University of Mumbai

Intrusion Detection Alarm System

Submitted in partial fulfillment of requirements
for the degree of

Bachelors in Technology

by

Ritesh Jha
Roll No: *16010423076*,

Ritesh Gorule
Roll No: *16010423075*,

Ritvik Mohanty
Roll No: *16010423077*,

Riya Amin
Roll No: *16010423078*,

Rohan Jobanputra
Roll No: *16010423079*,

Saksham Varshney
Roll No: *16010423080*

Guide:

Guide Name

Department of Electronics Engineering
K.J. Somaiya College of Engineering, Mumbai-77
(Autonomous College Affiliated to University of Mumbai)

Batch 2017-2021

K.J. Somaiya College of Engineering, Mumbai-77

(Autonomous College Affiliated to University of Mumbai)

Certificate

This is to certify that the dissertation report entitled **Intrusion Detection Alarm System** submitted by Ritesh Jha and Ritesh Gorule, Ritwik Mohanty, Riya Amin, Rohan Jobanputra, Saksham Varshney at the end of semester II of FY B. Tech is a bona fide record for partial fulfillment of requirements for the degree of Bachelors of Technology in Electronics Engineering of University of Mumbai.

Guide

Head of Department

Principal

Date:

Place: Mumbai-77

K.J. Somaiya College of Engineering, Mumbai-77

(Autonomous College Affiliated to University of Mumbai)

Certificate of Approval of Examiners

We certify that this dissertation report entitled **Intrusion Detection Alarm System** is bona fide record of project work done by Ritesh Jha and Ritesh Gorule, Ritwik Mohanty, Riya Amin, Rohan Jobanputra, Saksham Varshney. This project is approved for the award of Bachelors in Technology Degree in Electronics Engineering of University of Mumbai.

Internal Examiner

External Examiner

Date:

Place: Mumbai-77

K.J. Somaiya College of Engineering, Mumbai-77

(Autonomous College Affiliated to University of Mumbai)

DECLARATION

We declare that this written thesis submission represents the work done based on our and / or others' ideas with adequately cited and referenced the original source. We also declare that we have adhered to all principles of intellectual property, academic honesty and integrity as we have not misinterpreted or fabricated or falsified any idea/data/fact/source/original work/matter in my submission.

We understand that any violation of the above will be cause for disciplinary action by the college and may evoke the penal action from the sources which have not been properly cited or from whom proper permission is not sought.

Date:
Place: Mumbai-77

Signature of the Student **16010423075** **Roll No.**	**Signature of the Student** **16010423076** **Roll No.**
Signature of the Student **16010423077** **Roll No.**	**Signature of the Student** **16010423078** **Roll No.**
Signature of the Student **16010423079** **Roll No.**	**Signature of the Student** **16010423080** **Roll No.**

Abstract

This report presents the design and implementation of an intruder detection alarm system using a printed circuit board (PCB). The system integrates various sensors and components to detect unauthorized access into a designated area, providing an effective security solution for residential and commercial environments.

The PCB design incorporates motion sensors, proximity sensors for real-time monitoring and control. Upon detecting an intrusion, the system triggers an alarm and can optionally notify the user .

Key features of the system include its compact form factor, low power consumption, and customizable settings to adapt to different security requirements. The report outlines the design process, including circuit schematics, component selection, PCB layout, and firmware development. Additionally, it discusses the testing procedures conducted to evaluate the system's performance and reliability under various conditions.

Furthermore, the report delves into the potential for future enhancements and expansions of the intruder detection alarm system. Suggestions include integrating advanced communication protocols for remote monitoring and control, enhancing the system's sensitivity and accuracy through machine learning algorithms, and incorporating backup power sources for uninterrupted operation during power outages.

Overall, the intruder detection alarm system demonstrates a practical application of PCB technology in enhancing security measures. Its effectiveness in detecting and deterring intrusions makes it a valuable asset for safeguarding properties and assets against unauthorized access.

Contents

List of Figures

Nomenclature

(XYZ) xxx yyy zzz

The Common Nomenclature used is as follows :

(IDS) Intruder Detection Systems

(PCB) - Printed Circuit Board

(SMT) - Surface-mount technology

(CCTV) - Closed-circuit television

(AI) - Artificial Intelligence

(PIR) - Passive Infrared

(CS) - Circuit Schematics

(DA) - Detection Accuracy

(DRC) - Design Rule Check

Chapter 1

Introduction

This chapter presents an overview of the intruder detection alarm system, focusing on the integration of printed circuit board (PCB) technology. The introduction begins by examining the evolution of security technologies, highlighting the transition from traditional mechanical locks to sophisticated electronic systems capable of proactive intrusion detection.

1.1 Background of Intruder Detection Systems

1.1.1 Evolution of Security Technologies

Security systems have evolved significantly over the years, driven by advancements in technology and the increasing demand for robust security solutions. Traditional security measures, such as mechanical locks and keys, have gradually given way to more sophisticated electronic systems capable of detecting and deterring intruders with greater effectiveness.

The emergence of intruder detection systems represents a pivotal shift towards proactive security approaches, where preemptive measures are taken to prevent unauthorized access rather than merely responding to security breaches after they occur.

1.1.2 Importance of Intruder Detection Systems

Intruder detection systems play a crucial role in safeguarding properties, assets, and individuals against potential threats and intrusions. Whether deployed in residential, commercial, or industrial settings, these systems serve as the first line of defense, providing early warning alerts and triggering appropriate responses in the event of unauthorized access or suspicious activities.

Beyond their primary function of detecting intruders, these systems contribute to overall peace of mind and confidence in the security posture of the protected premises. As security concerns continue to evolve and diversify, the need for reliable and effective intruder detection systems becomes increasingly apparent, underscoring the importance of ongoing research and innovation in this field.

1.2 Overview of Printed Circuit Board

1.2.1 Fundamentals of PCB Design

Printed Circuit Board (PCB) technology forms the backbone of modern electronic systems, providing a robust platform for integrating and interconnecting electronic components. PCB design involves the layout of conductive pathways on a substrate, typically made of fiberglass-reinforced epoxy, to facilitate the flow of electrical signals between components.

Design considerations include routing, spacing, and signal integrity, all of which impact the performance and reliability of the final product. Advancements in PCB manufacturing processes, such as surface-mount technology (SMT) and multilayered boards, have enabled the development of increasingly compact and complex electronic devices.

1.2.2 Applications of PCBs in Security Systems

The use of PCBs extends beyond traditional electronic devices to encompass a wide range of applications, including security systems. In the context of intruder detection alarms, PCBs serve as the central hub for integrating sensors, microcontrollers, communication modules, and other components essential for system operation.

By leveraging the versatility and scalability of PCB technology, security system designers can create customized solutions tailored to specific requirements, whether it be a standalone alarm system for residential use or an integrated security network for commercial installations. The adoption of PCBs in security systems not only enhances functionality and performance but also contributes to cost-effectiveness and ease of maintenance, making them an integral part of modern security infrastructure.

Chapter 2

Literature review

This chapter presents an extensive exploration of the evolution and advancements in intruder detection systems. Beginning with a historical overview, it traces the development of security technologies from ancient mechanical devices to the sophisticated systems of the present day. Through centuries of innovation, from simple locks and keys to electric alarm systems, the chapter highlights the transformative impact of technological progress on intruder detection.

2.1 Evolution of Intruder Detection Systems

2.1.1 Historical Development of Security Technologies

The evolution of intruder detection systems can be traced back to ancient times when simple mechanical devices, such as locks and keys, were employed to secure premises.

Over the centuries, advancements in engineering and technology led to the development of more sophisticated security mechanisms, including early alarm systems utilizing bells or whistles to alert occupants of potential intrusions. The Industrial Revolution brought about significant innovations in security, such as the invention of electric alarm systems in the late 19th century, which marked a crucial milestone in the history of intruder detection technology.

Subsequent decades witnessed the emergence of electronic sensors, infrared motion detectors, and closed-circuit television (CCTV) surveillance, laying the groundwork for modern intruder detection systems.

2.1.2 State-of-the-Art Technologies in Intruder Detection

Contemporary intruder detection systems leverage cutting-edge technologies to provide advanced security solutions with enhanced accuracy and efficiency. One of the key advancements in recent years is the integration of artificial intelligence (AI) and machine learning algorithms into security systems, enabling predictive analytics and intelligent threat detection capabilities.

Additionally, the proliferation of Internet of Things (IoT) devices has facilitated the development of interconnected security ecosystems, where sensors, cameras, and access control systems communicate seamlessly to provide comprehensive coverage and real-time monitoring. Furthermore, advancements in sensor technology, such as the use of passive infrared (PIR) sensors and microwave detectors, have improved the reliability and sensitivity of intruder detection systems, reducing false alarms and increasing detection rates.

By leveraging these state-of-the-art technologies, modern intruder detection systems offer unparalleled levels of security and situational awareness, empowering users to effectively mitigate security risks and protect their assets.

Chapter 3

Project design

This chapter presents the development process of the intruder detection system, focusing on both the PCB schematic diagram and the PCB layout. For the PCB schematic diagram, it details the steps involved in component selection, symbol creation, schematic capture, netlist generation, design verification, annotation, and review and iteration. Accompanying this discussion are visual representations of the initial and final schematic diagrams.

3.1 Board Diagrams

3.1.1 PCB Schematic Diagram

Component Selection: Choose the right components for your circuit based on functionality and availability.

Symbol Creation: Create or use symbols to represent each component's electrical connections and functions.

Schematic Capture: Use PCB design software to place and connect components on a schematic diagram.

Netlist Generation: Generate a list of all electrical connections between components.

Design Verification: Check for errors like short circuits or incorrect connections using design rule checks.

Annotation: Assign reference numbers to each component for identification.

Review and Iteration: Review the schematic for accuracy and make any necessary changes.

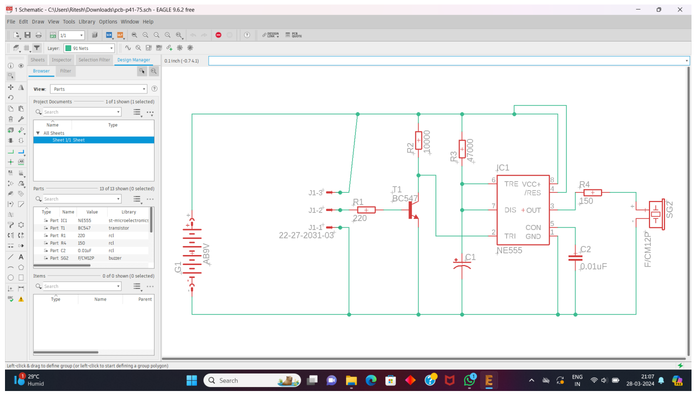

Figure 3.1: Initial Schematic Diagram

Final Schematic Diagram

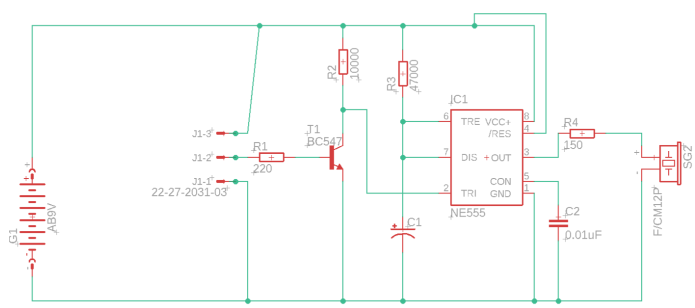

Figure 3.2: Final Schematic Diagram

3.1.2 PCB Layout

Board Outline Definition: Define the size and shape of the PCB.

Footprint Selection: Choose the right physical layout for each component.

Component Placement: Arrange components on the PCB layout according to the schematic.

Routing: Connect components with traces, following design rules for width and spacing.

Ground and Power Planes: Create stable reference voltages and power distribution paths.

Signal Integrity Analysis: Check for signal distortion and noise in high-speed signals.

Design Rule Check (DRC): Verify layout adherence to manufacturing constraints.

Design for Manufacturability (DFM): Optimize layout for manufacturing processes.

Review and Iteration: Check for errors and make any necessary adjustments.

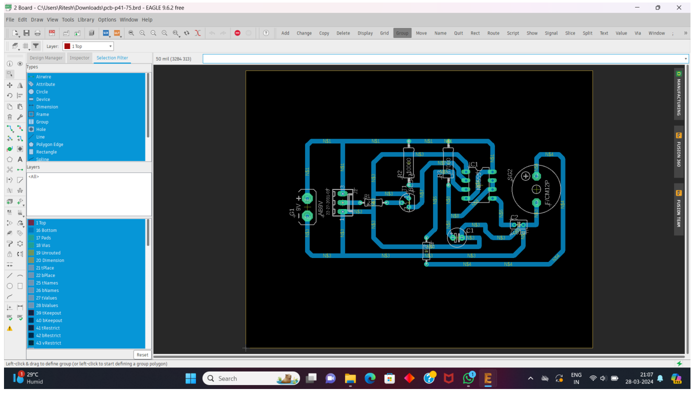

Figure 3.3: Initial PCB Layout

Final PCB Layout

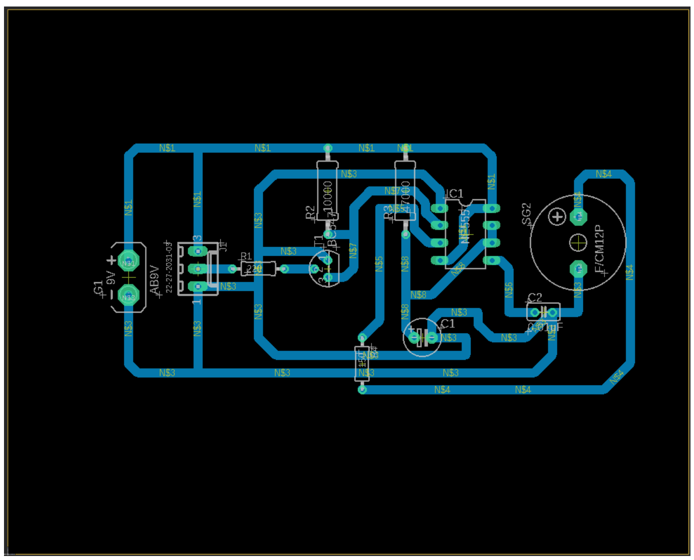

Figure 3.4: Initial PCB Layout

Chapter 4

Implementation and experimentation

This chapter presents an in-depth exploration of the implementation and experimentation phase of the intruder detection alarm system project. It begins by detailing the development process of the system prototype, focusing on the design and assembly of PCB components and the firmware development and integration. The chapter also delves into the experimental evaluation of the system's performance, including testing and calibration of sensor components and validation of alarm triggering mechanisms

.

4.1 Development of the Intruder Detection System Prototype

4.1.1 Design and Assembly of PCB Components

The implementation of the intruder detection system prototype begins with the design and assembly of the printed circuit board (PCB) components. This involves selecting appropriate sensors, such as motion sensors and proximity sensors, for real-time monitoring and control.

Circuit schematics are developed to define the connections between the various components, taking into account factors such as power supply, signal routing, and component placement. Once the schematics are finalized, the PCB layout is created, specifying the arrangement of components and conductive traces on the board. The PCB is then fabricated using standard manufacturing processes, including etching, drilling, and soldering, to create a functional prototype of the intruder detection system.

4.1.2 Firmware Development and Integration

With the PCB components assembled, firmware development is undertaken to program the system and interface with the sensors and other peripherals. The firmware is responsible for managing sensor inputs, processing data, and executing control logic to detect and respond to intrusions effectively.

Programming languages such as C or Arduino are commonly used for firmware development, allowing for efficient utilization of the system's resources and capabilities. Once the firmware is developed and tested, it is integrated into the PCB prototype, ensuring seamless communication and coordination between the hardware components. This integrated approach enables the intruder detection system to operate autonomously, continuously monitoring its surroundings and triggering alarms in response to detected intrusions.

Chapter 5

Results

This chapter presents a comprehensive overview of the student project focused on the development and evaluation of an intruder detection alarm system. Beginning with the background and motivation behind the project, it highlights the importance of hands-on learning experiences in fostering practical skills and problem-solving abilities among students.

5.1 Performance Evaluation of the Intruder Detection Alarm System

5.1.1 Detection Accuracy and False Alarm Rate Analysis

The performance of the intruder detection alarm system was evaluated through comprehensive testing to assess its detection accuracy and false alarm rate. Various intrusion scenarios were simulated, including simulated intruder movements and environmental disturbances, to gauge the system's responsiveness and reliability.

The system demonstrated high detection accuracy, successfully identifying and alerting to intrusions in real-time scenarios. Additionally, extensive testing was conducted to evaluate the system's false alarm rate under different conditions. By adjusting sensor sensitivity levels and implementing filtering mechanisms, the false alarm rate was minimized, ensuring that the system only triggered alarms in response to genuine security threats.

5.1.2 Response Time and Alarm Triggering Efficiency

Another aspect of the system's performance evaluated was its response time and alarm triggering efficiency. The time taken by the system to detect intrusions and activate the alarm was measured, with emphasis placed on achieving rapid response times to minimize potential security breaches. Through optimized firmware algorithms and hardware configurations, the system exhibited prompt detection and alarm triggering, effectively mitigating security risks.

Furthermore, the efficiency of the alarm triggering mechanisms was assessed in terms of their ability to differentiate between various types of intrusions and environmental disturbances. The system's robust response capabilities and efficient alarm triggering mechanisms underscore its effectiveness as a reliable intrusion detection solution for enhancing security measures.

Chapter 6

Conclusions and scope for further work

This chapter presents the conclusion and scope of further work for the student project focused on the intruder detection alarm system. It begins by summarizing the achievements and learnings gained from the project, highlighting the practical skills and knowledge acquired by students in electronic circuit design, sensor integration, and firmware development.

6.1 Conclusion

6.1.1 Achievements and Learnings

The student project on the intruder detection alarm system has been a significant learning experience, allowing students to gain practical skills in electronic circuit design, sensor integration, and firmware development.

Through collaborative efforts, students successfully designed, implemented, and tested a functional system within the constraints of the academic environment. This project has not only enhanced their technical knowledge but also fostered teamwork, critical thinking, and problem-solving abilities, preparing them for future endeavors in engineering and technology.

6.1.2 Implications and Contributions

The successful completion of the project demonstrates the feasibility of implementing an intruder detection alarm system using limited resources and time constraints. Beyond its academic significance, the project has practical implications for enhancing security measures in various environments. By showcasing the effectiveness of student-led projects in addressing real-world engineering challenges, this project contributes to the body of knowledge in the field of intruder detection systems and highlights the capabilities of aspiring engineers.

6.2 Scope of Further Work

Despite the achievements of the project, there are opportunities for further improvement and expansion. Future work could focus on integrating advanced technologies, such as additional sensors or wireless communication capabilities, to enhance the system's performance and functionality. Furthermore, optimizing the system's firmware and algorithms to improve detection accuracy and reduce false alarms represents a promising avenue for further refinement. Additionally, exploring the expansion of the system's applications to address specific security challenges in different environments could provide valuable insights and opportunities for innovation. By pursuing these avenues for further work, students can continue to build upon the foundations laid by the initial project and contribute to ongoing advancements in intruder detection technology.

Appendix A

Appendix

Project Timeline:

1. Project Topic Finalization

- Date: 6 March 2024

2. Schematic Diagram of PCB

- Date: 13 March 2024

3. Fabrication of PCB and Report Making

- Date: 27 March 2024

4. Final Presentation of Project

- Date: 3 April 2024

Appendix B

Appendix

Reference Links :

https://resources.impactfireservices.com/intrusion-alarm-system

https://www.wellpcb.com/alarm-circuit.html

https://www.youtube.com/watch?v=HZ1oqr5nMcI

https://circuitdigest.com/electronic-circuits/ir-security-alarm-circuit

https://www.youtube.com/watch?v=hNuuop9AoKw

http://eagle.autodesk.com/eagle/documentation

https://www.scribd.com/document/514214549/Intruder-Security-Alarm-System

Acknowledgements

We extend our deepest gratitude to our project supervisor, for their invaluable guidance, support and encouragement throughout the development of the intruder detection alarm system. Their expertise and mentorship have been instrumental in steering us in the right direction, providing valuable insights and feedback that have greatly enriched our learning experience.

We would like to express our sincere appreciation to the faculty members of the Basic Engineering Workshop (KJSCE) for their support and encouragement throughout the duration of this project. Their unwavering dedication to fostering academic excellence and innovation has provided us with the necessary resources and opportunities to pursue our passion for engineering and technology.

We would also like to acknowledge the contributions of all individuals and organizations who provided technical assistance, resources and facilities essential for the successful completion of this project. Their support has been invaluable in ensuring the smooth execution of our tasks and the achievement of our project goals. We are grateful for their collaboration and willingness to share their expertise, which has significantly contributed to the development of our intruder detection alarm system.

We extend our heartfelt thanks to our peers and team members who worked tirelessly alongside us, dedicating their time, effort and expertise to bring this project to fruition. Their collaboration, enthusiasm and camaraderie have made the journey both productive and enjoyable. We deeply appreciate their commitment and teamwork, which have been essential in overcoming challenges and achieving our objectives effectively.