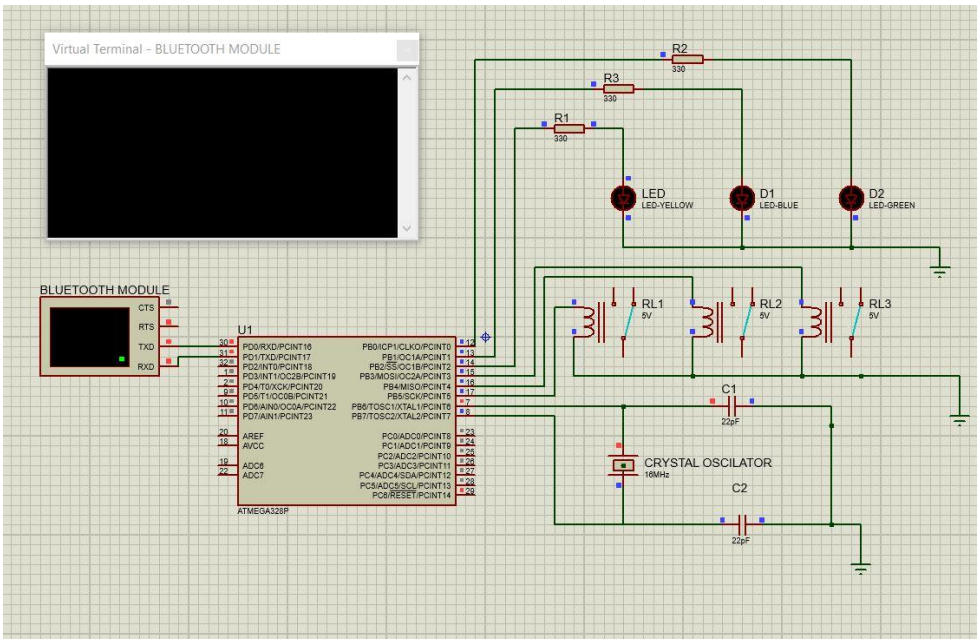
9. Method

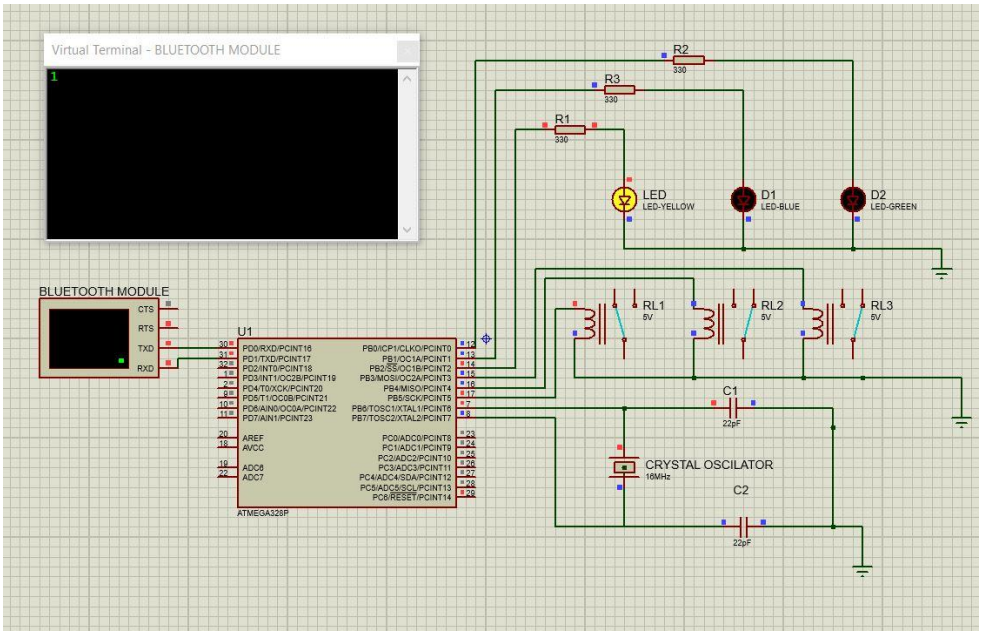
9.1. Circuit Block Diagram

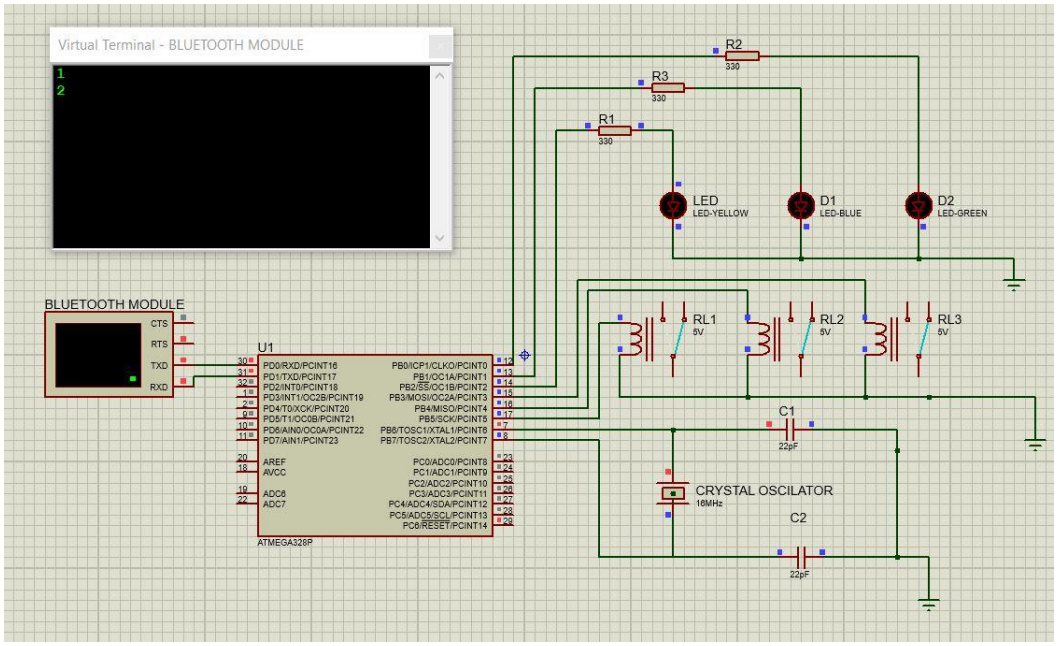


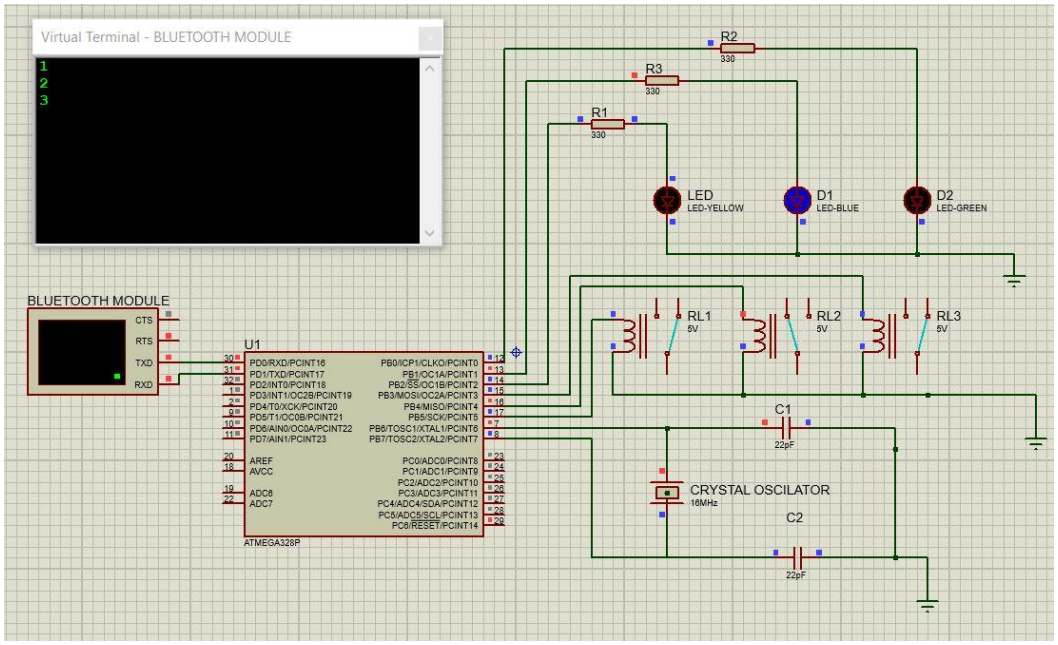


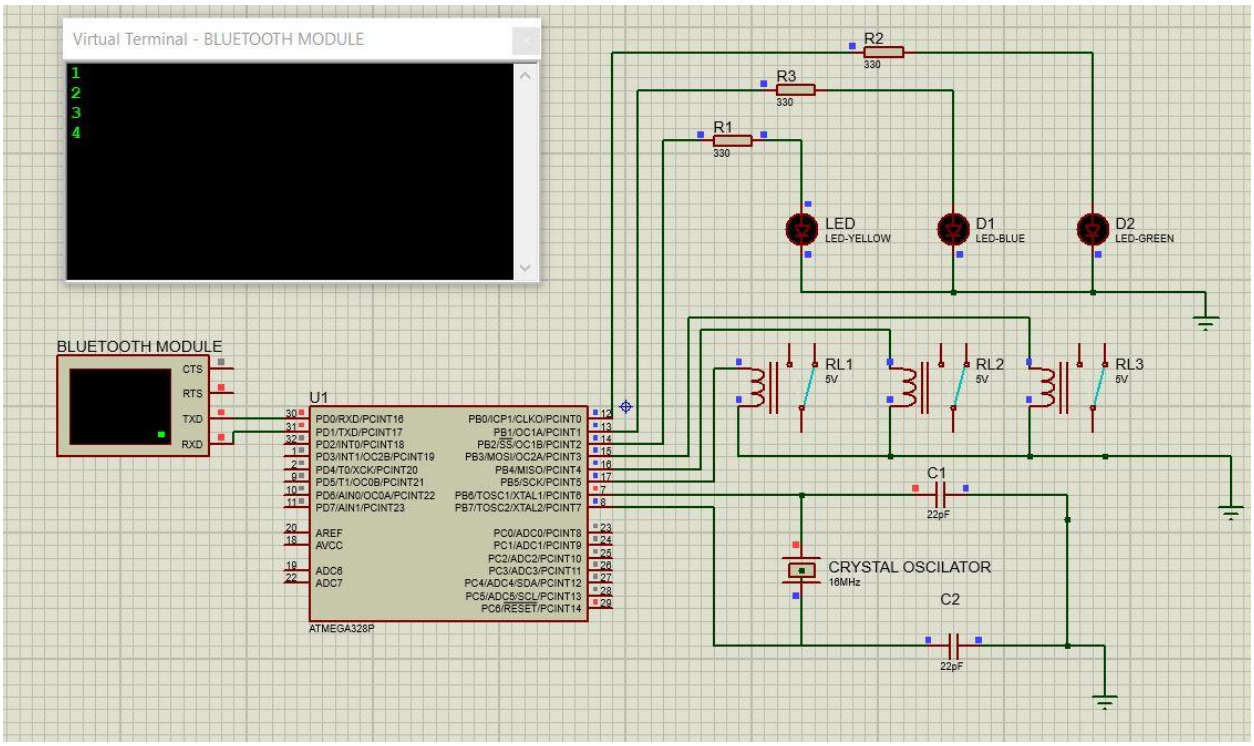
9.2. Proteus Circuit Simulation

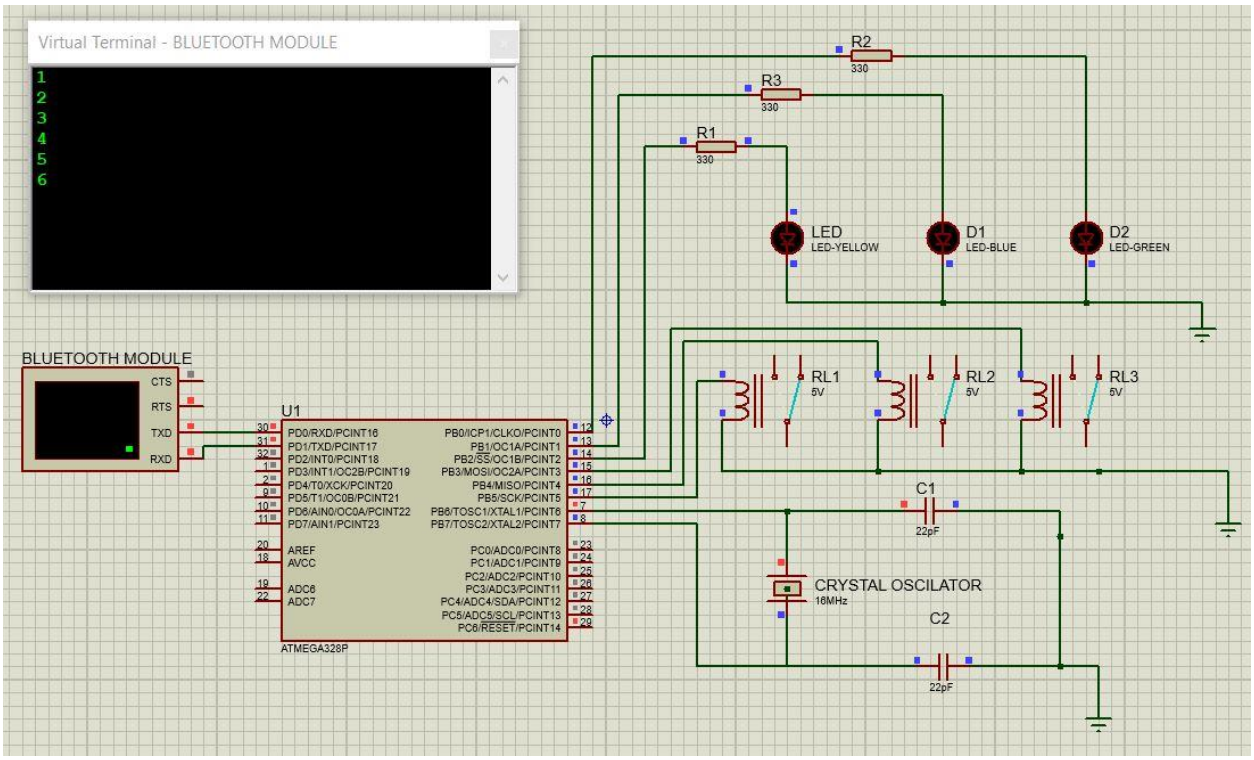


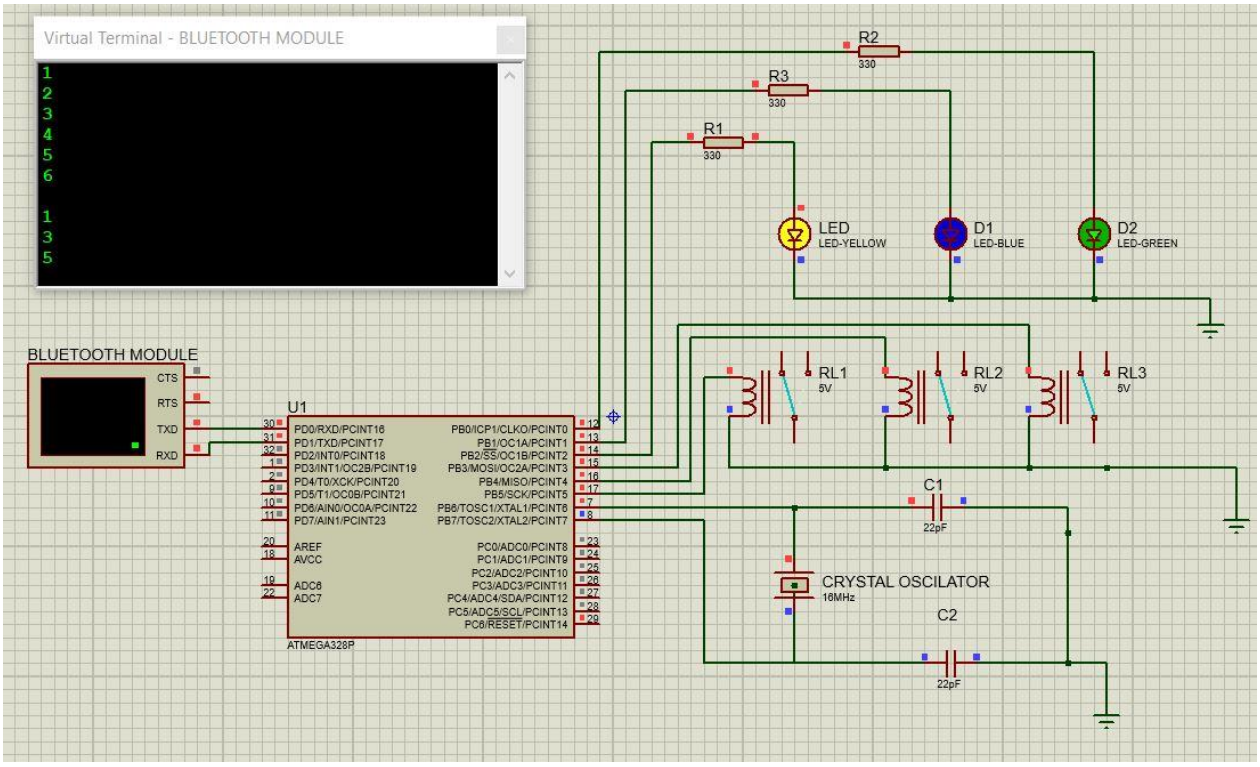


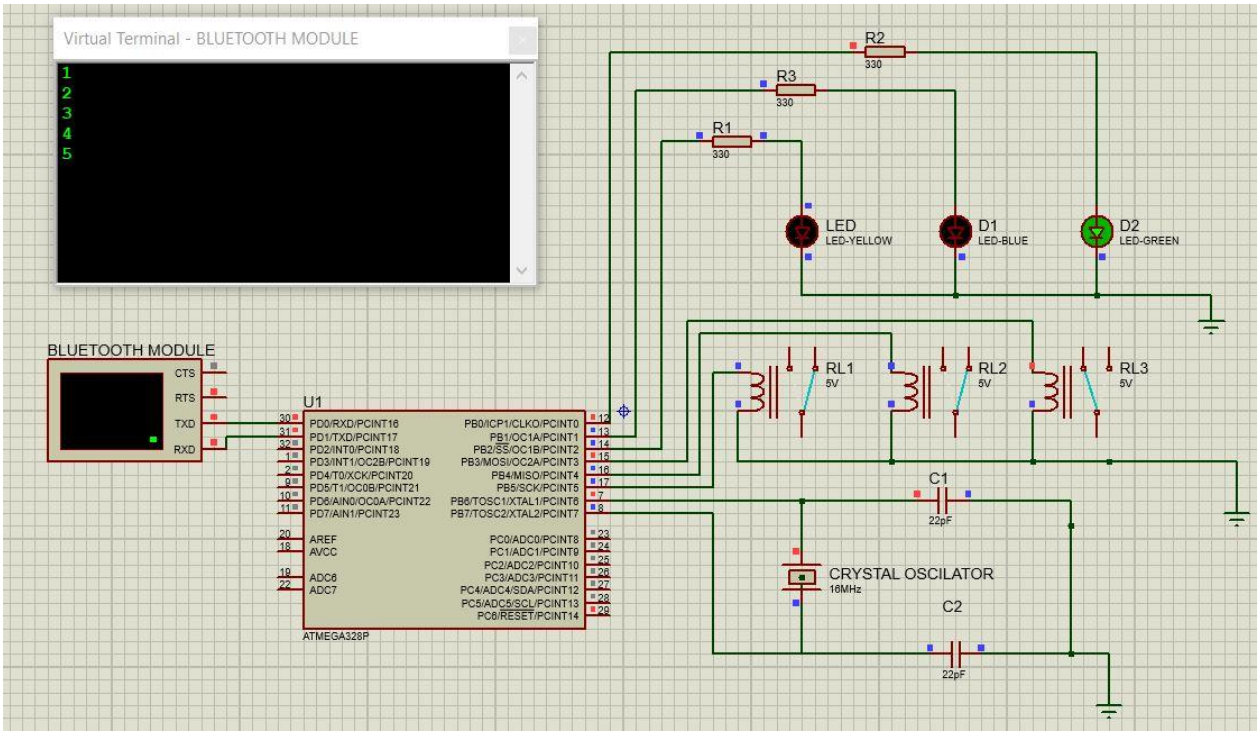

Virtual Terminal - BLUETOOTH MODULE
1
2
R2
330
R3
330
R1
330
LED
LED-YELLOW
D1
LED-BLUE
D2
LED-GREEN
BLUETOOTH MODULE
CTS
RTS
TXD
RXD
U1
RL1
5V
RL2
5V
RL3
5V
C1
22pF
CRYSTAL OSCILLATOR
16MHz
C2
22pF
ATMEGA328P


Virtual Terminal - BLUETOOTH MODULE
1
2
3
R2
330
R3
330
R1
330
LED
LED-YELLOW
D1
LED-BLUE
D2
LED-GREEN
BLUETOOTH MODULE
CTS
RTS
TXD
RXD
U1
RL1
5V
RL2
5V
RL3
5V
C1
22pF
CRYSTAL OSCILLATOR
16MHz
C2
22pF
ATMEGA328P

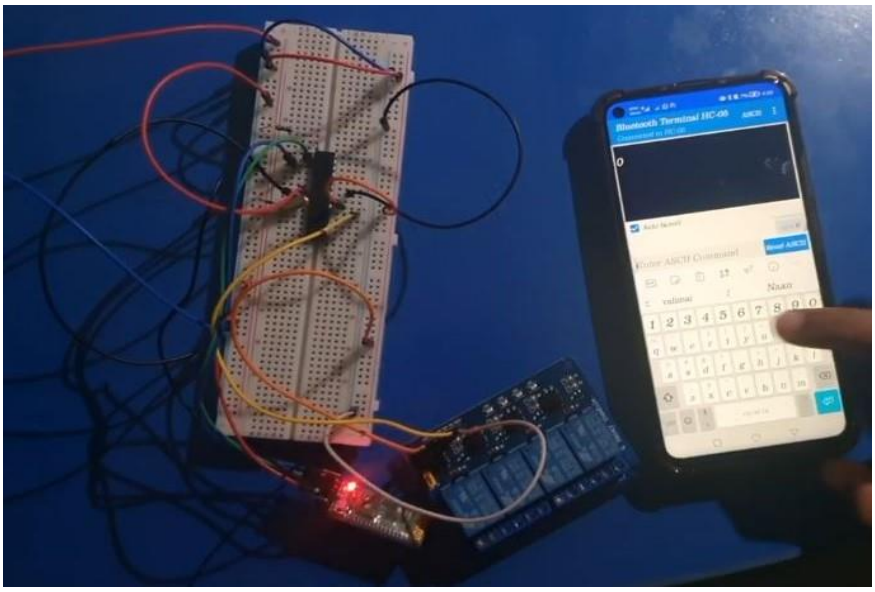

Virtual Terminal - BLUETOOTH MODULE
1
2
3
4
R2
330
R3
330
R1
330
LED
LED-YELLOW
D1
LED-BLUE
D2
LED-GREEN
BLUETOOTH MODULE
CTS
RTS
TXD
RXD
U1
RL1
5V
RL2
5V
RL3
5V
C1
22pF
CRYSTAL OSCILATOR
16MHz
C2
22pF
ATMEGA328P

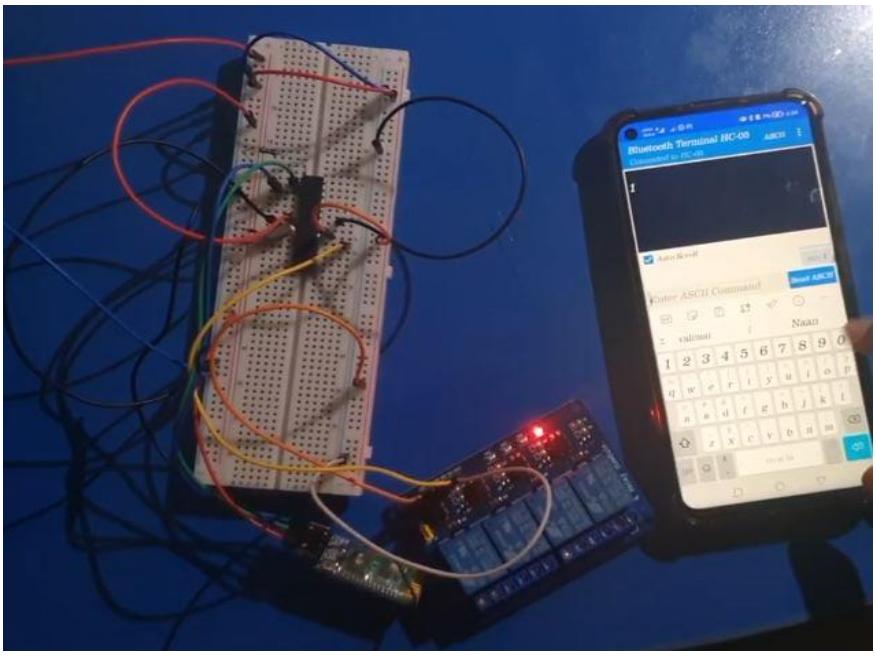

Virtual Terminal - BLUETOOTH MODULE
1
2
3
4
5
6
R2
330
R3
330
R1
330
LED
LED-YELLOW
D1
LED-BLUE
D2
LED-GREEN
BLUETOOTH MODULE
CTS
RTS
TXD
RXD
U1
RL1
5V
RL2
5V
RL3
5V
C1
22pF
CRYSTAL OSCILATOR
16MHz
C2
22pF
ATMEGA328P


Virtual Terminal - BLUETOOTH MODULE
1
2
3
4
5
6
1
3
5
R2
330
R3
330
R1
330
LED
LED-YELLOW
D1
LED-BLUE
D2
LED-GREEN
BLUETOOTH MODULE
CTS
RTS
TXD
RXD
U1
PD0/RXD/PCINT16
PD1/TXD/PCINT17
PD2/INT0/PCINT18
PD3/INT1/OC2B/PCINT19
PD4/T0/XCK/PCINT20
PD5/T1/OC0B/PCINT21
PD6/AIN0/OC0A/PCINT22
PD7/AIN1/PCINT23
AREF
AVCC
ADC6
ADC7
PB0/ICP1/CLKO/PCINT0
PB1/OC1A/PCINT1
PB2/SS/OC1B/PCINT2
PB3/MOSI/OC2A/PCINT3
PB4/MISO/PCINT4
PB5/SCK/PCINT5
PB6/TOSC1/XTAL1/PCINT6
PB7/TOSC2/XTAL2/PCINT7
PC0/ADC0/PCINT8
PC1/ADC1/PCINT9
PC2/ADC2/PCINT10
PC3/ADC3/PCINT11
PC4/ADC4/SDA/PCINT12
PC5/ADC5/SCL/PCINT13
PC6/RESET/PCINT14
ATMEGA328P
RL1
5V
RL2
5V
RL3
5V
C1
22pF
CRYSTAL OSCILATOR
16MHz
C2
22pF


Virtual Terminal - BLUETOOTH MODULE
1
2
3
4
5
R2
330
R3
330
R1
330
LED
LED-YELLOW
D1
LED-BLUE
D2
LED-GREEN
BLUETOOTH MODULE
CTS
RTS
TXD
RXD
U1
PD0/RXD/PCINT16
PD1/TXD/PCINT17
PD2/INT0/PCINT18
PD3/INT1/OC2B/PCINT19
PD4/T0/XCK/PCINT20
PD5/T1/OC0B/PCINT21
PD6/AIN0/OC0A/PCINT22
PD7/AIN1/PCINT23
AREF
AVCC
ADC6
ADC7
PB0/ICP1/CLKO/PCINT0
PB1/OC1A/PCINT1
PB2/SS/OC1B/PCINT2
PB3/MOSI/OC2A/PCINT3
PB4/MISO/PCINT4
PB5/SCK/PCINT5
PB6/TOSC1/XTAL1/PCINT6
PB7/TOSC2/XTAL2/PCINT7
PC0/ADC0/PCINT8
PC1/ADC1/PCINT9
PC2/ADC2/PCINT10
PC3/ADC3/PCINT11
PC4/ADC4/SDA/PCINT12
PC5/ADC5/SCL/PCINT13
PC6/RESET/PCINT14
ATMEGA328P
RL1
5V
RL2
5V
RL3
5V
C1
22pF
CRYSTAL OSCILATOR
16MHz
C2
22pF

9.3. Prototype Simulation





9.4. List of Components

Components	Quantity
AtMega328p IC	1
22pf Capacitor	2
16 MHz Crystal Oscillator	1
MD0688 – 5VDC 3-way 3-channel Relay Module	1
Bluetooth Module	1
LED Red	1
AC 240V to DC 5V Convertor	1
10kOhm Resistor	1
Terminal Block	1
330Ohm Resistor	3
Male Headers	12
Switches	4
Normal LEDs	3

9.5. Component Description

9.5.1. ATmega328p Micro Controller

This particular IC was suggested to use in our product due to its special properties and functionalities and the ease of use. Although the main ground reasons for the use of this IC can be listed as follows.

I. Low Power Consumption
II. Sufficient number of pins for the application
III. Support for 16MHz Crystal Oscillator

Figures below shows the outlook of the ATmega328p micro controller and how its pin configuration is established.

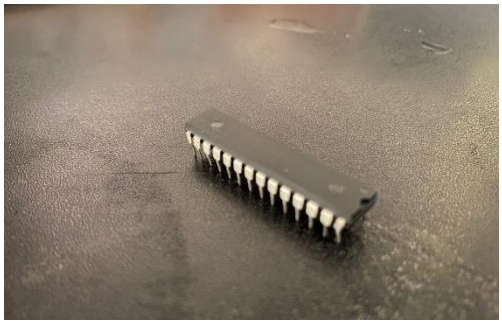
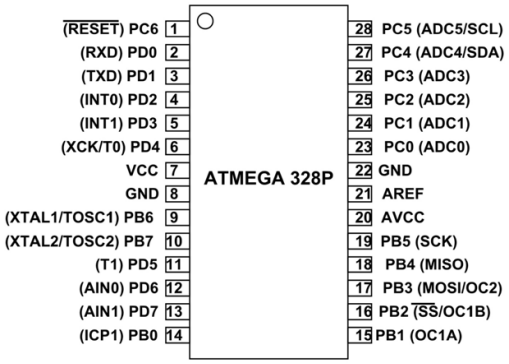


Figure 1 - ATmega328p Outlook



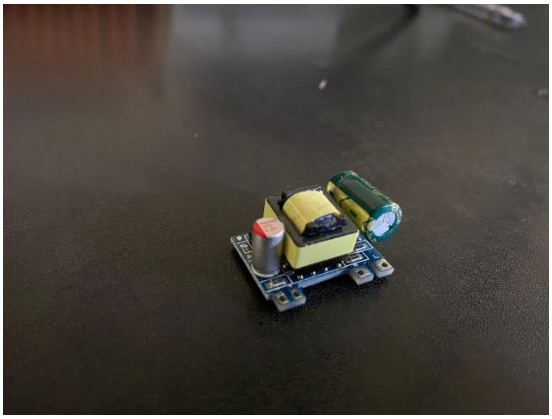
9.5.2. MD0688 – 5VDC 3-way 3-channel Relay Module

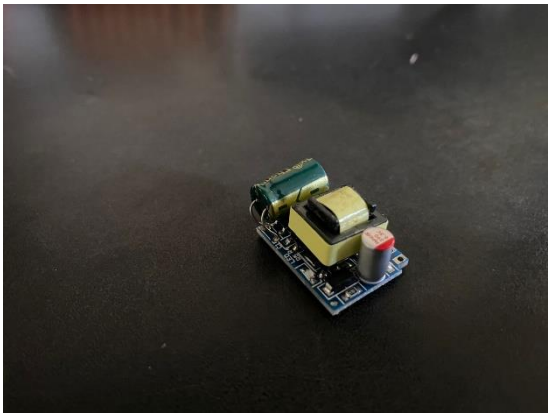
This module is specially used to close or open a particular circuit path. Here in smart multiplug we use it in order to close or open the current path of a particular electrical device according to the desire of the user. As we are developing the first phase of our smart multiplug we use this module and hope to expand the number of modules as we develop this more in future. This module is operated by an electromagnet. The following figure shows an outlook of a MD0688 – 5VDC 3-way 3-channel relay module.

Figure 2 - MD0688 – 5VDC 3-way 3-channel Relay Module

9.5.3. AC 240V to DC 5V Convertor

In the circuit this module is used to convert the 240V home power supply to 5V supply. We use this ADC to supply power to the ATmega328p micro controller. It needs power to operate in the active region. But since we are gaining power to the circuit by the home AC power supply, we have to convert it to a suitable amount of voltage at which the microcontroller can operate accurately. Here is the physical appearance of an AC 240V to DC 5V converter.





9.5.4. Bluetooth Module

Here in our product, the main technology we use is Bluetooth technology. In that case we use a Bluetooth module which consists of a circuit mounted on a PCB with an antenna. By mean of this module, we connect the ATmega328p microcontroller via Bluetooth. Therefore, we can activate or deactivate any device using the mobile app. In the figure shown below is the Bluetooth module.

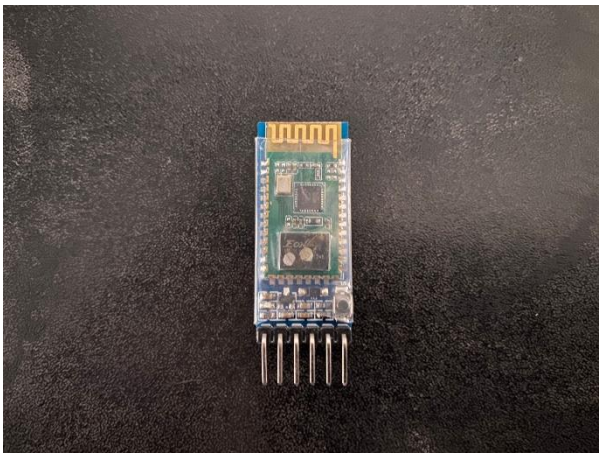


Figure 3 - Bluetooth Module

9.6. PCB Design

PCB design was designed by using the Altium software. In the project document a schematic library document was added in order to create the connections directly according to the Proteus circuit simulation (which is indicated in the circuit simulation – 2.2 Proteus Simulation). Here we used the 2-layer PCB design to compact the PCB board more. Also, the widths of the current paths were designed at a maximum width of 2mm while the preferred and minimum were at 1mm. Hole size was at a 1.2mm diameter. All components were selected with the footprints. In the table shown below are dimensions of the actual PCB board.

Width	50mm
Length	57mm

Also, a 3D view of the PCB board is represented below.

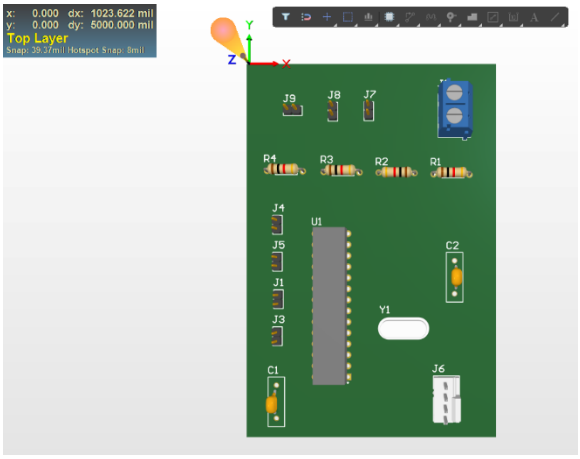


Figure 4 - PCB 3D View 1

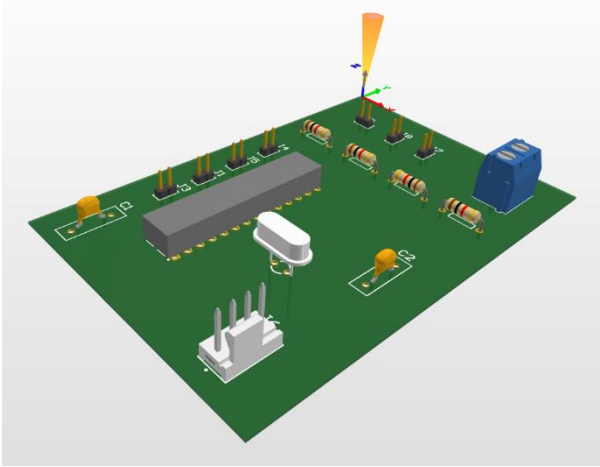


Figure 5 - PCB 3D View 2

9.6.1. Source Codes

```
char Incoming_value = 0;
void setup()
{

Serial.begin(9600);
  pinMode(13, OUTPUT);
  pinMode(12, OUTPUT);
  pinMode(11, OUTPUT);
  pinMode(10, OUTPUT);
  pinMode(9, OUTPUT);
  pinMode(8, OUTPUT);

}

HIGH);
      digitalWrite(9, HIGH);  }
    else if(Incoming_value == '4') {
      digitalWrite(12, LOW);
      digitalWrite(9, LOW);}
    if(Incoming_value == '5')   {
      digitalWrite(11, HIGH);
      digitalWrite(8, HIGH);  }
    else if(Incoming_value == '6')   {
      digitalWrite(11, LOW);
      digitalWrite(8, LOW); }
  }             }
```

```
    void loop()
{
 if(Serial.available() > 0)
 {
  Incoming_value = Serial.read();
  Serial.print(Incoming_value);
  Serial.print("\n");
  if(Incoming_value == '1'){
   digitalWrite(13, HIGH);
   digitalWrite(10, HIGH);  }

  else if(Incoming_value == '2')  {
   digitalWrite(13, LOW);
   digitalWrite(10, LOW);  }
  if(Incoming_value == '3')    {
   digitalWrite(12, HIGH);
   digitalWrite(9, HIGH);  }
  else if(Incoming_value == '4') {
   digitalWrite(12, LOW);
   digitalWrite(9, LOW);}
  if(Incoming_value == '5')   {
   digitalWrite(11, HIGH);
   digitalWrite(8, HIGH);  }
  else if(Incoming_value == '6')   {
   digitalWrite(11, LOW);
   digitalWrite(8, LOW); }
 }             }
```

9.7. ENCLOSURE DESIGN

9.7.1. Initial Sketch

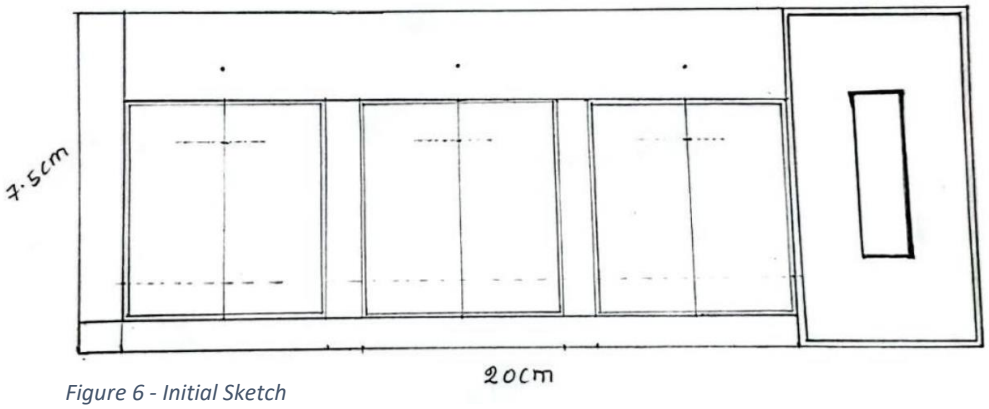


Figure 6 - Initial Sketch

9.7.2. Final Sketch

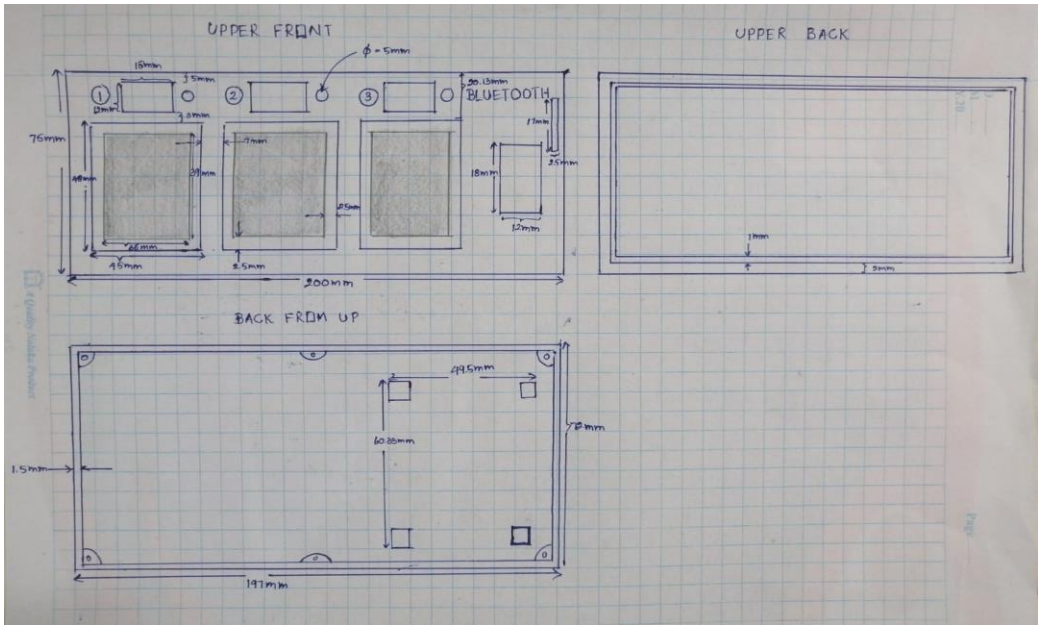


Figure 7 - Final Sketch

9.7.3. Final Design

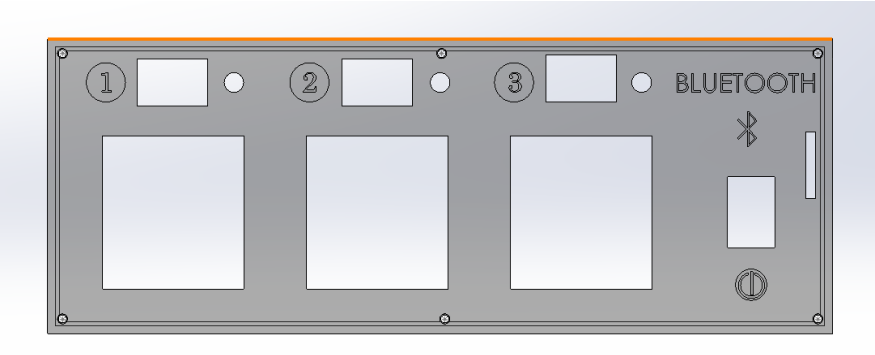


Figure 8 - Final Design Upper Part

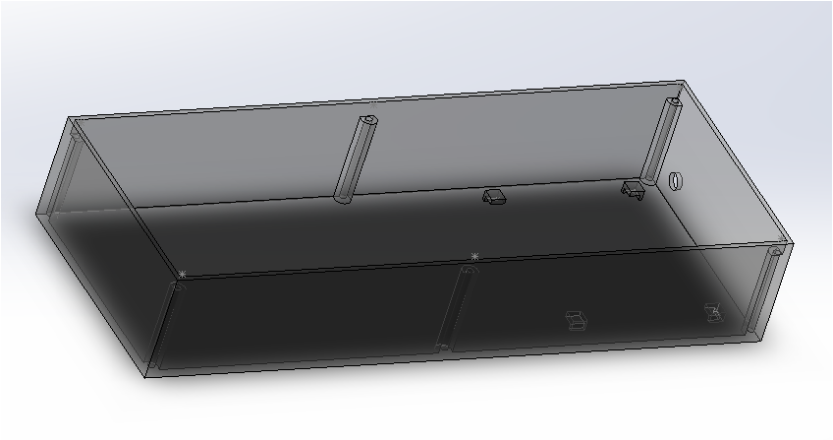


Figure 9 - Final Design Lower Part

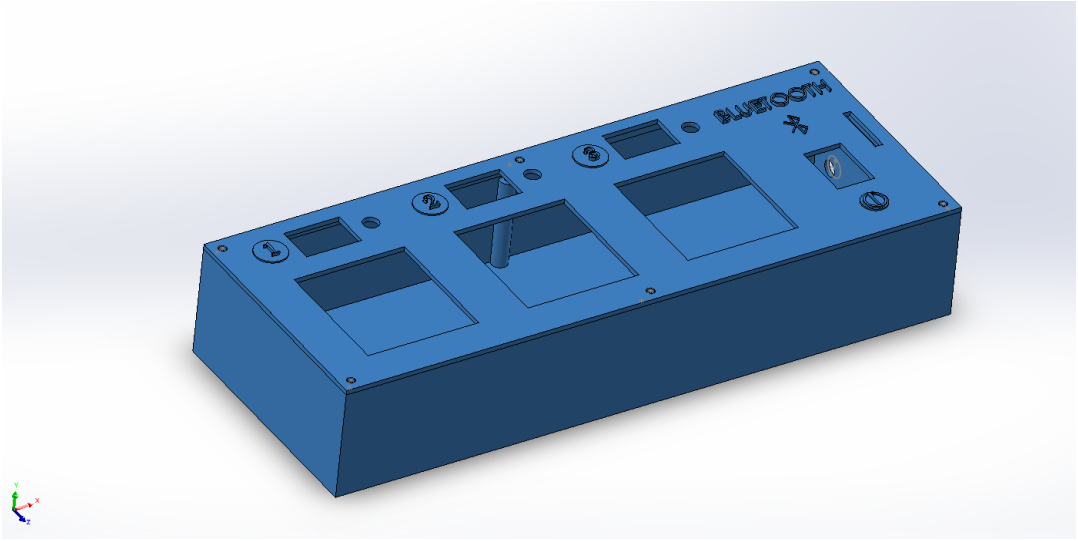


Figure 10 - Final Enclosure

Multiplug enclosure was designed using *Solid Works* software. Plastic have been used as the material. We use 3 separate plug sockets. There are 3 holes in the enclosure to mount that plug sockets. Another small 4 holes were made to mount 4 switches. 3 LEDs and 1,2,3 numbering system have been used to uniquely identify sockets by the user. 4 holders were made in the lower part of the enclosure to place the PCB inside the box.

Figure 11 - Plug Socket

Figure 12 - Switch

10. Results

In the initial stage we checked whether the Bluetooth device and relay module is working properly by connecting it to the microcontroller. Required power supply to the circuit was obtained through the USB port from a laptop. After connecting mobile phone to the Bluetooth device by pressing number 1 using the app relay module switched on and by pressing number 0 it switched off.

In the final stage we connected all the required components and parts of the design as our circuit diagram (Connected AC to DC convertor & AC output plug sockets). After connecting mobile phone following results were seen as the code which we have implemented.

By pressing number,

1=>AC current goes to the socket 1.

2=>Block (switch off) ac current to the socket 1.

3=> AC current goes to the socket 2.

4=> Block (switch off) ac current to the socket 2.

5=> AC current goes to the socket 3.

6=> Block (switch off) ac current to the socket 3.

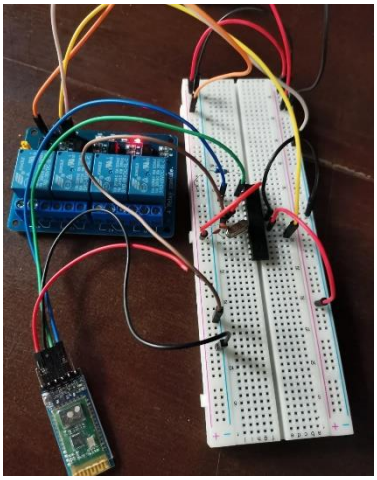


Figure 14 - Initial Prototype

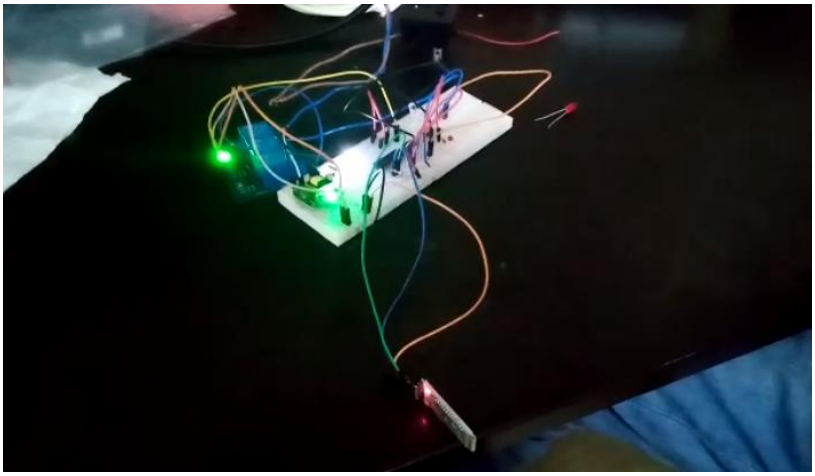


Figure 13 - Final Prototype

11. Discussion

11.1. AC to DC converter did not work properly

Even though it generated small current but multimeter readings indicated that the desired current was not being received by the load. So, we had to replace previous AC to DC converter with a new one. New one worked properly.

11.2. Unavailability of Components

Because of the current chip shortages and import reductions of electronic components we had to find alternative solutions to supply components when developing the prototype. We extracted an ATmega328P from an existing Arduino Uno board. We had to search in several areas in our country for existing stocks of components

11.3. PCB design error

In our first PCB design we have used a surface mount technique to mount components to the PCB. After receiving the printed PCB, we got to know that surface mount technique is not possible to do. So, we had to redesign our PCB to mount components using through hole method.

12. Marketing

12.1. The marketing environment

12.1.1. Competitive forces

The competition in the specialty advertising industry is very strong on a global basis but somewhat weak nationally. Sales figures for the industry as a whole are difficult to obtain since very little business is conducted. Competitive forces can be identified in online global markets such as Ali express, Amazon etc.

12.1.2. Economic forces

Since the major components of this device (micro-controllers and other electronic components) must be imported and with the current situation in the country it could make in impact.

12.1.3. Sociocultural forces

Today, consumers have less time for work or leisure. The hallmarks of today's successful products are convenience and ease of use. In short, if the product does not save time and is not easy to use, consumers will simply ignore it. Software-based product like this fits this consumer need quite well.

12.2. Target markets

Differently able community

• Since they are incapable of handling things easily, it becomes very easy to switch devices through mobile

Children and youth

• Since they are fond of new technologies

Content creators

• Easy to concentrate on their workstations

Officers

12.3. SWOT Analysis

12.3.1. Strengths

- Distance controllability
- Ability to connect several devices simultaneously

12.3.2. Weaknesses

- Limitation of distance
- Need of IT literacy
- lack of initial capital

12.3.3. Opportunities

- Demand increase for local electronic devices
- Available opportunities in recognized online global markets

12.3.4. Threats

- Import restrictions for electronic components
- Market competition

12.4. Product Budget

Components	Quantity	Price (Rs.)
ATmega328p Microcontroller	1	1650.00
Bluetooth Module	1	990.00
16MHz Crystal Oscillator	1	40.00
MD0688 – 5VDC 3-way 3-channel Relay Module	1	450.00
AC 240V to DC 5V Convertor	1	285.00
22pF Capacitor	2	15.00
LED – Red and other LEDs	4	30.00
Enclosure		2000.00
PCB		550.00
Circuit Wires and Other Expenditures		850.00
TOTAL (Single Product)		**6860.00**

13. Appendix

13.1. ATmega328p Datasheet

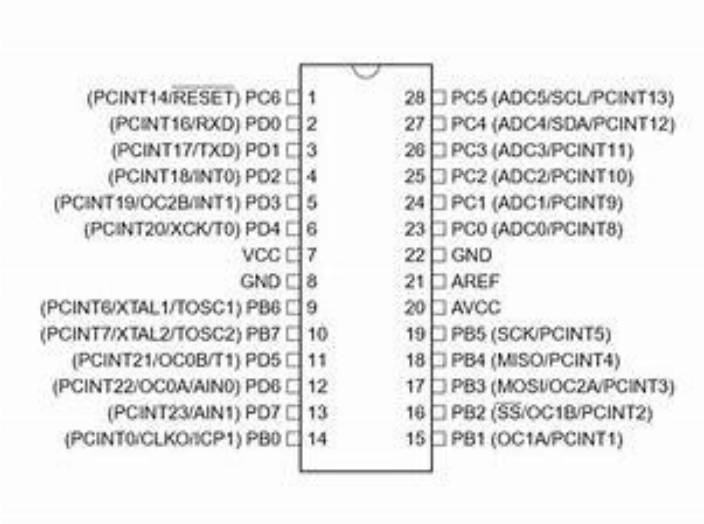
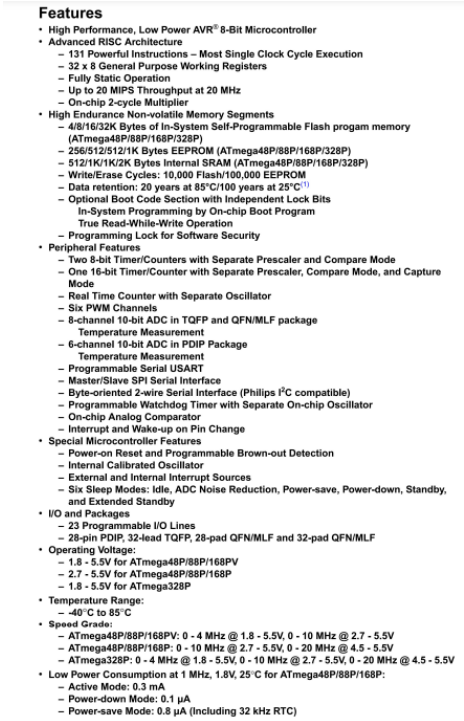


Figure 15 – Atmega328p Datasheet Pin Configuration



Features

- High Performance, Low Power AVR® 8-Bit Microcontroller
- Advanced RISC Architecture
  - 131 Powerful Instructions – Most Single Clock Cycle Execution
  - 32 x 8 General Purpose Working Registers
  - Fully Static Operation
  - Up to 20 MIPS Throughput at 20 MHz
  - On-chip 2-cycle Multiplier
- High Endurance Non-volatile Memory Segments
  - 4/8/16/32K Bytes of In-System Self-Programmable Flash progam memory (ATmega48P/88P/168P/328P)
  - 256/512/512/1K Bytes EEPROM (ATmega48P/88P/168P/328P)
  - 512/1K/1K/2K Bytes Internal SRAM (ATmega48P/88P/168P/328P)
  - Write/Erase Cycles: 10,000 Flash/100,000 EEPROM
  - Data retention: 20 years at 85°C/100 years at 25°C(1)
  - Optional Boot Code Section with Independent Lock Bits
    - In-System Programming by On-chip Boot Program
    - True Read-While-Write Operation
  - 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
  - 8-channel 10-bit ADC in TQFP and QFN/MLF package
    - Temperature Measurement
  - 6-channel 10-bit ADC in PDIP Package
    - Temperature Measurement
  - Programmable Serial USART
  - Master/Slave SPI Serial Interface
  - Byte-oriented 2-wire Serial Interface (Philips I²C compatible)
  - Programmable Watchdog Timer with Separate On-chip Oscillator
  - On-chip Analog Comparator
  - Interrupt and Wake-up on Pin Change
- Special Microcontroller Features
  - Power-on Reset and Programmable Brown-out Detection
  - Internal Calibrated Oscillator
  - External and Internal Interrupt Sources
  - Six Sleep Modes: Idle, ADC Noise Reduction, Power-save, Power-down, Standby, and Extended Standby
- I/O and Packages
  - 23 Programmable I/O Lines
  - 28-pin PDIP, 32-lead TQFP, 28-pad QFN/MLF and 32-pad QFN/MLF
- Operating Voltage:
  - 1.8 - 5.5V for ATmega48P/88P/168PV
  - 2.7 - 5.5V for ATmega48P/88P/168P
  - 1.8 - 5.5V for ATmega328P
- Temperature Range:
  - -40°C to 85°C
- Speed Grade:
  - ATmega48P/88P/168PV: 0 - 4 MHz @ 1.8 - 5.5V, 0 - 10 MHz @ 2.7 - 5.5V
  - ATmega48P/88P/168P: 0 - 10 MHz @ 2.7 - 5.5V, 0 - 20 MHz @ 4.5 - 5.5V
  - ATmega328P: 0 - 4 MHz @ 1.8 - 5.5V, 0 - 10 MHz @ 2.7 - 5.5V, 0 - 20 MHz @ 4.5 - 5.5V
- Low Power Consumption at 1 MHz, 1.8V, 25°C for ATmega48P/88P/168P:
  - Active Mode: 0.3 mA
  - Power-down Mode: 0.1 µA
  - Power-save Mode: 0.8 µA (Including 32 kHz RTC)

Figure 16 - ATmega328p Datasheet Features

13.2. PCB

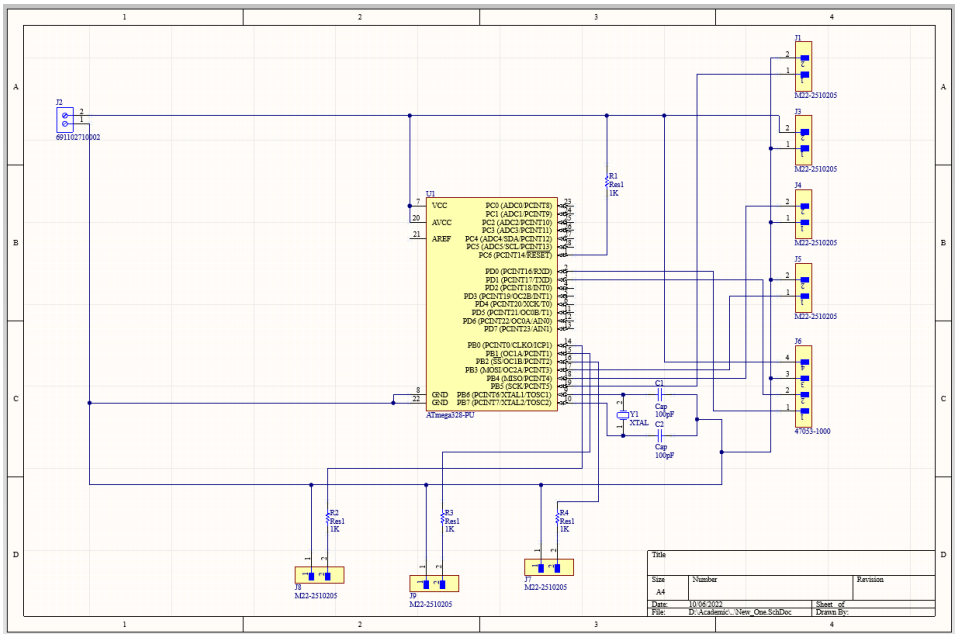


Figure 17 - PCB Design Schematic Library

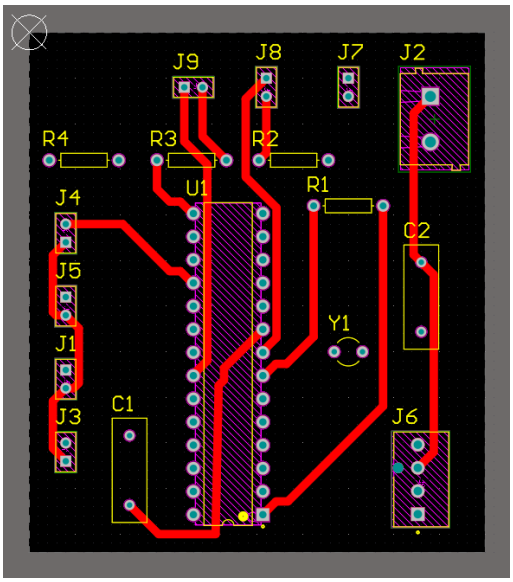


Figure 10 - PCB Design 2D Top Layer View

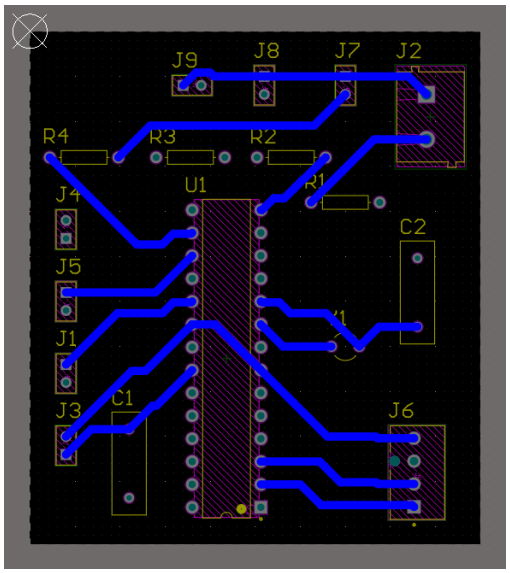


Figure 18 - PCB Design 2D Bottom Layer View

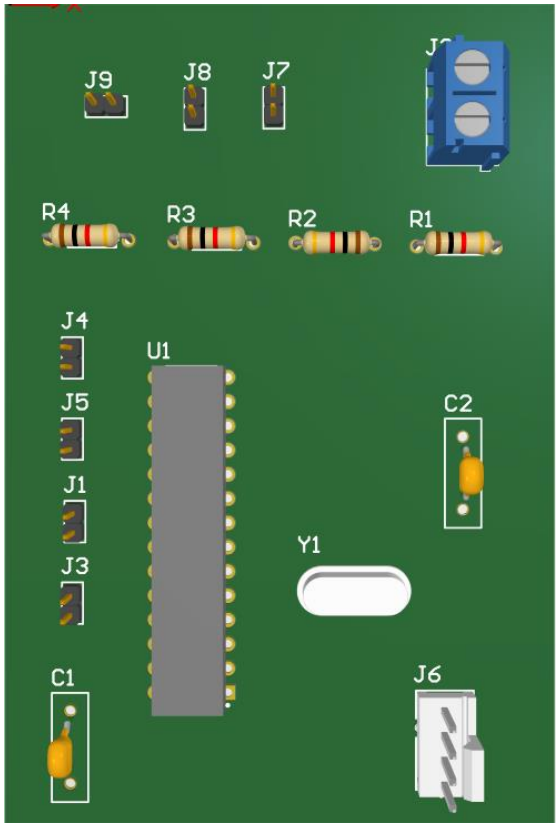


Figure 12 - PCB Design 3D View

14. Resources

ATmega328P Datasheet :-

https://ww1.microchip.com/downloads/en/DeviceDoc/Atmel-7810-Automotive-Microcontrollers-ATmega328P_Datasheet.pdf

Bluetooth module HC-05 :-
https://components101.com/sites/default/files/component_datasheet/HC-05%20Datasheet

Mobile App (Switching) :-
https://play.google.com/store/apps/details?id=project.bluetoothterminal

https://play.google.com/store/apps/details?id=appinventor.ai_maimonmoshe.bluetooth

15. ACKNOWLEDGEMENT

A special thanks goes to our lecturer Dr. Ajith Pasqual for the project instructing and guiding. The help and guidance received from him throughout the duration of the project was very valuable for us. He pointed out deficiencies and points that need to be improved in the design. Also, thanks for the sessions of Altium designer training conducted by Mr. Onila Fonseka and Solid Works training. The support received from our peers in acquiring knowledge about the certain areas is greatly appreciated.