DEPARTMENT OF ELECTRONIC AND TELECOMMUNICATION ENGINEERING
UNIVERSITY OF MORATUWA

EN2160: ELECTRONIC DESIGN REALIZATION

Access Smart
FINAL PRODUCT REPORT

Ranaraja S.V
200506K

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Table of Contents

Abstract

Access Smart is a revolutionary smart door lock that redefines door access control for both homes and businesses. This advanced security solution seamlessly integrates motion detection technology and a 4-digit PIN entry system, ensuring enhanced security and convenience. With continuous power supply through AC power and a reliable Li-ion battery backup, Access Smart operates flawlessly in any situation.

The standout feature of Access Smart lies in its incorporation of a GSM SIM 900A module, enabling real-time SMS alerts when suspicious activities are detected near the door. The product report provides comprehensive insights into its specifications, Bill of Materials (BoM), schematics, SolidWorks designs, conceptual design, and preliminary design. Market goals are directed towards homeowners, office spaces, and small businesses seeking an intelligent and modern access control system at a competitive price point. Assembling instructions and testing methodologies are also covered to ensure seamless implementation and optimum functionality. Access Smart, with its cutting-edge technology, convenience, and robust security measures, promises to be the go-to solution for modern door access control needs.

Smart Door Lock with Motion Detection – Report

1. Introduction

Introduction:

The smart door lock with motion detection is designed to provide enhanced security and convenience for door access. It incorporates features intruder alerts using SMS facility to pre-entered phone number, motion detection automatic lock and continuous power supply through AC power and backup power using a Li-ion battery. The lock offers two modes: manual mode with a 4-digit PIN entry and automatic mode utilizing motion detection. This innovative device aims to safeguard premises from potential threats by detecting suspicious activities near the door and sending real-time SMS alerts using the GSM SIM 900A module.

Product Goals:

The primary functionality of the smart door lock is to offer secure and convenient access control to residential and commercial spaces. It combines motion detection and PIN entry to ensure only authorized individuals can enter the premises. The market goals focus on targeting homeowners, office spaces, and small businesses seeking an efficient and modern access control system. The pricing strategy aims to strike a balance between affordability and value, making the smart door lock an attractive choice for consumers seeking advanced security solutions.

Price

Approximate Cost per Unit – Rs. 18,000.00
Market Price – Rs. 20,000.00
Annual Gross Profit – Rs. 200,000.00

2. Features

- **Continuous Power Supply:** Utilizes a 12V, 2A power adaptor to provide uninterrupted power to the smart door lock.
- **Backup Power:** Employs a TP4056 Li-ion battery charger to charge a 3.7V 18650 battery, offering backup power in case of AC power failure.
- **Overcharging and Short Circuit Protection:** The TP4056 module ensures safe charging of the Li-ion battery by providing overcharging and short circuit protection.
- **Buzzer for Notifications:** Incorporates a buzzer to provide audible notifications for various events, such as successful/unsuccessful PIN entry or motion detection.
- **Manual Mode:** Enables secure access with a 4-digit PIN. The door can be opened by entering the correct PIN.
- **Automatic Mode:** Utilizes motion detection to automatically unlock the door when motion is detected.
- **Easy access for door lock from inside the house:** pushbutton is located on the other side of the door lock, allowing for easy manual unlocking from inside.
- **Trigger Mechanism:** Employs an MG90 metal servo to trigger the locking mechanism securely.
- **Intruder alert:** Notify users when suspicious activity is detected near the door using PIR sensor readings through SMS facility.

3. Specifications

Microcontroller: Atmega 328p
Power Supply: 12V, 2A AC Power Adaptor
Backup Power: 3.7V 18650 Li-ion Battery
Battery Charger: TP4056 Module with Overcharging and Short Circuit Protection
User Input: 4x4 keypad (4-Digit PIN Entry), PIR sensor (Motion Detection)
Output: Buzzer, MG90 Metal Servo for Locking Mechanism
Communication: GSM sim 900A module
Dimensions: 15cm x 12cm

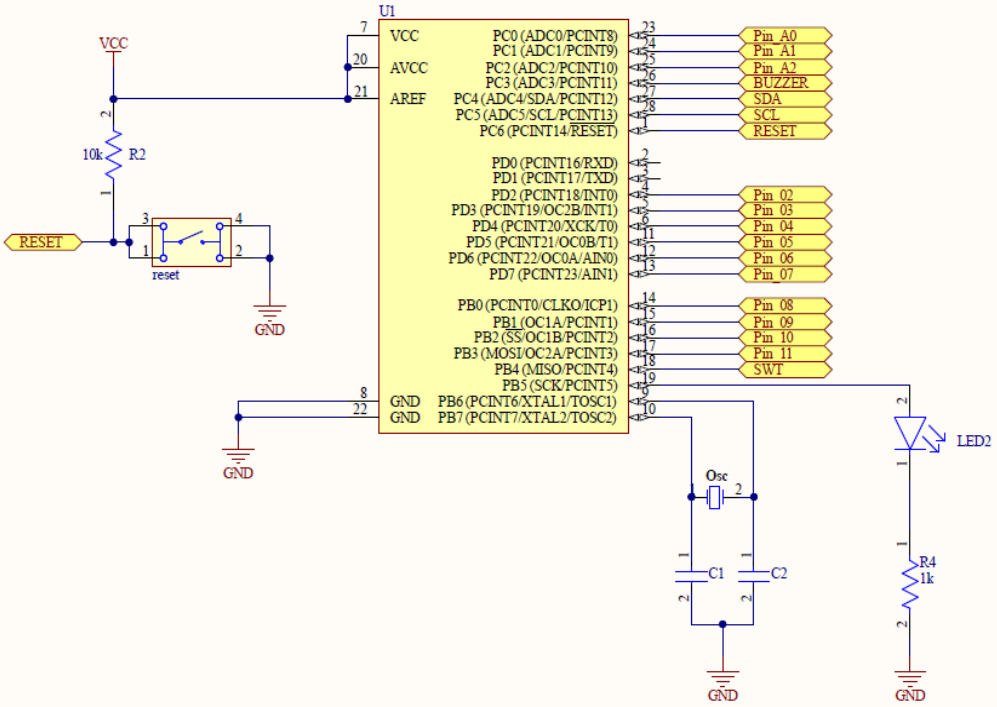
04. Bill of Materials (BoM)

Component	Manufacturer	Shop
Diodes 1N4007 x 10	Diodes Incorporated	Arrow
Capacitors (electrolytic)	Panasonic	Arrow
1uF x 5	Panasonic	Arrow
10uF x 5	Panasonic	Arrow
Capacitors (non-electrolytic)	Vishay	LCSC
22pF x 5	Vishay	LCSC
Crystal Oscillator 16MHz	Abracon	LCSC
Voltage Regulators	STMicroelectronics	Arrow
L7805CV x 3	STMicroelectronics	Arrow
L78S05 x 3	STMicroelectronics	Arrow
SMD Green LED x 5	Lite-On Technology	Arrow
TP4056 Modules x 2		Tronic.lk
12V Power Adaptor	-	-
2-pin Power Connectors x 5	JST	LCSC
3-pin Header Connectors x 5	JST	LCSC

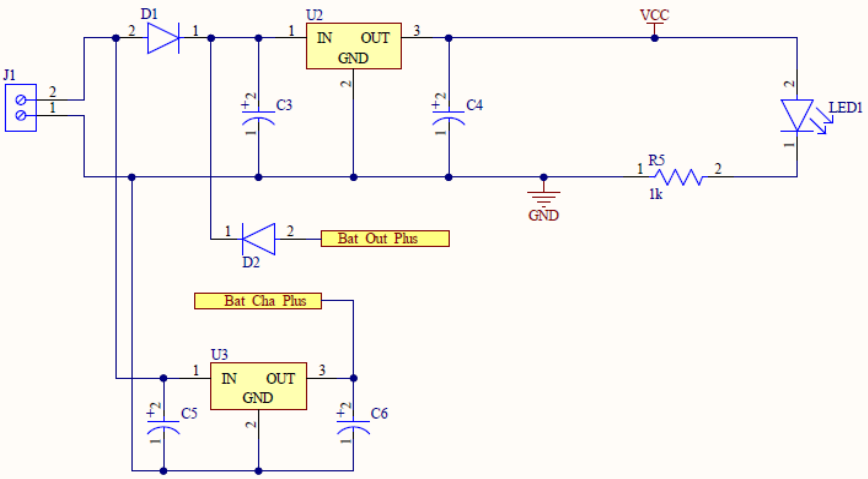
4-pin Header Connectors x 5	JST	LCSC
8-pin Connectors x 2	JST	LCSC
Li-ion Single Battery Case x 2	Adafruit	LCSC
PIR Motion Sensor x 1	HC-SR501	Tronic.lk
Push Button x 1	Tactile Push Button	Tronic.lk
Buzzer x 1	Piezo Buzzer	LCSC
1K x 10	Vishay	LCSC
10K x 10	Vishay	LCSC
Atmega 328p x 1		LCSC
Upconverter (5V - 24V)	-	Tronic.lk
GSM Sim900A module	-	LCSC

05. Schematics and functional block diagram

Micro-controller

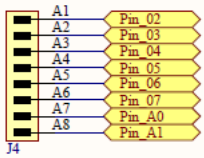


Power Supply

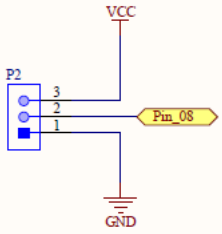


Input Sensors

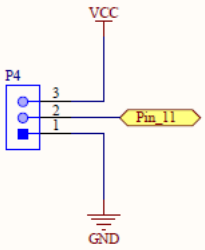
KeyPad



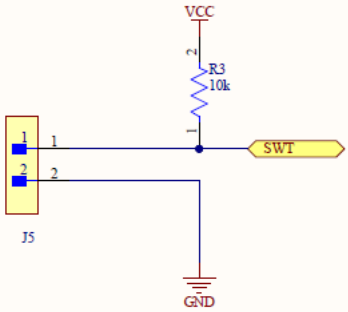
PIR Sensor



Collision Sensor

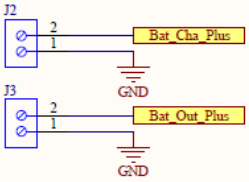


Switch

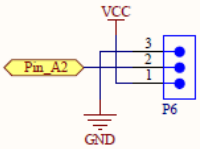


Output Sensors

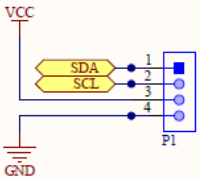
TP4056 module



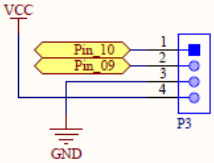
Servo Motor



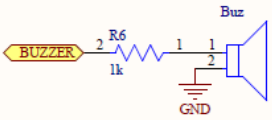
OLED



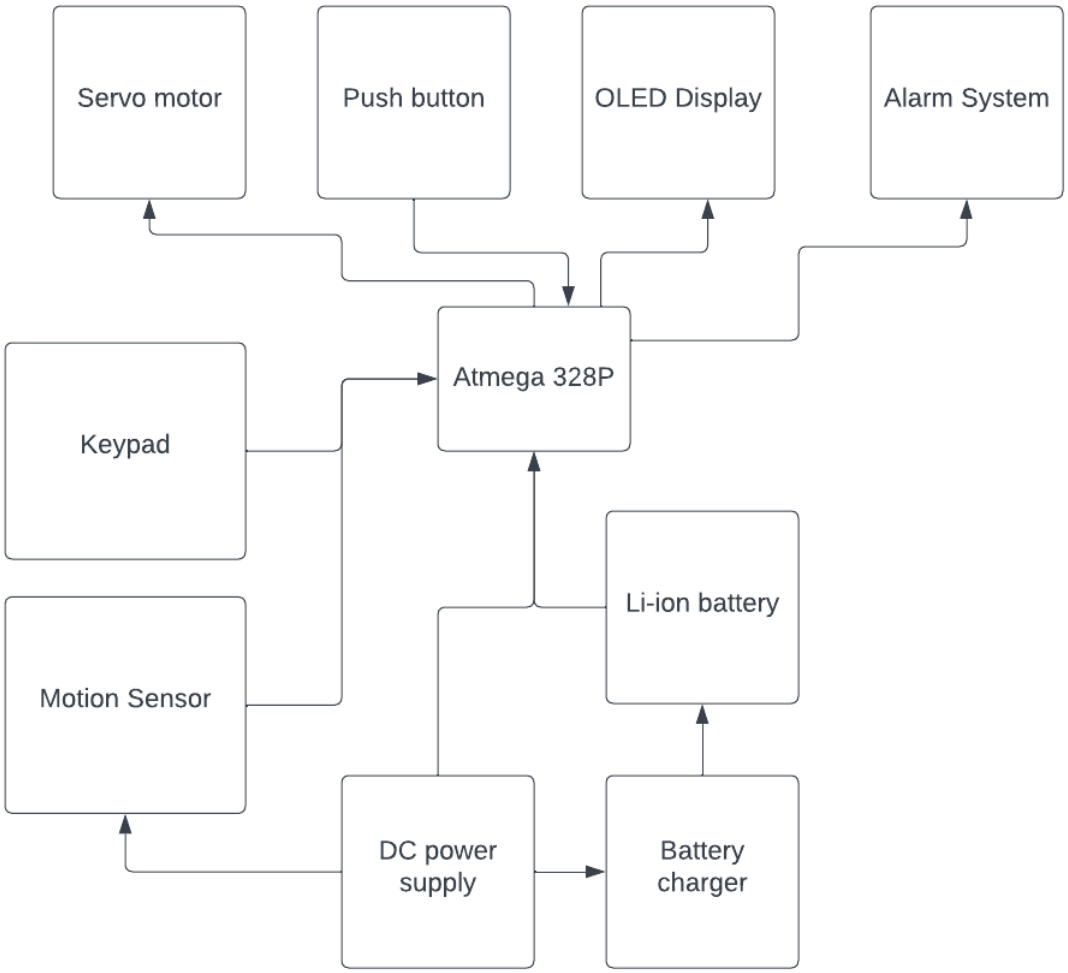
GSM Module



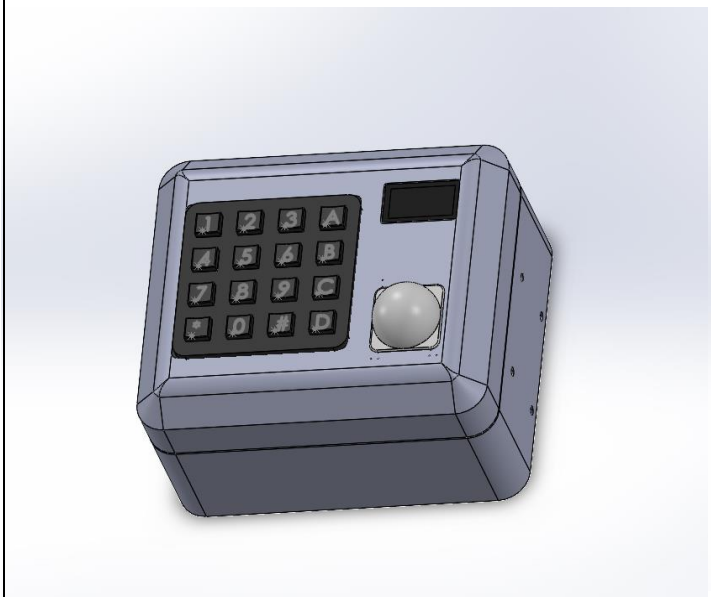
Buzzer

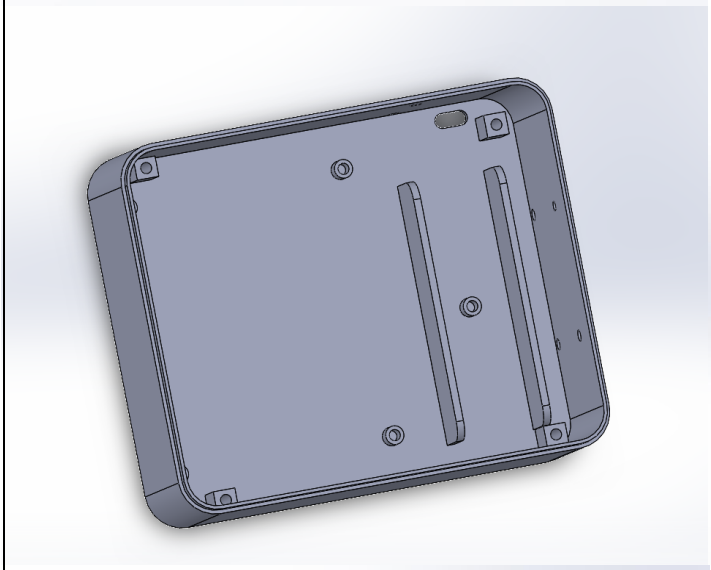


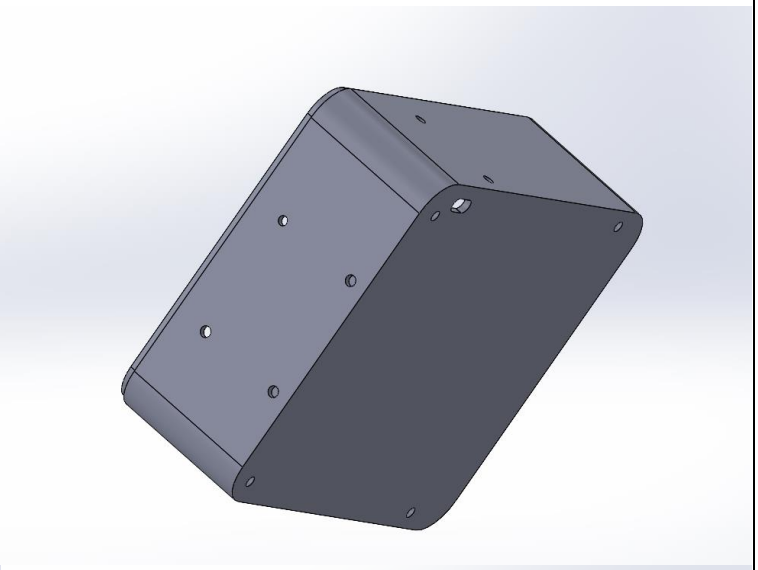
Functional Block diagram

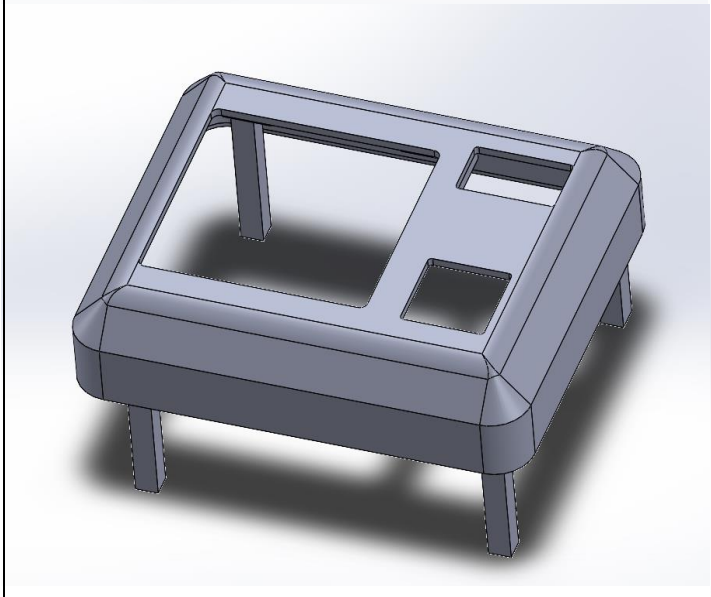


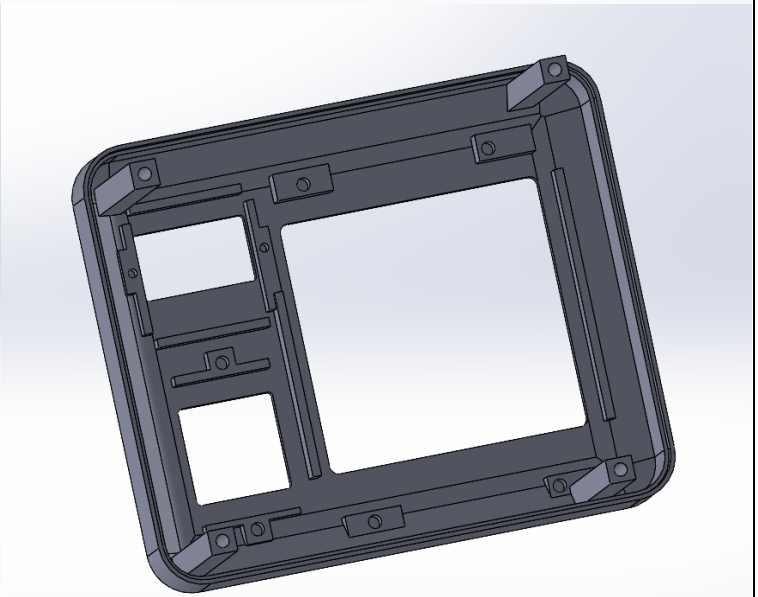
06. SolidWorks Designs











07.Instructions for Assembly

Before proceeding with the assembly of the smart door lock, ensure that you have all the required components and tools ready. Follow these step-by-step instructions to assemble the device:

Step 1: Gather Components and solder the PCB.

- Refer to the Bill of Materials (BoM) and make sure you have all the necessary components at hand.
- Solder the components to the PCB along with the connectors according to the schematic.

Step 2: Prepare the Enclosure

- Assemble and prepare the enclosure for the smart door lock.
- Mount keypad, oled display and PIR sensor to the enclosure lid and fix them with 3mm diameter screws securely within the enclosure.
- Use JST connectors to connect OLED, PIR sensor and keypad to the PCB.

Step 3: Connect the Microcontroller

- Connect the Atmega 328p microcontroller to the appropriate pin headers on the PCB.
- Ensure proper orientation and alignment of the microcontroller.

Step 4: Connect Power Supply and Battery

- Connect the 12V, 2A AC power adapter to the power input of the PCB.
- Attach the TP4056 Li-ion battery charger to the PCB and connect the 3.7V 18650 Li-ion battery to the charger.
- Double-check the polarity and connections to avoid any damage to the components. Connect the Upconverter to the named terminal blocks in the PCB.
- Mount the TP4056 module and Upconverter before mounting PCB to the enclosure.

Step 5: Wiring

- Refer to the schematics to determine the necessary wiring connections between the PCB and the external modules (TP4056 module, Upconverter module, Battery pack).
- Use appropriate wires (JST connectors) and connectors (Terminal blocks) to make secure and reliable connections according to the schematics.

Step 6: Set Up the MG90 Metal Servo

- Attach the MG90 metal servo to the locking mechanism as per the SolidWorks design.
- Ensure smooth movement of the servo's arm to trigger the locking mechanism effectively.
- Then connect the metal bar for door lock to the servo motor using 2.5mm diameter screws.

Step 7: Firmware Upload

- Prepare the firmware (hex file or Arduino code) for the microcontroller with the required code for motion detection, PIN entry, and control logic.
- Upload the firmware to the microcontroller using a suitable programmer or upload the firmware and then insert the microcontroller to the PCB.

Step 8: Test the Components

- Verify that the keypad is functioning correctly for PIN entry.
- Test the motion detection sensor to ensure it accurately detects motion.
- Check the buzzer for proper notifications and feedback.
- Validate the MG90 servo for smooth operation and secure locking.

Step 9: Assemble the Enclosure

- Carefully place the PCB on the mounting holes within the enclosure.
- Secure all components and wiring inside the enclosure to prevent damage during operation.
- Close and fasten the enclosure appropriately, making sure it is well-sealed and fix it with 3mm diameter screws.

Step 10: Final Checks

- Double-check all connections and wiring to avoid any potential short circuits.
- Confirm that the power supply and battery connections are secure.
- Test the device's functionality thoroughly to ensure everything works as expected. If the product is malfunctioning, please refer the next chapter about product testing and verification.

Step 11: Installation

- Install the smart door lock on the intended door, keeping hardware components within the wall to ensure the safety.
- Ensure the lock is properly aligned and secured to prevent any issues with the locking mechanism.

08. Testing and validating functionality

1. **Check Input Power and Power LED:**
    - Ensure the AC adaptor is connected to the smart door lock.
    - Verify if the Power LED on the device is turned on, indicating that it is receiving power from the AC adaptor.

2. **TP4056 Module Charging:**
    - Check if the TP4056 charging module is receiving the required voltage from the power source.
    - Confirm that the TP4056 module is charging the Li-ion battery as intended.

3. **Check Voltage Stability of TP4056 Output:**
    - While the AC adaptor is turned off, observe the voltage on the output terminals of the TP4056 module.
    - Ensure that the voltage remains constant, indicating the battery is supplying power to the system without interruption.

4. **Debug Charging and Discharging Circuit:**
    - If the voltage on the TP4056 output terminals fluctuates when the AC adaptor is turned off, troubleshoot and debug the charging and discharging circuit based on the schematic provided.

5. **Connect Atmega and OLED:**
    - Connect the Atmega chip and OLED display components to the system.
    - Ensure that the OLED display turns on, providing visual feedback of the system status.

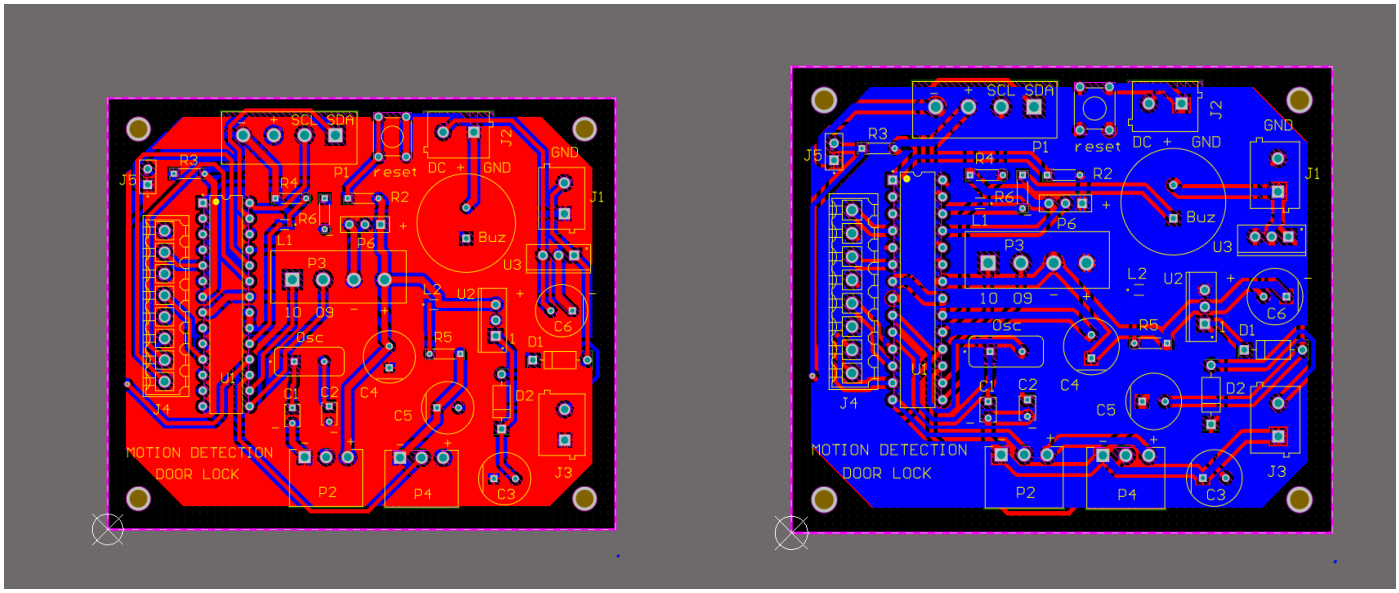
6. **Test Motion Sensor:**
    - Verify the motion sensor's functionality by observing the output displayed on the OLED screen when motion is detected.

7. **Check GSM SIM 900A Module Connection:**
    - After powering on the system with the battery, allow up to 3 minutes for the GSM SIM 900A module to connect to the network for communication.
    - Check the status of LEDs on the GSM SIM 900A module to confirm network connection.

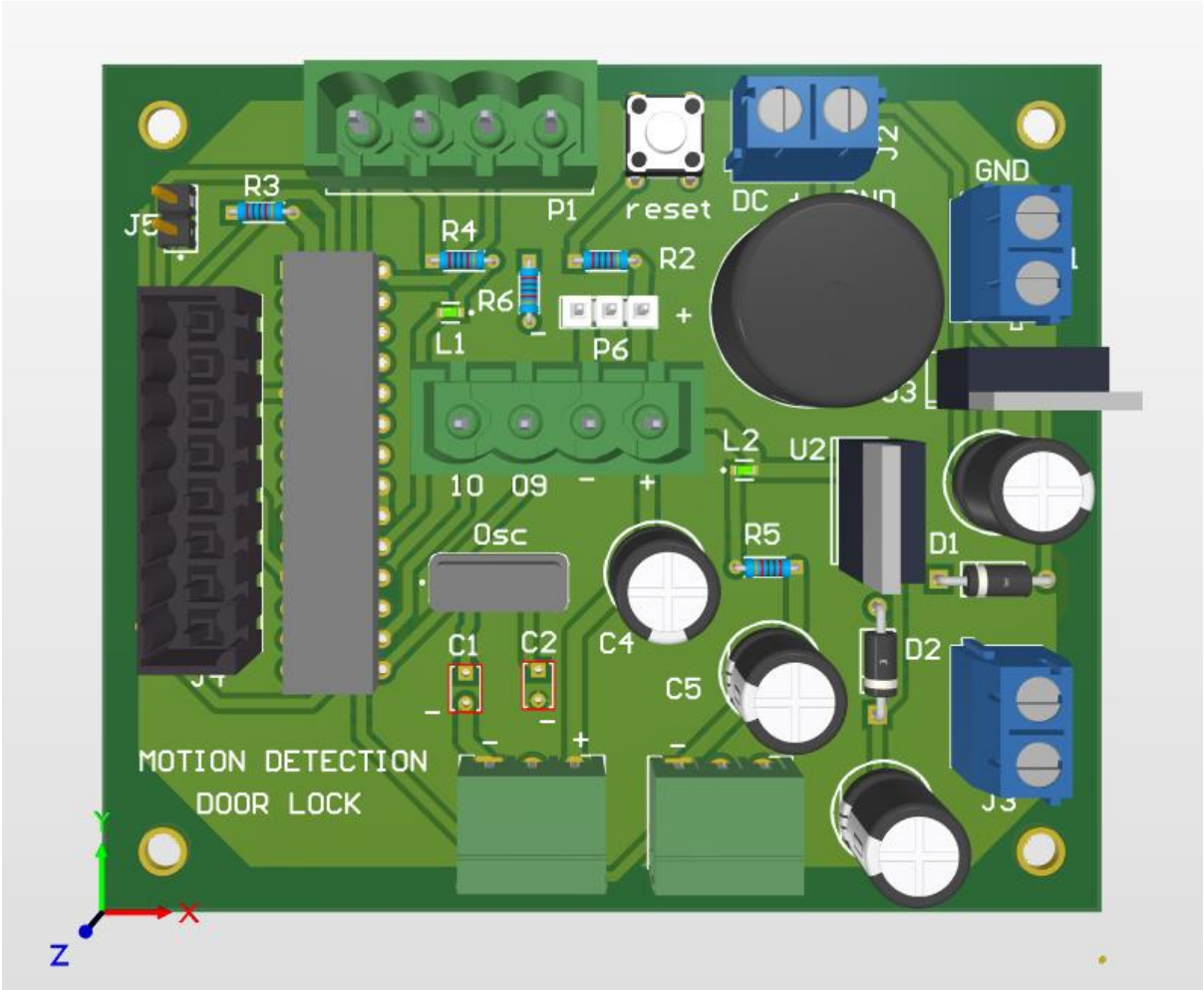
By following these testing procedures, you can ensure that Access Smart functions correctly and reliably, providing users with the enhanced security and convenience it promises.

Appendix

Top Layer Design **Bottom Layer Design**



3D View



Final Assembly view