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Team: SSRT Tonics

Temperature Sensitive Switch

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EN1190 Engineering Design Project
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Abstract
In many households and workplaces, fans are often left running unnecessarily—especially during the night or in unoccupied rooms—leading to discomfort and significant energy waste. Users frequently wake up feeling too cold or forget to turn off the fan, resulting in excessive power consumption.

We propose a **smart plug-based temperature-sensitive switch** that:

- Turns the fan ON/OFF based on temperature and humidity
- Allows scheduling via a mobile app
- Enables remote control for convenience

Our goals are:

- **Energy Efficiency**
- **User-Friendly Operation**
- **Affordability**

Contents

1 Problem Description

1.1 Problem

People usually leave their fan running through the night while they sleep. But sometimes they wake up needing to turn it off because it's too cold. Also in offices and homes a lot of power is wasted because of fans running when people aren't using them.

1.2 Expected Goals

- **Energy Efficiency**
- **User-Friendly Operation**
- **Affordability**

1.3 Solution

We propose a **smart plug-based temperature-sensitive switch** that:

- Turns the fan ON/OFF based on temperature and humidity
- Allows scheduling via a mobile app
- Enables remote control for convenience

1.4 Justification of Selection

The selection of this system was primarily driven by its ability to address the specific needs of modern users seeking convenience, efficiency, and automation. Among various available alternatives, this solution was chosen due to its simplicity of implementation, low cost, and compatibility with widely accessible technology such as smartphones and Bluetooth modules. The decision was further justified by the flexibility it offers for future upgrades, such as IoT integration or remote access via mobile applications. Additionally, its user-friendly design ensures that it can be easily adopted in both domestic and industrial environments without the need for specialized training or infrastructure changes.

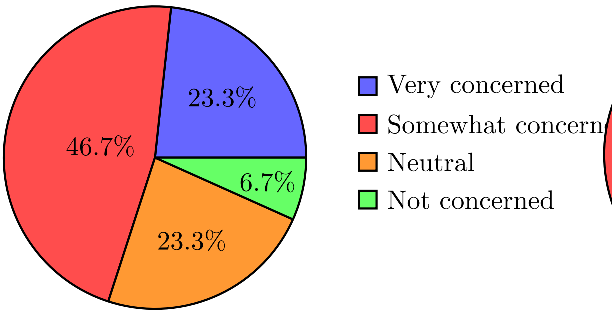
2 Market Analysis

According to a survey we conducted, about 70 percent of respondents were at least somewhat concerned about the power consumption of their fans or coolers. This device addresses that concern by offering efficient control to reduce unnecessary energy use. Additional features include the ability to set a timetable for when the device turns ON or OFF, set a customizable temperature threshold, and a plug-and-play design that allows a wide variety of electrical appliances to take advantage of its functionality.Our survey also revealed that most people would be willing to pay between LKR 1,000 and LKR 5,000 for such a device, which makes production and distribution economically feasible while maintaining affordability for the average consumer.

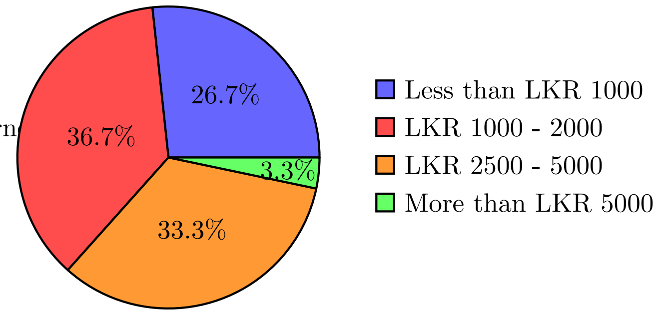
Potential business models include direct-to-consumer sales as well as targeting businesses. For example, large office spaces with many fans, cooling devices, or other appliances that only need to operate during work hours can use this device to optimize energy usage and reduce operational costs.

The price for the unit we made should be 6000 as this its close to the expected value from customers and also has a fair amount of profit.

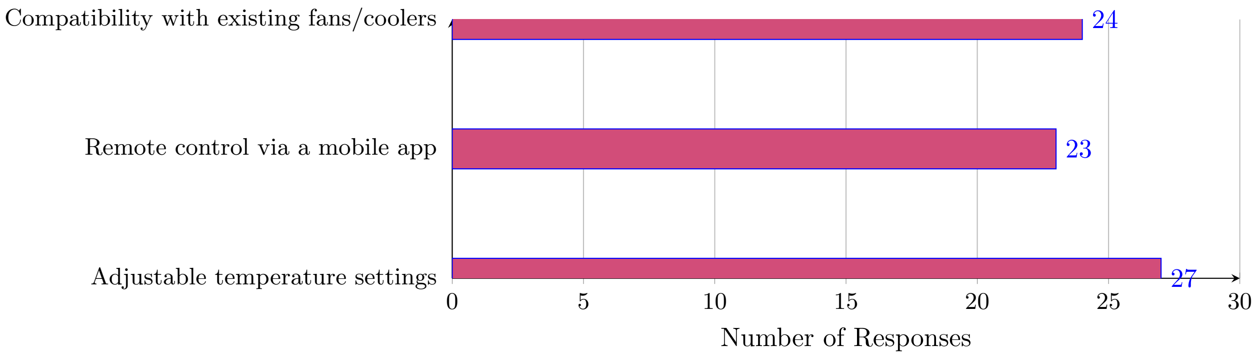
Are you concerned about the energy consumption of your fan or cooler?



How much would you be willing to pay for such a device?



What features would you expect from a temperature-sensitive smart switch?



3 Product Feasibility

3.1 Technical Feasibility

We successfully completed the development of our device and ensured its technical functionality using readily available components. A DHT11 sensor was used to measure ambient temperature and humidity, while an ATmega328P microcontroller processed the sensor data. The system included a relay module to control external devices based on defined thresholds. For user interaction and monitoring, we incorporated an I2C-enabled LCD to display real-time readings and adjustable threshold values. Bluetooth communication was enabled using the HC-05 module, allowing users to send ON/OFF commands wirelessly through a mobile application. The entire setup was powered through a regulated power supply to ensure stable operation.

3.2 Hardware Feasibility

- **Microcontroller:** ATmega328
- **Relay Module:** MD0486
- **Bluetooth Module:** HC-05
- **Sensors:** DHT11 (Temperature and Humidity)
- **Display:** LCD 1602

3.3 Software Feasibility

Software	Programming Language	Purpose
Arduino	C++	To program the ATMega328P chip and the display
Android Studio	Kotlin	To create the mobile app

4 Applications and Extensions(Future Improvements)

Applications:

- Suitable for both residential and commercial environments.
- Can control exhaust fans, heaters, or any temperature-sensitive electrical appliance.
- Improves comfort and saves energy through temperature-based automation.
- Especially useful in:
  - Bedrooms
  - Offices

Extensions:

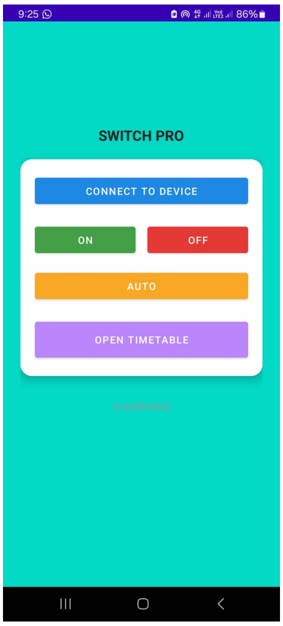
- Can be adapted to work with **any standard electrical appliance**.
- Enables automation based on a **custom timetable** via the mobile app.
- Transforms regular appliances into smart devices.
- Offers:
  - Greater convenience
  - Improved energy management
  - Integration with future smart home systems

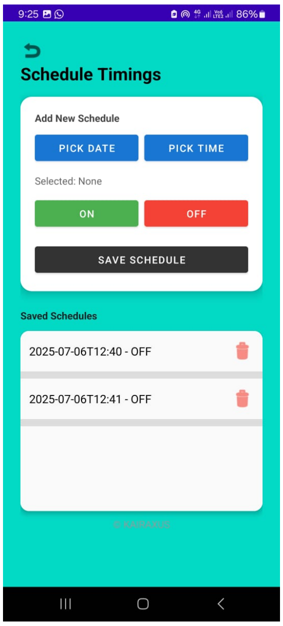
5 Mobile App

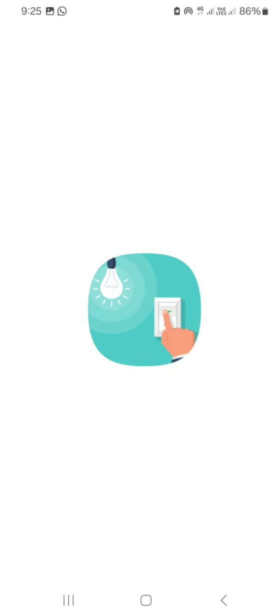
The **Switch Pro** mobile application offers a range of features for convenient and intelligent control over connected devices:

- **Bluetooth Device Pairing:** Seamlessly connect to the relay control hardware via the HC-05 Bluetooth module.
- **Manual Control:** Instantly turn devices ON or OFF using clearly labeled buttons.
- **Automatic Mode:** Activate the AUTO feature to operate based on a user-defined temperature threshold.
- **Schedule Management:**
  - Define custom ON/OFF schedules using date and time pickers.
  - View or delete saved schedules from an intuitive timeline.
- **Timetable View:** Access and manage all upcoming automated actions in one place.

- **Responsive UI:** Clean, color-coded interface optimized for ease of use and reliability.





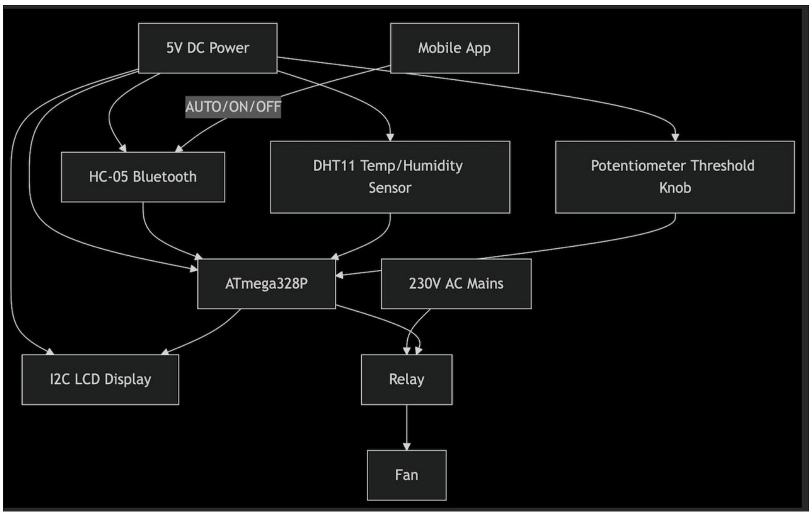


6 Product Specifications

- **Type:** Electrical Plug-in Device
- **Bluetooth:** Yes (Wireless connectivity enabled)
- **Dimensions:** Height-8 cm length-10 cm width-7cm
- **Weight:** 200 grams
- **Display Size:** 1.23-inch TFT LCD (Rectangular Display)
- **Maximum Power Dissipation:** $5V \times 600mA = 3W$

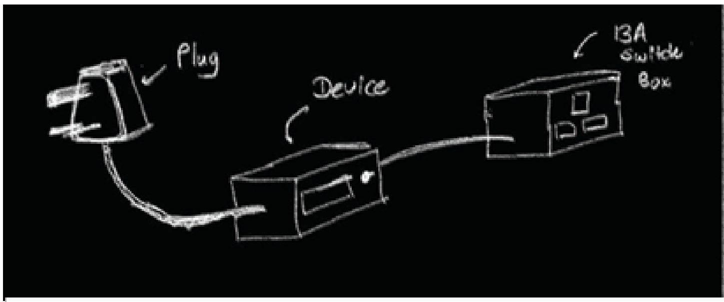
7 Product Architecture

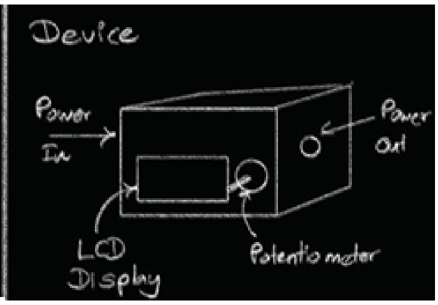
Block Diagram

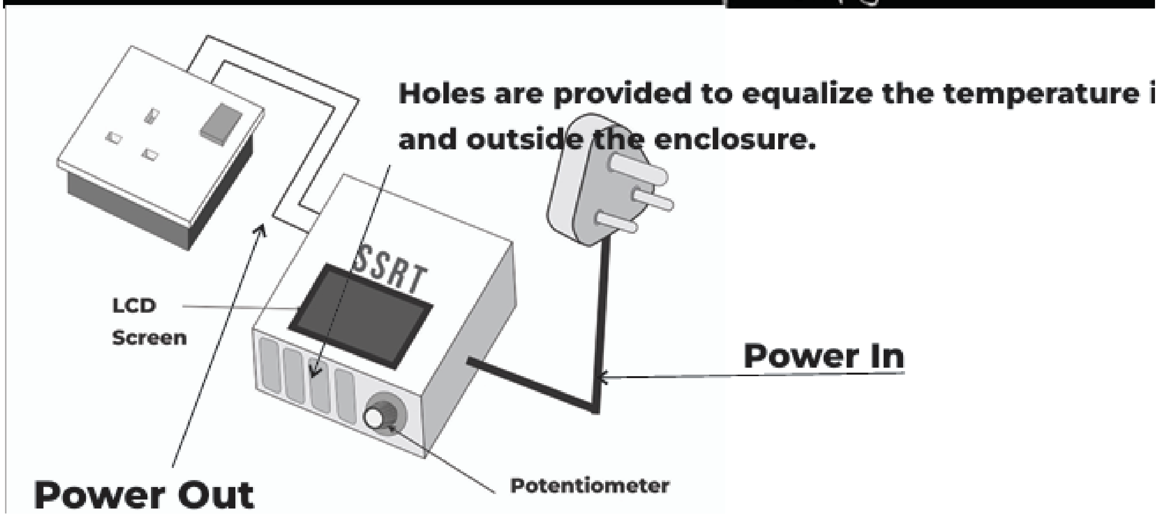


8 Sketches of Product Design

8.1 Initial Sketch

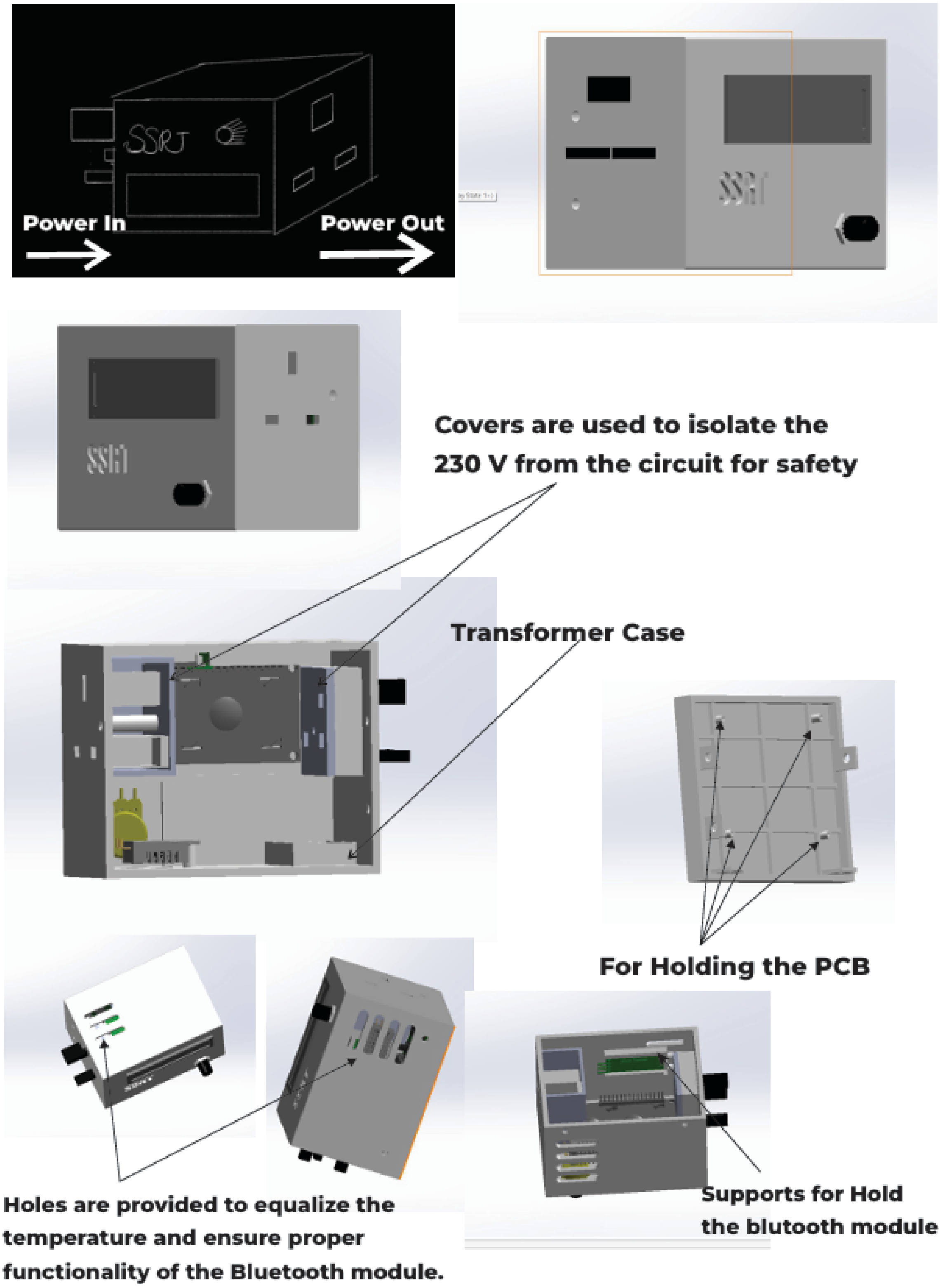






Initially, we designed our device with three separable parts. However, from the customer's perspective, we realized it might feel a bit bulky. So, we decided to revise the design by combining the three parts into a single unit. At first, we planned to use batteries to power the device, but later we thought it might be inconvenient and add extra cost for the customer. Therefore, we redesigned the device to use a transformer instead.

8.2 Final Sketch



9 PCB Design

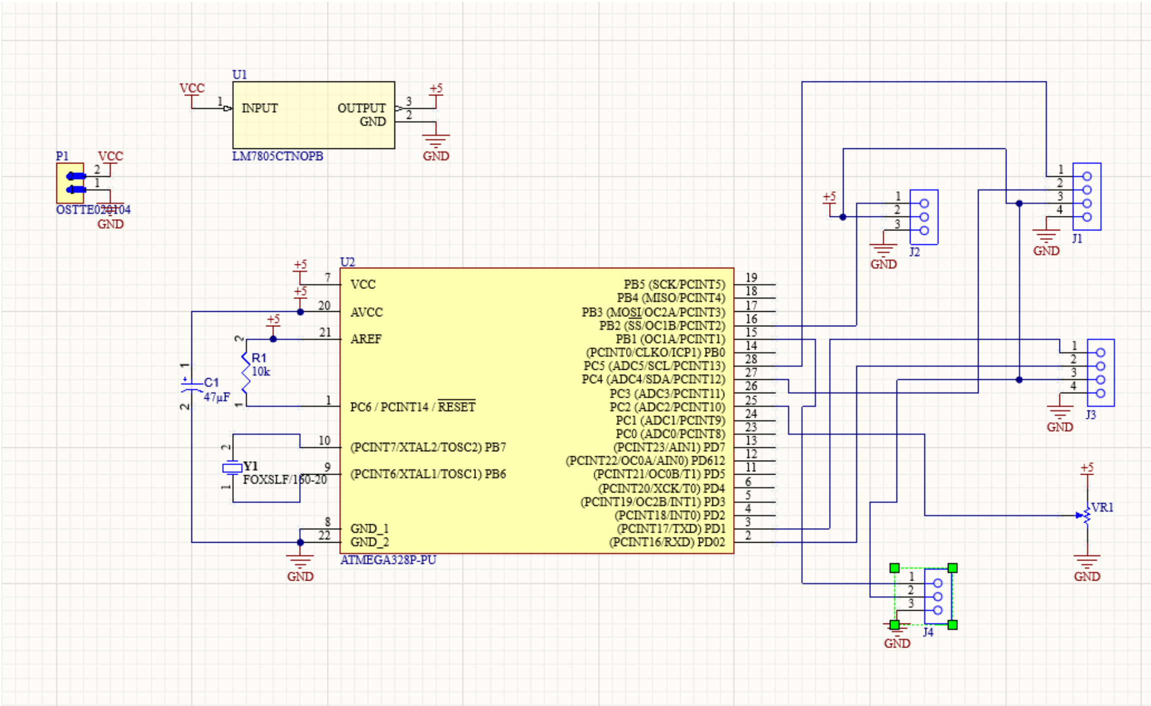


Figure 1: Schematic Diagram

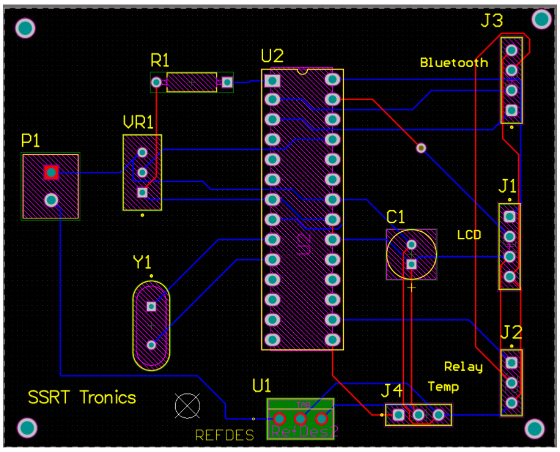


Figure 2: PCB 2D

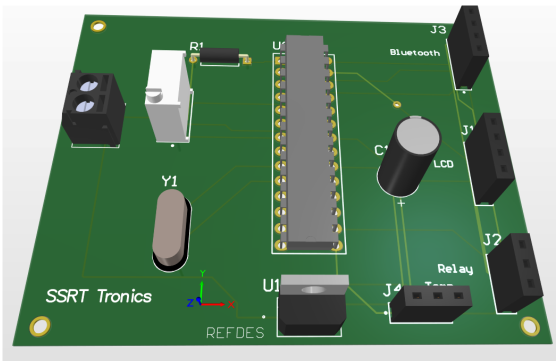
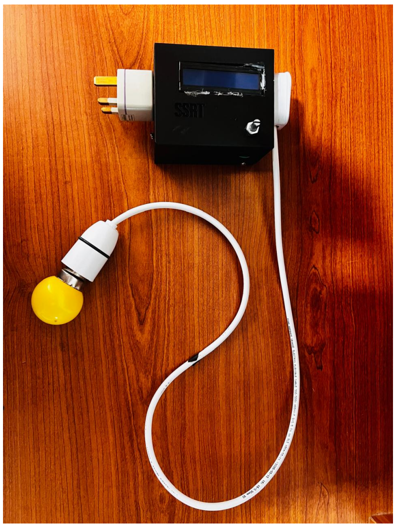


Figure 3: PCB 3D

10 Final Product



11 Team Task Allocation

Name	Task Allocation
R.K.T.Dissanayake (230164K)	Mobile app development, Soldering, Assembling, Enclosure Testing
R.M.S.H.Ratnayake (230548R)	Mobile app development, Circuit Design, PCB Design, Sensor integration and testing
M.N.N.Shehan (230613M)	Enclosure Design, Circuit Analysis, Component Selection, Code Debugging
U.G.R.B.Tennakoon (230629R)	Microcontroller Programming, Circuit Design, PCB Design, Sensor integration and testing

12 Final Budget

Our final budget came to about Rs.5270 which is too expensive considering that the customers are expecting to buy it around the same price. But we believe that the cost per component will be lower if bought in bulk and therefore the cost will be lower when a large number of units are made.

Component	Price (Rs.)
DHT11 Sensor	390
Relay Module	150
LCD Display (I2C)	600
ATmega328P IC	450
HC-05 Bluetooth	860
Enclosure	1000
Hi-Link Power Supply	1100
Potentiometer	60
PCB	3300/5
Total Cost	**5270**

Table 1: Component unit prices with total cost