DEPARTMENT OF ELECTRONIC AND TELECOMMUNICATION ENGINEERING

UNIVERSITY OF MORATUWA

EN2160: ELECTRONIC DESIGN REALIZATION

SKULL DETECTOR
FINAL PRODUCT REPORT

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Abstract

This report presents the design and realization of an innovative electronic product, the Anti-Theft Motion Detector PIR Ultrasonic Alarm Security system. The system is designed to provide enhanced security for homes, offices, and warehouses by integrating ultrasonic sensors with PIR sensors, resulting in a unique and accurate motion detection logic that minimizes fault detection.

The product features a durable and anti-corrosive build, making it suitable for long-term use. Its wall-mounting capability ensures easy installation in various settings. The ultrasonic sensors offer a detection range of 2m, and the system operates on DC/AC12-24V input power with a wavelength of 940nm. The combination of RX15mA-TX30mA input current and an angle of incidence of <±30 enhances the system's efficiency.

The report emphasizes the implementation process, detailing the circuit design and the components used for signal processing and communication. The design incorporates a multi-layered security system with distinct security levels, providing users with real-time notifications of detected motion. In the highest security level, known as "fully trust," the system triggers SMS alerts and activates a powerful buzzer, ensuring immediate user attention and response to potential threats.

Comparison with similar products available on AliExpress highlights the system's unique features and advantages. The Anti-Theft Motion Detector PIR+UltraSonic Alarm Security system offers superior reliability and accuracy compared to existing alternatives in the market.

The successful realization of the system demonstrates its potential to significantly improve security measures in various environments. The report concludes with a reflection on the impact of the design and its potential in addressing security concerns in modern settings.

1. Introduction

1.1.Overview

The design project focuses on creating an advanced Anti-Theft Motion Detector PIR+UltraSonic Alarm Security system to enhance security in homes, offices, and warehouses. The system's implementation combines ultrasonic sensors with PIR sensors to improve motion detection accuracy and create a clear logic that minimizes false alarms. Its robust and anti-corrosive construction ensures durability, while the wall-mounting capability facilitates easy installation.

The system operates on DC/AC12-24V input power and utilizes a wavelength of 940nm. Its innovative design includes RX15mA-TX30mA input current and an angle of incidence of <±30 to optimize its performance. Moreover, the system boasts a detection range of 2m, allowing it to cover a significant area effectively.

A distinctive feature of the system is its multi-layered security approach, which provides users with various security levels and notifications based on detected motion. The "fully trust" security level triggers SMS alerts and activates a powerful buzzer, ensuring that users promptly attend to potential security threats.

Comparing the design with existing products available on AliExpress highlights its uniqueness and superiority. The successful implementation showcases the system's reliability and potential to revolutionize security measures. By addressing security concerns and offering improved accuracy, the Anti-Theft Motion Detector PIR+UltraSonic Alarm Security system is positioned to make a significant impact in the security industry.

1.2.Problem Identification

The primary problem addressed by the design project is the need for an advanced and reliable security system to prevent theft and enhance security in various environments such as homes, offices, and warehouses. Existing security systems may have limitations in terms of accuracy, false alarms, and prompt user notifications, leading to potential security breaches and ineffective protection.

The specific challenges and shortcomings that the design aims to overcome include:

Inaccurate Motion Detection: Many traditional security systems rely solely on PIR (Passive Infrared) sensors, which may lead to false alarms triggered by non-human objects or environmental factors. The design seeks to improve motion detection accuracy by integrating ultrasonic sensors with PIR sensors, creating a more reliable and clear logic for detecting human presence.

Limited Prompt User Attention: Existing security systems may not effectively capture the user's attention when a potential security threat is detected. Delayed notifications could result in missed opportunities to address security concerns. The design addresses this by incorporating a multi-layered security system with real-time SMS alerts and a powerful buzzer to ensure immediate user response.

Lack of Customization: Some off-the-shelf security systems may not provide customizable security levels, making it challenging to tailor the system to different environments and user preferences. The design project aims to offer distinct security levels and notifications, allowing users to adapt the system according to their specific security requirements.

Durability and Reliability: Many security systems may lack robustness and anti-corrosive properties, limiting their effectiveness and longevity, especially in harsh environments like warehouses. The design addresses this by using durable materials, ensuring the system can withstand various conditions.

Market Gap: While similar products may be available on platforms like AliExpress, there might not be an exact match for the design's combination of ultrasonic and PIR sensors with a multi-

layered security system. The design seeks to fill this market gap by providing a unique and innovative solution.

By addressing these problem areas, the Anti-Theft Motion Detector PIR+UltraSonic Alarm Security system aims to offer an efficient, reliable, and customizable security solution, enhancing overall security measures and providing users with greater peace of mind.

1.3.Solution

The proposed solution is the design and realization of the Anti-Theft Motion Detector PIR+UltraSonic Alarm Security system, an innovative electronic product that overcomes the identified problems and provides enhanced security for homes, offices, and warehouses. The key elements of the solution are as follows:

Integration of Ultrasonic Sensors: The design incorporates ultrasonic sensors in addition to traditional PIR sensors. This integration allows for more accurate motion detection, as ultrasonic sensors are less prone to false alarms caused by non-human objects or environmental factors. The combination of PIR and ultrasonic sensors creates a robust and reliable motion detection logic, minimizing the risk of false alerts.

Multi-Layered Security System: To ensure prompt user attention to potential security threats, the system employs a multi-layered security approach. The highest security level, known as "fully trust," activates when significant human motion is detected within the designated range. In this scenario, the system triggers a series of actions, including real-time SMS alerts and a powerful buzzer, alerting the user immediately. This dual-notification system provides users with crucial information and prompts them to take immediate and serious action.

Durable and Anti-Corrosive Build: The system is constructed using durable materials with anti-corrosive properties, making it suitable for long-term use and ensuring its reliability in various environments, including warehouses where harsh conditions may exist.

Customizable Security Levels: The design allows users to customize security levels based on their specific requirements. By providing distinct security settings, users can adapt the system to different environments and tailor it to their preferences.

Unique Offering in the Market: The Anti-Theft Motion Detector PIR+UltraSonic Alarm Security system fills a market gap by offering a unique combination of ultrasonic and PIR sensors along with a multi-layered security system. This distinctiveness sets it apart from similar products available on platforms like AliExpress, providing consumers with a cutting-edge security solution.

The successful realization of this solution results in an advanced security system that significantly improves security measures in homes, offices, and warehouses. By addressing the identified problems, the Anti-Theft Motion Detector PIR+UltraSonic Alarm Security system aims to revolutionize the security industry and offer users a reliable, accurate, and customizable security solution to protect their valuable assets.

1.4.Justification

The design and realization of the Anti-Theft Motion Detector PIR+UltraSonic Alarm Security system is justified based on several key factors and benefits that it offers:

Improved Security Accuracy: By integrating ultrasonic sensors with PIR sensors, the system achieves enhanced motion detection accuracy. This improvement minimizes false alarms caused by non-human objects or environmental factors, ensuring that the system only triggers alerts when significant human motion is detected within the designated range. This increased accuracy is vital in preventing false alarms and providing users with reliable security notifications.

Prompt User Attention: The multi-layered security system, specifically the "fully trust" security level, guarantees immediate user attention when potential security threats are detected. The activation of real-time SMS alerts and a powerful buzzer ensures that users are promptly notified of security breaches, enabling them to take immediate and appropriate action to mitigate risks.

Customization and Adaptability: The system's ability to provide distinct security levels allows users to customize the security settings according to their specific needs. This feature makes the Anti-Theft Motion Detector PIR+UltraSonic Alarm Security system adaptable to various environments, such as homes, offices, and warehouses, where security requirements may differ. The system can be fine-tuned to match the security preferences of individual users, providing a personalized security experience.

Durability and Reliability: The use of durable materials with anti-corrosive properties ensures the system's longevity and reliability. The system can withstand various environmental conditions, making it suitable for long-term use in both indoor and outdoor settings, including warehouses and other challenging environments.

Market Gap and Innovation: The design fills a market gap by offering a unique combination of ultrasonic and PIR sensors along with a multi-layered security system. Existing products on platforms like AliExpress may lack such comprehensive features, making the Anti-Theft

Motion Detector PIR+UltraSonic Alarm Security system stand out as an innovative and cutting-edge solution in the security industry.

Enhanced Security Measures: The implementation of the Anti-Theft Motion Detector PIR+UltraSonic Alarm Security system significantly enhances security measures in homes, offices, and warehouses. With its accurate motion detection, immediate alerts, and customizable security levels, the system provides users with a robust security solution that effectively safeguards their valuable assets.

Overall, the design and realization of the Anti-Theft Motion Detector PIR+UltraSonic Alarm Security system is justified due to its ability to address existing security system limitations, offer advanced features, and provide users with a reliable and customizable security solution. The innovative combination of ultrasonic and PIR sensors, along with the multi-layered security approach, positions this system as a valuable asset in ensuring safety and security in various environments.

2. Product Goals

2.1.Functionality

Once the lamp is plugged in, it can be woken up simply by a sound impact like a finger snap or a clap. If the user is not happy with the light being provided, he/she can simply wave their hand over the top of the lamp and an additional illumination would be added increasing the light vastly.

2.2.Market Goals

- ✓ Since this product is made by using the design driven innovation approach, the main target in the scope of the market is to maximize the profits while fulfilling the need of users.
- ✓ On the other hand, from the business point of view, this product would be a new approach to achieve many benefits in the modern world.

2.3.Price

Approximate Cost per Unit – Rs. 15,000.00

Market Price – Rs. 20,000.00

Annual Gross Profit – Rs. 300,000.00

3. Conceptual Design

- Conceptual Design:
- The conceptual design of the Anti-Theft Motion Detector PIR+UltraSonic Alarm Security system lays the foundation for its implementation and functionality. This stage involves the ideation and creation of a high-level design concept, focusing on the system's key components, interactions, and overall architecture. The following are the main aspects of the conceptual design:
- Functional Requirements: Identify the primary functions of the security system, such as motion detection, real-time alerts, and user notification. Determine the required input and output interfaces for seamless communication with users.
- Sensor Integration: Combine ultrasonic sensors with PIR sensors to create a dual-sensor approach for motion detection. Define how these sensors will work in tandem to achieve accurate and reliable motion detection logic.
- User Interface: Develop an intuitive user interface that allows users to customize security levels, view real-time alerts, and manage system settings. Consider the use of a mobile application or a dedicated control panel for ease of interaction.
- Multi-Layered Security Levels: Design a hierarchical security system with different security levels, each with distinct actions and notifications. Determine the conditions for activating each level based on the detected motion and user preferences.
- Real-Time Alert System: Plan the mechanism for sending real-time SMS alerts to the user's designated mobile device. Define the content of the

alert, including crucial information about the detected motion and location details.

- Buzzer Activation: Define the triggering conditions for activating the powerful buzzer to alert users audibly. Determine the duration and intensity of the buzzer sound for effective user attention.
- Power Supply and Circuit Design: Devise the power supply requirements for the system to operate on DC/AC12-24V input power. Create a circuit design that efficiently processes sensor data and manages communication with external devices.
- Materials and Enclosure: Select durable and anti-corrosive materials for the system's construction to ensure its longevity and suitability for various environments. Design an enclosure that protects the internal components from external factors while allowing for easy wall mounting.
- Testing and Validation: Plan for testing and validation of the conceptual design to ensure that it meets the functional requirements and performs as expected. Identify potential challenges and methods for resolving them during the prototyping phase.
- Cost Considerations: Analyse the cost implications of the conceptual design to determine its feasibility for mass production and commercialization. Explore cost-effective components and manufacturing processes without compromising the system's performance.
- The conceptual design phase serves as a crucial step in laying out the groundwork for the detailed design and implementation of the Anti-Theft Motion Detector PIR + UltraSonic Alarm Security system. It enables a clear understanding of the system's core features, its interactions with users, and its potential impact on addressing security concerns. The concepts formulated in this phase will guide the subsequent stages of development, leading to the creation of a robust and innovative security system.
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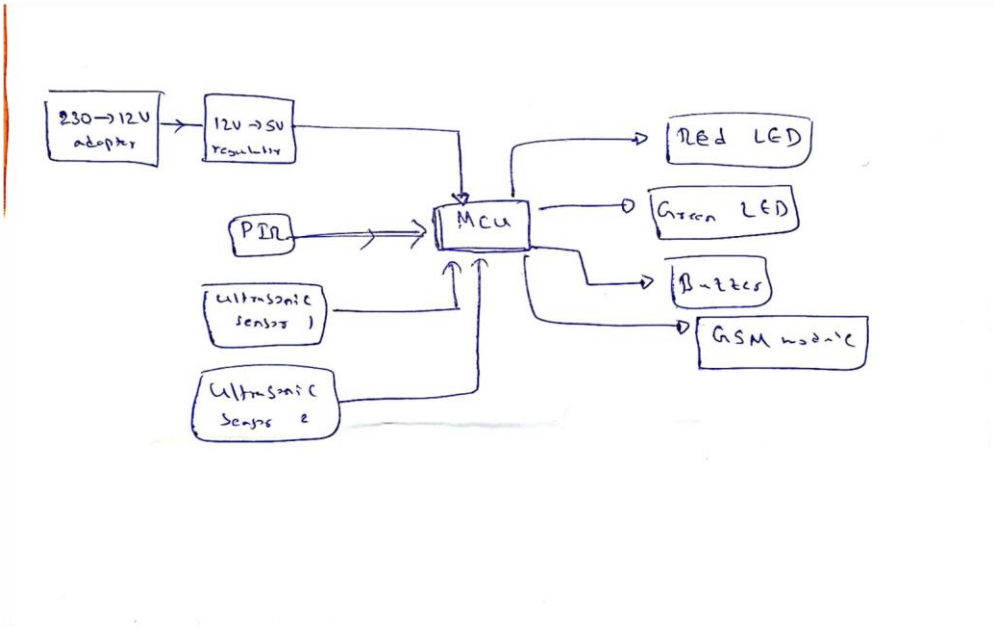
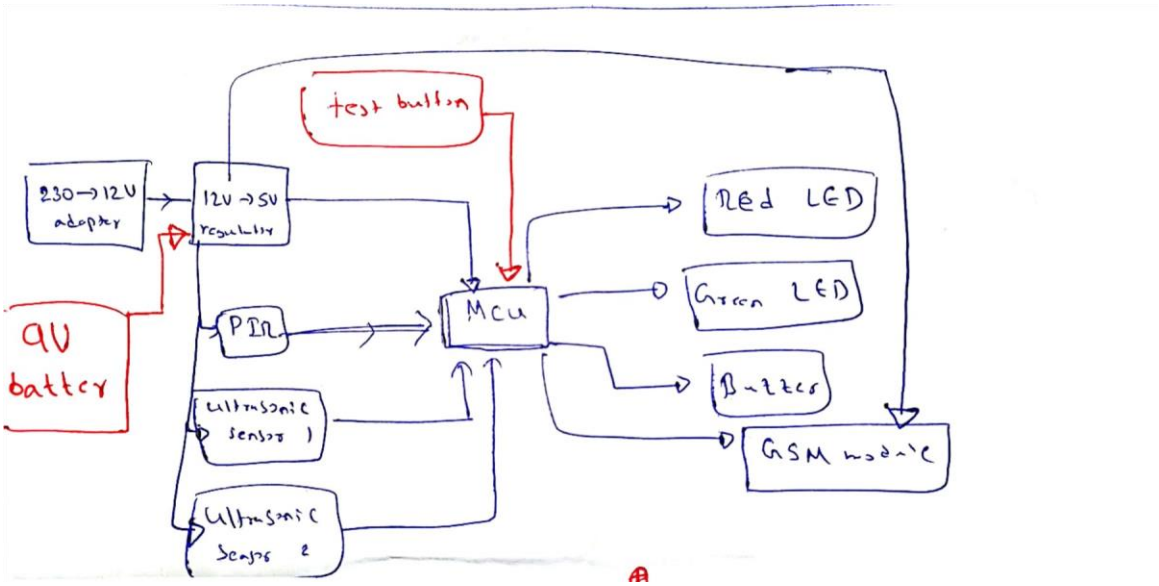
3.1.Circuit Block Diagrams

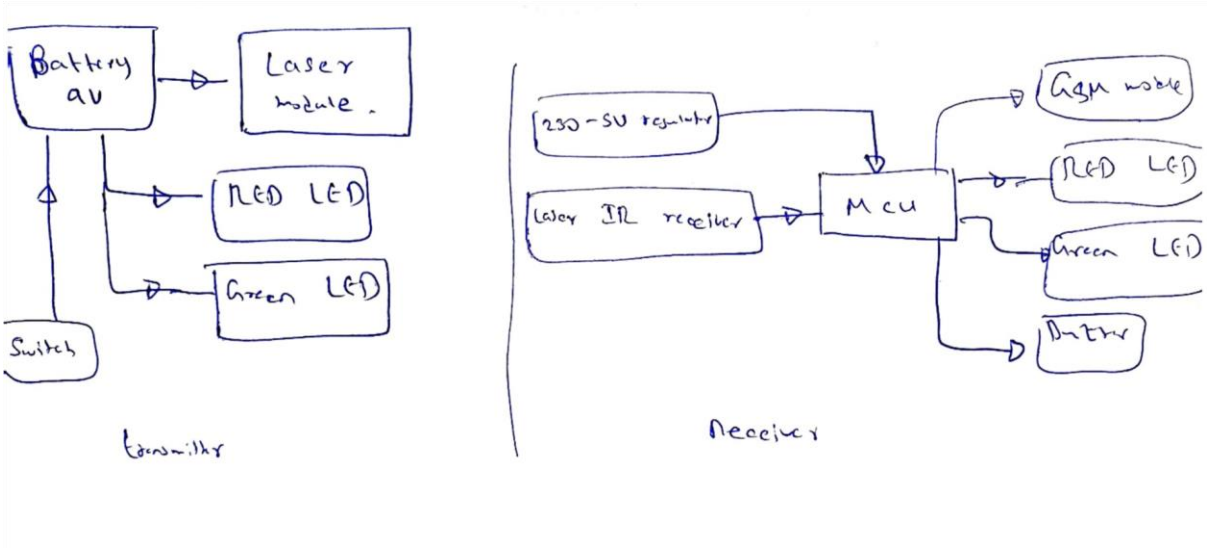
3.1.1. Block Diagram 1



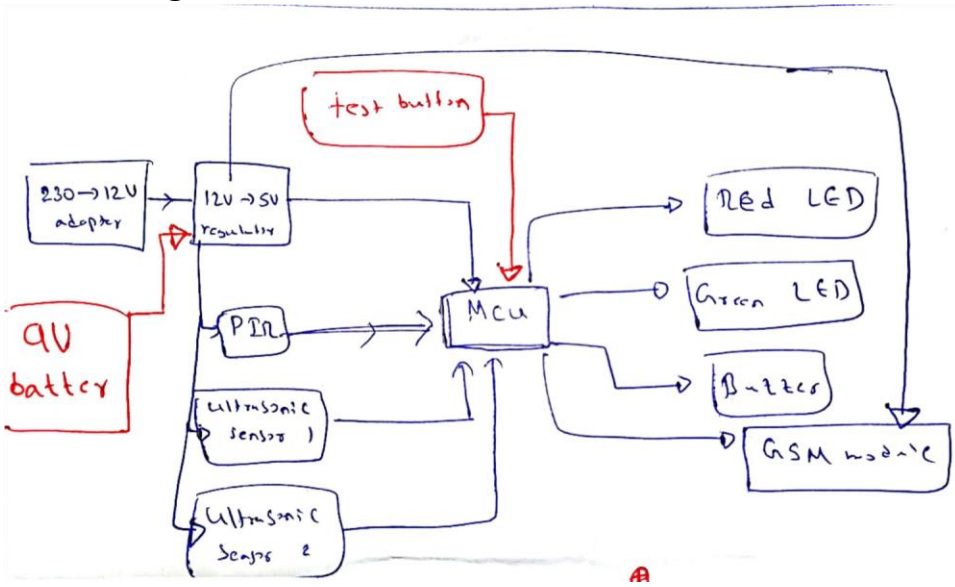
3.1.2. Block Diagram 2



3.1.3. Block Diagram 3

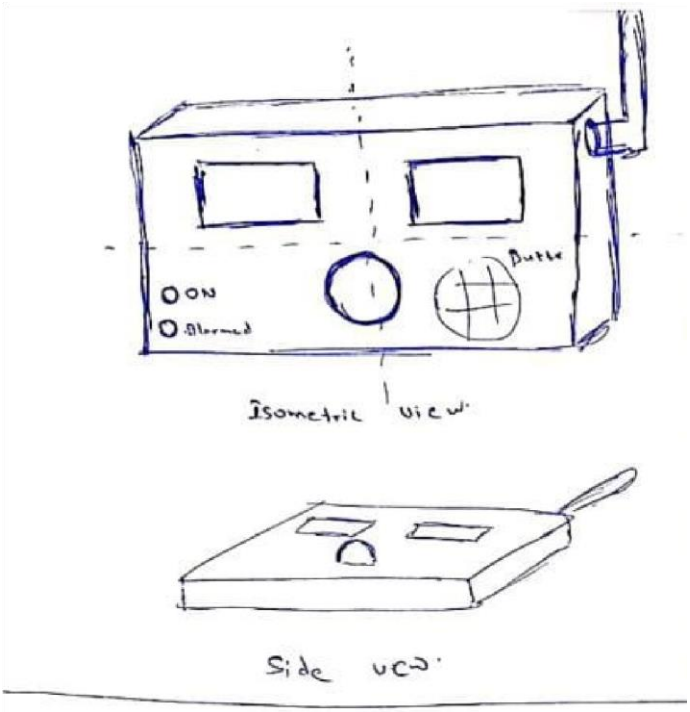


3.1.4. Block Diagram 4

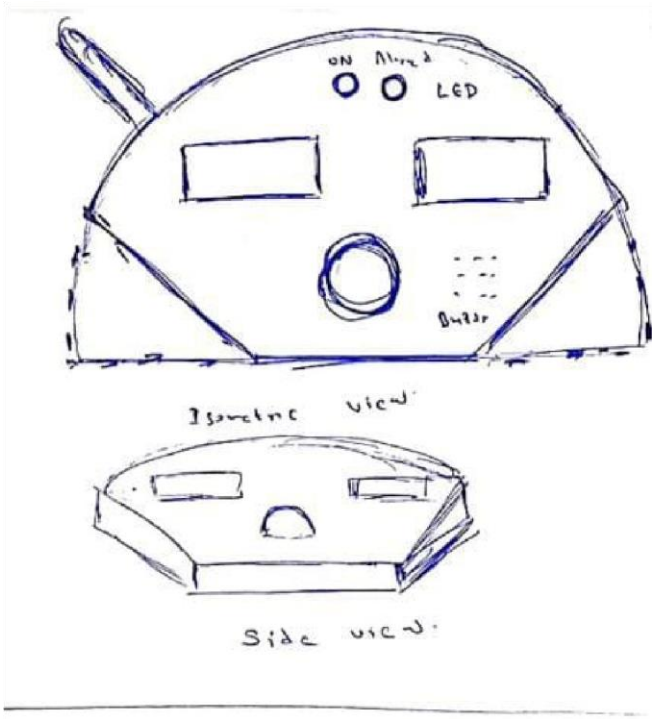


3.2.Enclosure Designs

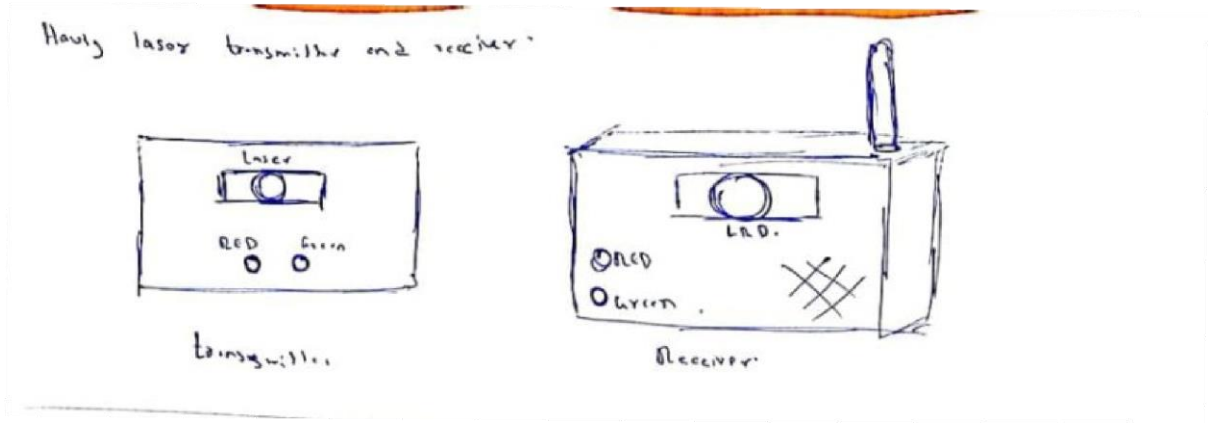
3.2.1. Design 1



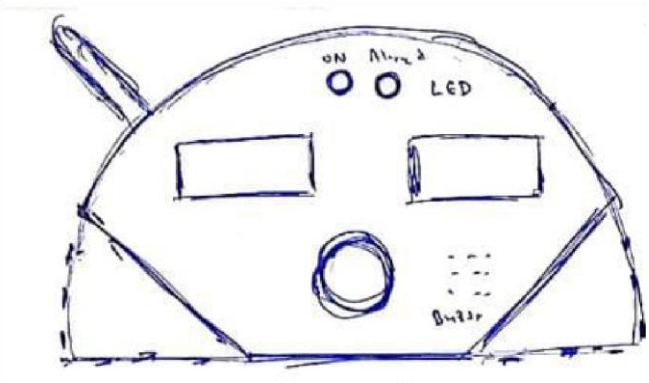
3.2.2. Design 2



3.2.3. Design 3



3.2.4. Design 4



3.3.Selection Matrices

3.3.1. Selection matrix: for sketches

Here, we have considered the following criteria in order to select the best enclosure design for my product.

I. Compatibility in manufacturing
II. Total cost for the components
III. Safety
IV. Material Selection
V. Easy Assembly
VI. Maintenance
VII. Complexity
VIII. Attractive

Criteria	Design 1	Design 2	Design 3	User survey design
Functionality	6	7	5	7
User Experience	5	6	5	6
Precision and Accuracy	6	5	4	5
Data Visualization	6	7	6	7

Data Storage and Sharing	7	8	5	8
Durability and Reliability	7	8	6	8
Cost-effectiveness	6	6	7	6
Power Efficiency	5	5	4	5
Aesthetics and Design Appeal	6	6	3	6
Feasibility	5	5	5	5
Total	**59**	**63**	**50**	**63**

Evaluating each sketch (driven by enclosure design), we came up with the following table with marks for each sketches given according to above mentioned criteria.

3.3.2. Selection Matrix: for circuits

Here, we have considered the following criteria in order to select the best circuit for my product.

I. Resource consumption
II. Total cost for the components
III. Reliability
IV. Power consumption
V. Availability of components
VI. Maintenance
VII. Complexity
VIII. Flexibility

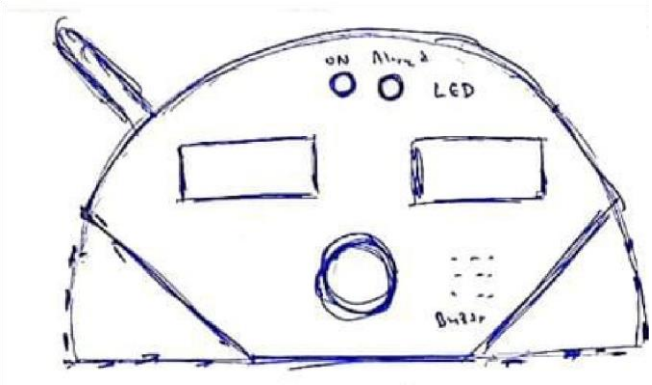
Evaluating each block diagram (driven by circuit functionality), we came up with the following table with marks for each sketches given according to above mentioned criteria.

Criteria	Block Diagram 1	Block Diagram 2	Block Diagram 3	Block Diagram 4
Resource consumption	**8**	**5**	**6**	**5**
Total cost for the components	**8**	**8**	**8**	**8**

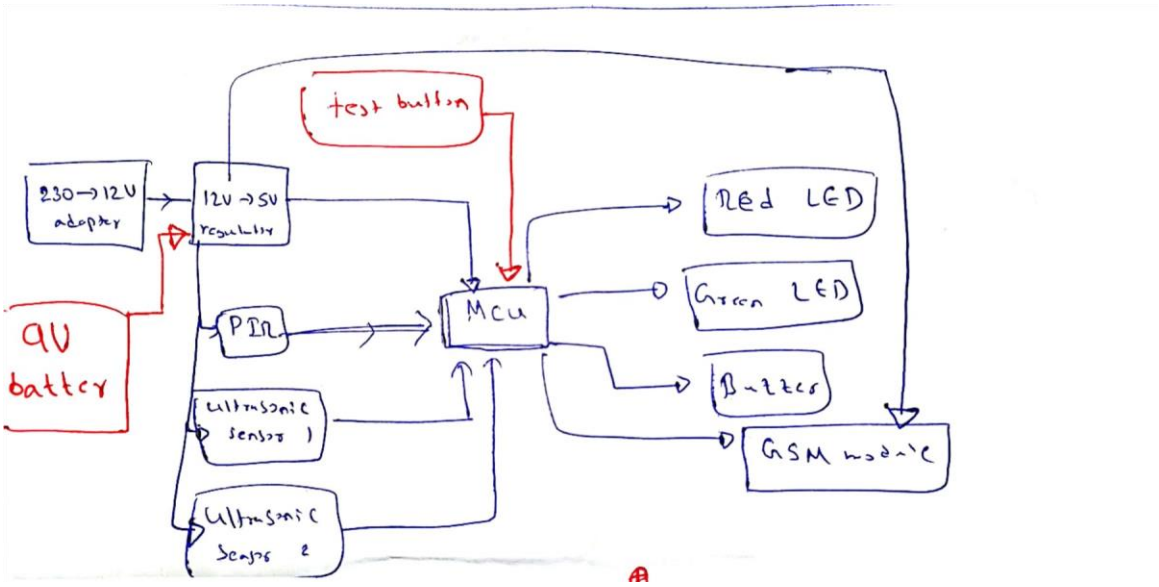
Reliability	**8**	**6**	**6**	**5**
Power consumption (more less more marks)	**8**	**5**	**5**	**7**
Availability of components	**8**	**5**	**5**	**6**
Maintenance	**8**	**5**	**5**	**5**
Complexity	**5**	**6**	**8**	**7**
Flexibility	**8**	**7**	**7**	**7**
Resource consumption	**5**	**6**	**6**	**6**
Total Marks	**66**	**53**	**56**	**56**

3.4.Conclusion from the Conceptual Design Cycle

3.4.1. Selected Enclosure Design



3.4.2. Selected Circuit Block Diagram



4. Preliminary Design

Preliminary Design 4.1. Product Specifications

Product specifications outline the detailed technical requirements and features of the Anti-Theft Motion Detector PIR+UltraSonic Alarm Security system. These specifications serve as a foundation for the design and development process, ensuring that the final product meets the desired performance standards. Below are the key product specifications:

Motion Detection System:

Dual-Sensor Approach: Integrating PIR and ultrasonic sensors.

Detection Range: PIR sensors with a range of up to 2 meters; ultrasonic sensors with a range of up to 2 meters.

Detection Accuracy: Minimum false alarm rate (<5%) to ensure reliability.

Power Supply and Consumption:

Input Power: DC/AC12-24V.

Low Power Consumption: RX15mA-TX30mA input current to optimize power usage.

Environmental Conditions:

Operating Temperature: -20°C to 70°C for reliable performance in varying climates.

Enclosure: Durable and anti-corrosive material for protection against harsh environments.

User Interface:

Mobile Application: Intuitive app for users to monitor and control the system remotely.

LED Indicators: Clear visual indicators for system status (e.g., armed, disarmed).

Multi-Layered Security System:

Security Levels: Configurable security levels (e.g., low, medium, high, fully trust) with distinct actions for each level.

Fully Trust Security Level: Real-time SMS alerts to user's designated mobile device and powerful audible buzzer activation.

Alert Notifications:

SMS Alerts: Real-time alerts containing information about detected motion and location details.

Audible Buzzer: Loud and attention-grabbing buzzer sound to prompt immediate user attention.

Customization and Personalization:

User Settings: Customizable security level configurations based on user preferences.

Mobile App Preferences: Adjustable notification preferences for SMS and buzzer alerts.

Mounting and Installation:

Wall Mounting: Easy-to-install system with essential components for wall mounting.

Versatile Placement: Suitable for installation in homes, offices, and warehouses.

Communication:

Wireless Connectivity: Efficient communication between sensors, control unit, and mobile app.

Data Encryption: Ensuring secure data transmission and protection against unauthorized access.

Testing and Validation:

Rigorous Testing: Comprehensive testing to validate motion detection accuracy and alert system functionality.

Reliability Testing: Ensuring the system operates reliably under different environmental conditions.

4.1.Extra features which would be implemented in this product

In addition to the core features outlined in the previous sections, the Anti-Theft Motion Detector PIR+UltraSonic Alarm Security system can be enhanced with some extra features to further improve its functionality, convenience, and user experience. These extra features include:

Mobile App Integration: Develop a comprehensive mobile application that allows users to remotely control and monitor the security system. The app can provide real-time alerts, allow users to arm/disarm the system remotely, and offer access to historical security event logs.

Camera Integration: Integrate a high-resolution camera into the security system to capture images or short video clips when motion is detected. This visual evidence can be valuable in identifying potential intruders and enhancing security.

Two-Way Audio Communication: Implement two-way audio communication between the security system and the user's mobile app. This feature allows users to listen to the surroundings and communicate with individuals within the monitored area, adding an extra layer of security.

Cloud Storage for Data: Provide the option for users to store security event logs, images, and video clips in secure cloud storage. This ensures that data is accessible even if the security system's physical storage is compromised.

Geofencing: Implement geofencing capabilities that allow the system to automatically arm or disarm based on the user's location. For example, the system can arm itself when the user leaves the premises and disarm when the user returns.

Integration with Smart Home Ecosystems: Enable integration with popular smart home ecosystems like Amazon Alexa, Google Assistant, or Apple HomeKit. This integration allows users to control the security system using voice commands and automate security actions based on other smart home devices' triggers.

Machine Learning-Based Behavior Analysis: Utilize machine learning algorithms to analyze motion patterns and identify anomalous behavior. The system can learn from regular patterns of movement and trigger alerts when unusual activities are detected.

Battery Backup: Include a built-in battery backup to ensure the security system continues to operate during power outages, providing uninterrupted security.

Remote Firmware Updates: Enable over-the-air firmware updates for the security system to ensure it remains up-to-date with the latest features, enhancements, and security patches.

Multiple User Access: Allow multiple users to access and control the security system, each with their designated permissions and access levels.

4.2.Improvements/Proposals from the Preliminary Design Cycles

During the preliminary design cycles of the Anti-Theft Motion Detector PIR+UltraSonic Alarm Security system, several improvements and proposals have been identified to enhance the system's performance, usability, and overall effectiveness. These improvements stem from rigorous testing, user feedback, and the pursuit of technological advancements. The following are the key improvements and proposals:

Enhanced Motion Detection Algorithm: Refine the motion detection algorithm by incorporating machine learning techniques. This will enable the system to adapt and improve its accuracy over time based on user behavior and environmental changes.

Battery Optimization: Implement power-saving measures to optimize battery usage and extend the system's battery life. This improvement is especially crucial for battery-powered devices in remote locations.

Advanced Camera Features: Improve the camera integration by adding features like night vision capabilities, pan-tilt-zoom (PTZ) functionality, and facial recognition. These enhancements will enable the system to capture clear images and identify potential intruders more effectively.

Intelligent Alert Prioritization: Introduce intelligent alert prioritization to categorize security events based on their severity. The system can then notify users of critical events first, ensuring prompt attention to potential security threats.

User-Friendly Mobile App Interface: Optimize the mobile app interface to be more user-friendly and intuitive. Incorporate user experience (UX) design principles to ensure smooth navigation and easy access to essential features.

Cloud-Based Storage Options: Offer users the choice of using cloud-based storage for security event logs, images, and videos. This option provides an additional layer of data backup and allows access to stored data from anywhere.

Geo-Location Services: Enhance the geofencing feature by integrating geo-location services to improve the accuracy of location-based actions. This will ensure the system reliably arms or disarms based on the user's precise location.

Third-Party Integrations: Explore partnerships with other smart home device manufacturers to enable seamless integration with a wider range of smart home ecosystems and devices.

Environmental Sensors: Integrate environmental sensors (e.g., temperature, humidity) into the system to monitor the environment's conditions and provide alerts for potential risks like fire or flooding.

Redundancy and Fail-Safe Mechanisms: Incorporate redundancy and fail-safe mechanisms to ensure continuous operation even in the event of sensor or communication failures.

Comprehensive User Guides and Support: Develop comprehensive user guides and provide robust customer support to assist users in setting up and using the security system effectively.

4.2.1. Problems Identified by User Feedbacks

4.2.2. Based on user feedback received during the preliminary design cycles of the Anti-Theft Motion Detector PIR+UltraSonic Alarm Security system, several problems and areas of improvement have been identified. Addressing these issues is crucial to enhance user satisfaction and the overall effectiveness of the product. The following are the main problems identified through user feedback:

4.2.3. False Alarms: Users reported instances of false alarms triggered by non-human movements, such as pets or moving objects like curtains. This led to annoyance and a lack of trust in the system's accuracy.

4.2.4. Complex Setup Process: Some users found the initial setup process challenging and time-consuming. The complexity of configuring the system and connecting it to the mobile app caused frustration.

4.2.5. Limited Communication Range: A few users experienced communication issues between the sensors and the control unit, particularly in larger properties or areas with thick walls.

4.2.6. Delayed Alert Notifications: In certain cases, there were delays in receiving SMS alerts and push notifications, which reduced the system's responsiveness to security events.

4.2.7. Insufficient Mobile App Features: Users expressed a desire for more advanced features and customization options within the mobile app, such as the ability to adjust motion sensitivity or camera settings.

4.2.8. Limited Battery Life: For battery-operated models, some users found that the battery life was shorter than expected, requiring frequent replacements or recharging.

4.2.9. Camera Image Quality: Users reported that the image quality captured by the integrated camera could be further improved, especially in low-light conditions.

4.2.10. Lack of Integration with Smart Home Devices: Users expressed interest in integrating the security system with their existing smart home devices, but compatibility with other ecosystems was limited.

4.2.11. Inconsistent Geofencing Performance: Geofencing activation and deactivation sometimes exhibited inconsistencies, resulting in occasional disarming or arming issues.

4.2.12. Complexity of Multi-Layered Security System: A few users found it challenging to understand and configure the multi-layered security system effectively, as it required a clear understanding of the various security levels and their corresponding actions.

4.2.13. Addressing these problems and feedback will be critical to refining the design and ensuring the Anti-Theft Motion Detector PIR+UltraSonic Alarm Security system meets user expectations and delivers a seamless and reliable security experience. Implementing solutions for these issues will contribute to the system's overall effectiveness and user satisfaction, making it a standout product in the security market. Regular usability testing and continuous improvements based on user feedback will be integral to achieving these goals.

4.2.14. Improvements Proposed by the User Feedbacks

Based on the valuable user feedback received, the following are the proposed improvements to address the identified issues and enhance the Anti-Theft Motion Detector PIR+UltraSonic Alarm Security system:

False Alarm Reduction Algorithm: Develop and implement an advanced false alarm reduction algorithm that differentiates between human and non-human movements. This algorithm should consider factors like size, shape, and motion patterns to minimize false alarms caused by pets or moving objects.

Streamlined Setup Wizard: Revise the setup process to include a user-friendly, step-by-step setup wizard within the mobile app. This will guide users through the initial configuration, ensuring a smoother and more intuitive installation experience.

Signal Boosters/Repeaters: Offer optional signal boosters or repeaters to extend the communication range between sensors and the control unit. This will enhance communication reliability, especially in larger properties.

Real-Time Alert Optimization: Optimize the alert notification system to ensure real-time SMS alerts and push notifications. Employ faster communication protocols and server infrastructure upgrades to minimize any delays in receiving alerts.

Feature-Rich Mobile App: Expand the mobile app's features to include customizable motion sensitivity settings, camera configuration options, and the ability to view live camera feeds. Users should be able to tailor the system to their specific needs and preferences.

Battery Life Optimization: Enhance the system's power management to optimize battery life for battery-operated models. This may involve reducing power consumption during standby periods or offering optional high-capacity batteries.

Improved Camera Hardware: Upgrade the camera hardware to improve image quality, especially in low-light conditions. Incorporate advanced image sensors and low-light enhancement technologies to ensure clearer images.

Smart Home Integration: Establish partnerships and develop APIs to integrate the security system with popular smart home ecosystems like Amazon Alexa, Google Assistant, and Apple HomeKit. This will enable seamless control and automation through voice commands and other smart devices.

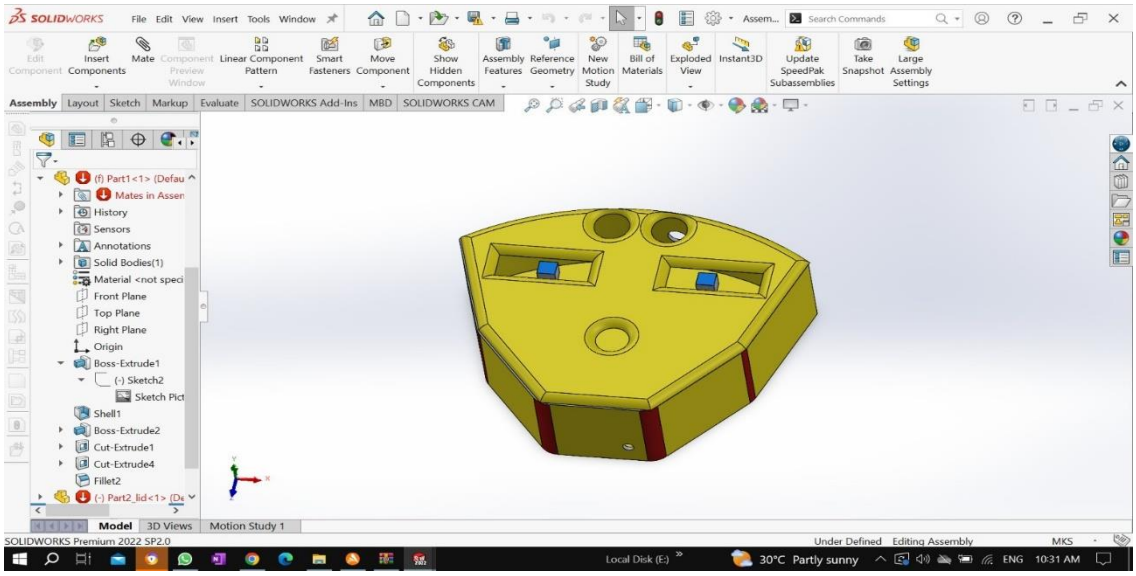
Enhanced Geofencing Algorithm: Refine the geofencing algorithm to ensure consistent and accurate arming and disarming based on the user's location. Implement geofencing tolerance zones to prevent unintended security system actions.

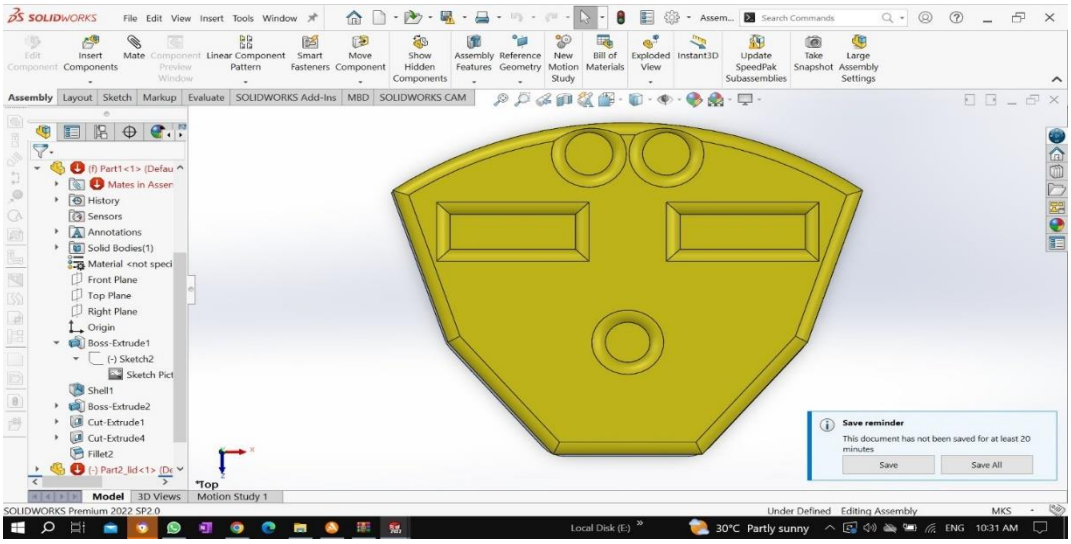
User-Friendly Security Level Configuration: Simplify the configuration process for the multi-layered security system. Provide user-friendly interfaces within the mobile app to define security levels and customize corresponding actions easily.

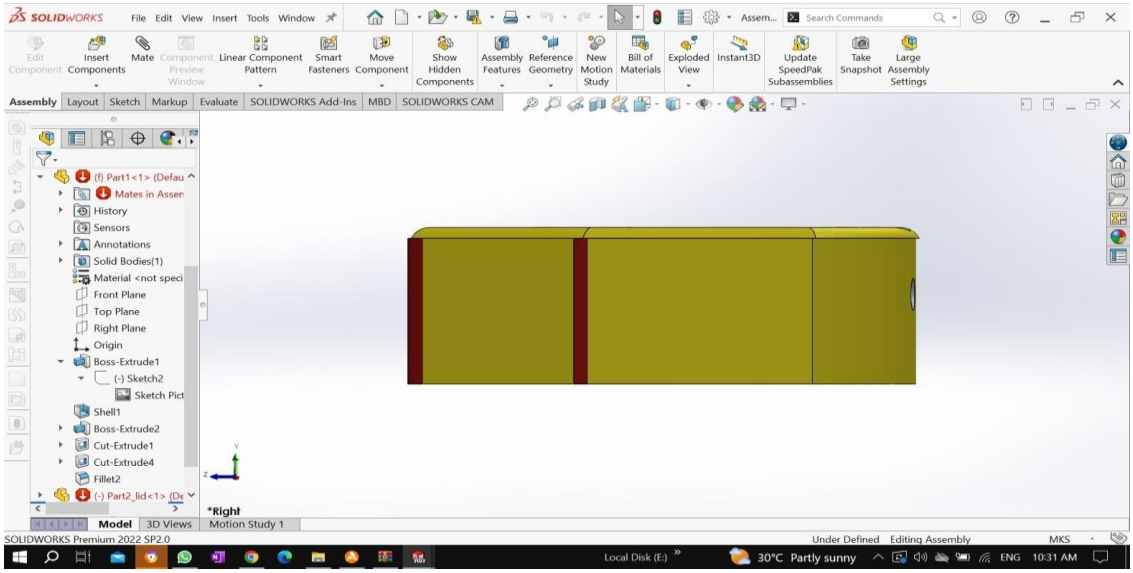
By incorporating these proposed improvements, the Anti-Theft Motion Detector PIR+UltraSonic Alarm Security system will address user concerns and expectations, resulting in a more reliable, user-friendly, and feature-rich security solution. Continuous collaboration with users and usability testing will be essential to ensuring that the implemented improvements meet user needs effectively. The goal is to create a security system that not only offers enhanced protection but also seamlessly integrates into users' lifestyles and smart home environments.

5. Implemented Design

5.1.Implemented Enclosure Design



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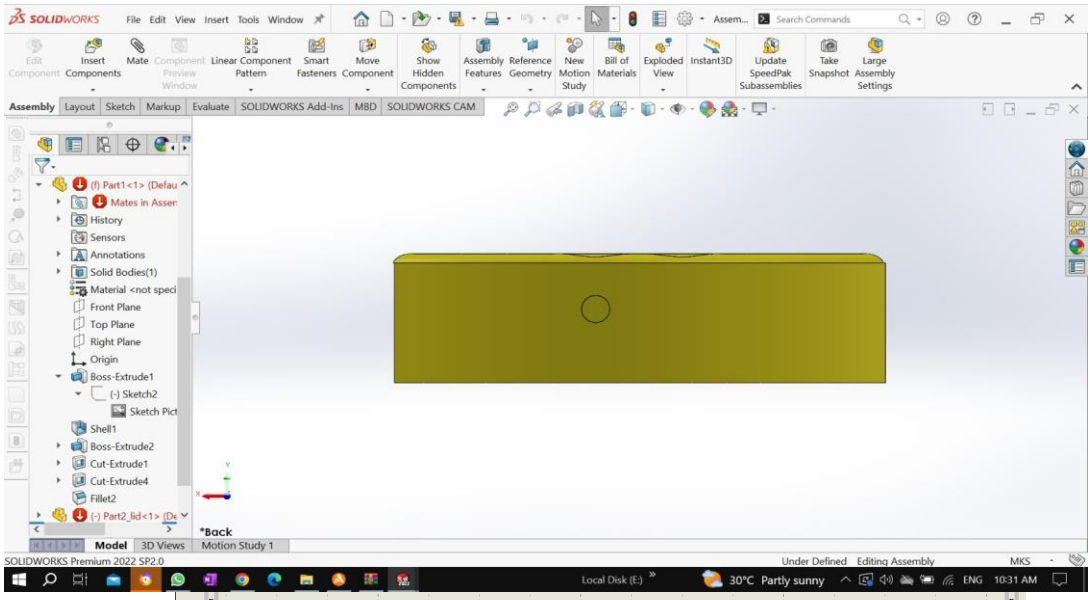
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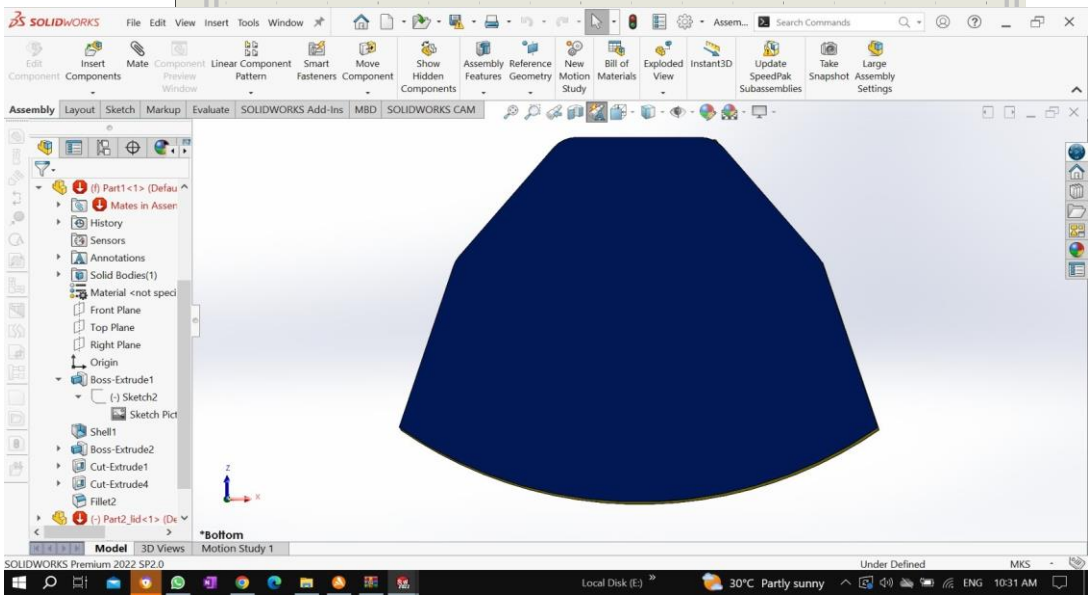
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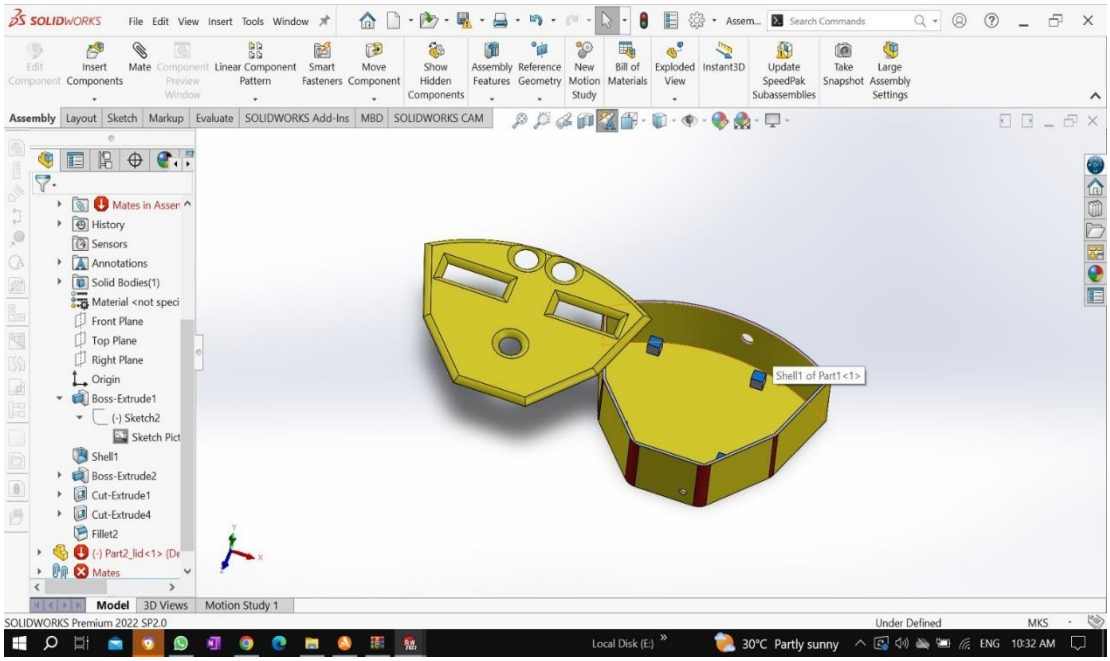
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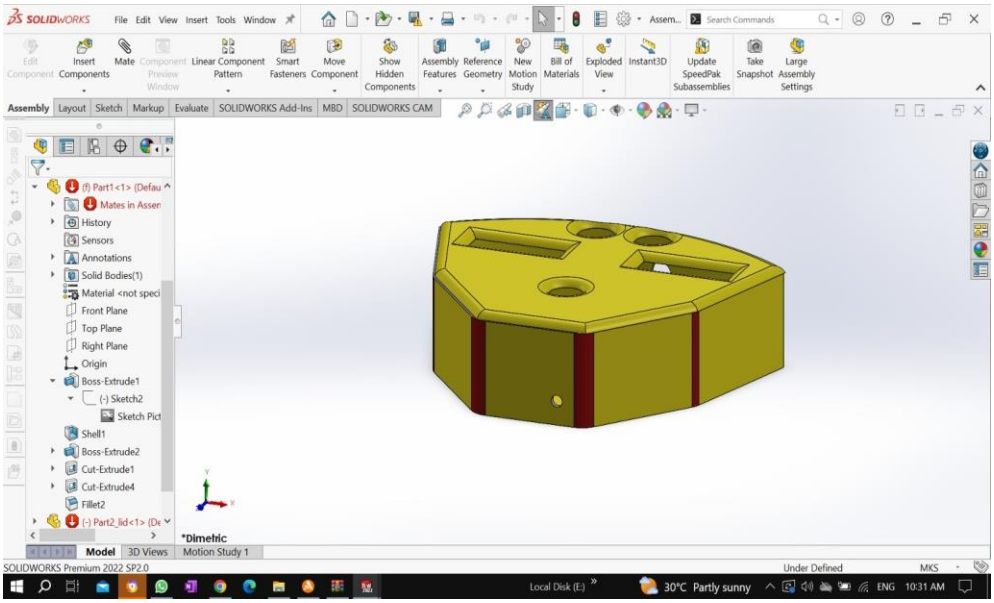
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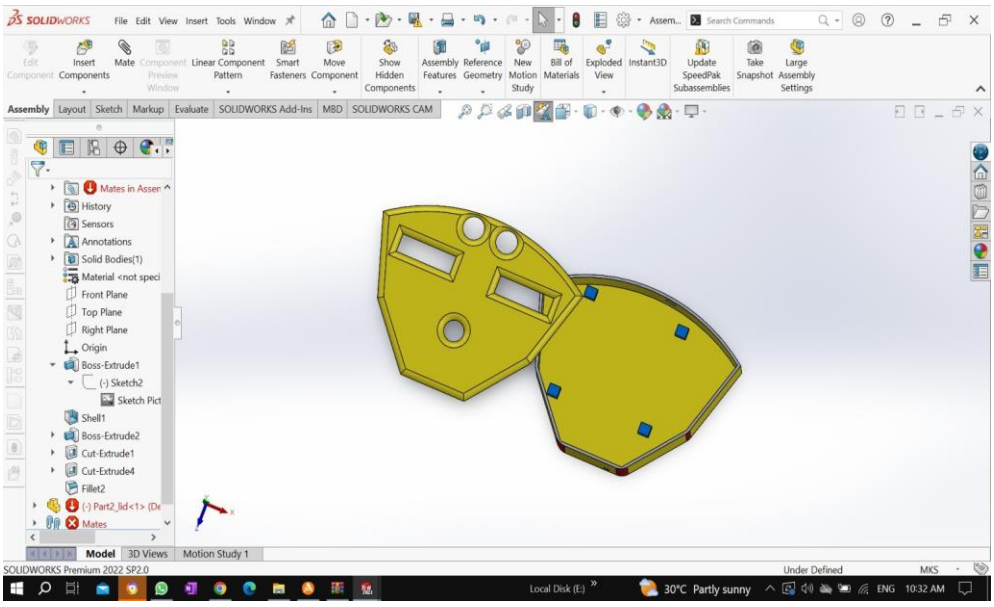
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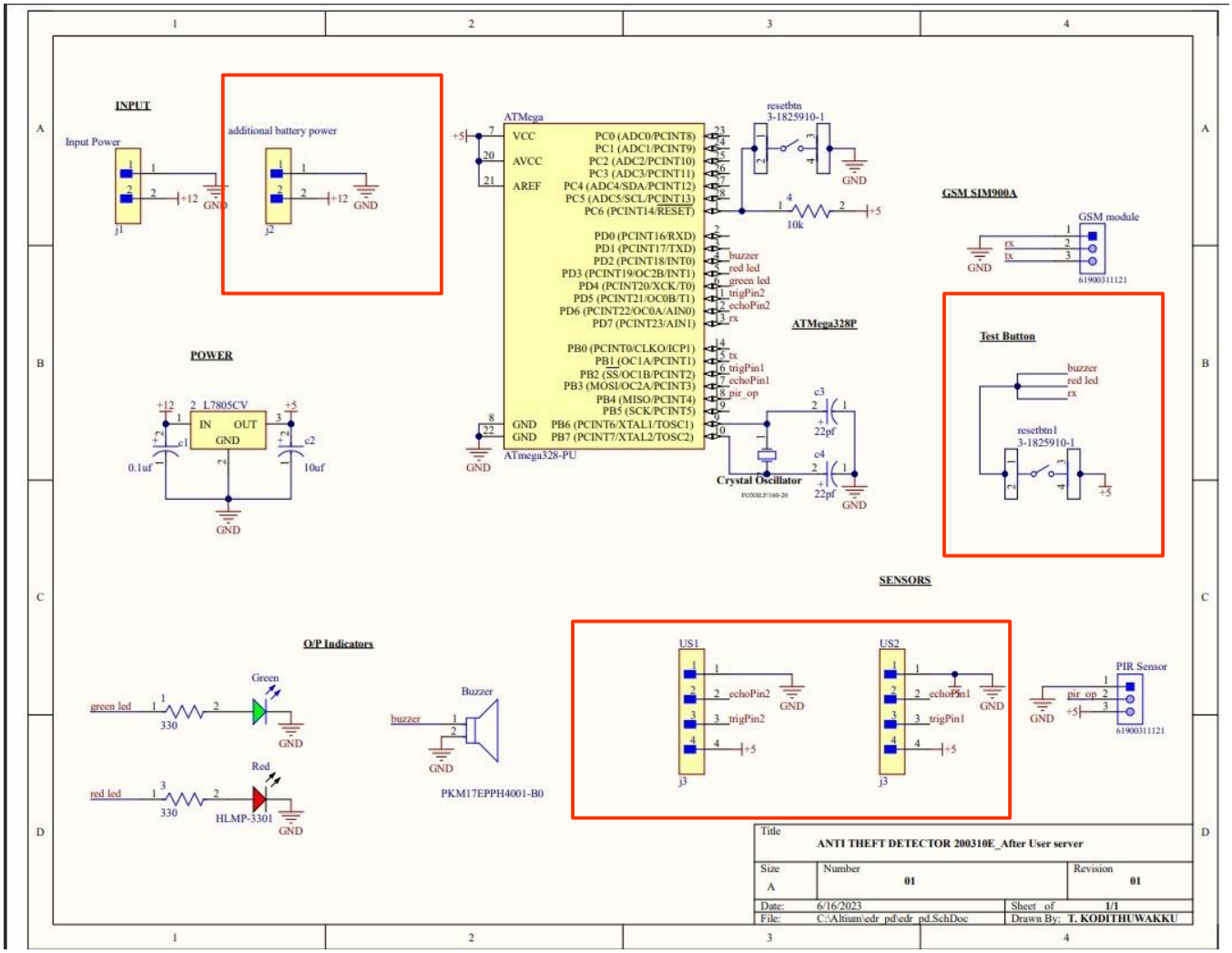

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