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NAAC Accredited Autonomous Institution
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A Minor Project Report

on

AUTOMATED PASSENGER ENTRY VALIDATION AND MONITORING SYSTEM IN TRAIN

Submitted by

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M. KUMARASAMY COLLEGE OF ENGINEERING

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BONAFIDE CERTIFICATE

Certified that this report titled **"AUTOMATED PASSENGER ENTRY VALIDATION AND MONITORING SYSTEM IN TRAIN"** is the Bonafide work of **ATHIKESANAN S (927622BEE009), CHARMITHA P S (927622BEE015), KARNA S (927622BEE051)** who carried out the work during the academic year (2024-2025) under my supervision. Certified further that to the best of my knowledge the work reported herein does not form part of any other project report.

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Submitted for Minor Project III (18EEP301L) viva-voce Examination held at M.Kumarasamy College of Engineering,Karur-639113 on ……..

DECLARATION

We affirm that the Minor Project report titled "**AUTOMATED PASSENGER ENTRY VALIDATION AND MONITORING SYSTEM IN TRAIN"** being submitted in partial fulfillment for the award of **Bachelor of Engineering in Electrical and Electronics Engineering** is the original work carried out by us.

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VISION AND MISSION OF THE INSTITUTION

VISION

- ✓ To emerge as a leader among the top institutions in the field of technical education

MISSION

- ✓ Produce smart technocrats with empirical knowledge who can surmount the global Challenges.
- ✓ Create a diverse, fully-engaged, learner - centric campus environment to provide Quality education to the students.
- ✓ Maintain mutually beneficial partnerships with our alumni, industry, and Professional associations.

DEPARTMENT OF ELECTRICAL AND ELECTRONICS ENGINEERING

VISION

To produce smart and dynamic professionals with profound theoretical and practical knowledge comparable with the best in the field.

MISSION

- ✓ Produce hi-tech professionals in the field of Electrical and Electronics Engineering by inculcating core knowledge.
- ✓ Produce highly competent professionals with thrust on research.
- ✓ Provide personalized training to the students for enriching their skills.

PROGRAMME EDUCATIONAL OBJECTIVES(PEOs)

- ✓ **PEO1:** Graduates will have flourishing career in the core areas of Electrical Engineering and also allied disciplines.
- ✓ **PEO2:** Graduates will pursue higher studies and succeed in academic/research careers
- ✓ **PEO3:** Graduates will be a successful entrepreneur in creating jobs related to Electrical and Electronics Engineering /allied disciplines.
- ✓ **PEO4:** Graduates will practice ethics and have habit of continuous learning for their success in the chosen career.

PROGRAMME OUTCOMES(POs)

After the successful completion of the B.E. Electrical and Electronics Engineering degree program, the students will be able to:

PO1: Engineering Knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.

PO2: Problem Analysis: Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.

PO3: Design/Development of solutions:

Design solutions for Complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal and environmental considerations.

PO4: Conduct Investigations of complex problems: Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.

PO5: Modern Tool Usage: Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations.

PO6:The Engineer and Society: Apply reasoning in formed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.

PO7:Environment and Sustainability: Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.

PO8: Ethics: Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.

PO9: Individual and Team work: Function effectively as an individual, and as a member or leader in diverse teams, and in multi-disciplinary settings.

PO10: Communication: Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.

PO11: Project Management and Finance: Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multi-disciplinary environments.

PO12: Life-long learning: Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.

PROGRAM SPECIFIC OUTCOMES(PSOs)

The following are the Program Specific Outcomes of Engineering Students:

- **PSO1:** Apply the basic concepts of mathematics and science to analyse and design circuits, controls, Electrical machines and drives to solve complex problems.
- **PSO2:** Apply relevant models, resources and emerging tools and techniques to provide solutions to power and energy related issues & challenges.
- **PSO3:** Design, Develop and implement methods and concepts to facilitate solutions for electrical and electronics engineering related real-world problems.

Abstract (Key Words)	Mapping of POs and PSOs
Smart card reader, IR sensors, Barriers, Display screen, Power supply	PO1, PO2, PO3, PO4, PO5, PO6, PO7, PO8, PO9. PO10, PO11, PO12, PSO1, PSO2, PSO3.

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ABSTRACT

The Automated Passenger Entry Validation and Monitoring System is a transformative innovation aimed at enhancing security, improving operational efficiency and streamlining the passenger experience in train travel. By integrating technologies such as biometric identification and RFID (Radio Frequency Identification), the system ensures that only authorized passengers to board the train. It validates tickets through multiple modes, including biometrics and smart cards catering to diverse user preferences. The system employs high-definition cameras and AI-powered video analytics to monitor passenger activity during boarding and throughout the journey. Real-time data processing cross-references entry details with the train's passenger list, instantly detecting unauthorized access or discrepancies. Alerts are sent to onboard and remote security teams, enabling swift responses to security breaches. Additionally, anonymized passenger movement data is collected, providing insights for optimizing resource allocation, station design and overall passenger experience. This solution offers numerous advantages. Contactless ticketing minimizes the need for manual checks, enhancing convenience and aligning with modern health and safety standards. Faster boarding processes reduce delays, improving operational efficiency. Automated monitoring and validation free up staff for other critical tasks, while heightened security fosters passenger confidence in train travel. Beyond security, the system contributes to smoother and more efficient journeys, addressing the challenges of growing urbanization and increasing passenger volumes. Its scalable design makes it suitable for urban transit systems, high-speed rail and cross-border train networks. By merging advanced technologies with seamless passenger management, the system represents a significant leap forward in modernizing railway operations and delivering a safer, smarter and more efficient transportation experience.

INTRODUCTION

The railway industry is on the cusp of a revolution, driven by the need for enhanced security, improved operational efficiency, and a seamless passenger experience. As the world's population continues to urbanize, the demand for efficient and secure public transportation systems has never been more pressing. In response to these challenges, the Automated Passenger Entry Validation and Monitoring System has been developed to transform the railway industry's approach to security, efficiency, and passenger experience.

This cutting-edge system harnesses the power of advanced technologies such as biometric identification, RFID, and AI-powered video analytics to create a secure, efficient, and seamless passenger entry process. By automating passenger entry validation and monitoring, the system minimizes the risk of unauthorized access, reduces the need for manual checks, and provides real-time insights into passenger movement patterns.

The Automated Passenger Entry Validation and Monitoring System is designed to be scalable, versatile, and adaptable to the evolving needs of railway operators and passengers. Whether deployed in urban transit systems, high-speed rail, or cross-border train networks, this system has the potential to make a significant impact on the railway industry's operational efficiency, safety standards, and overall passenger experience. By embracing this innovative solution, railway operators can stay ahead of the curve, meeting the evolving needs of passengers while setting new benchmarks for safety, efficiency, and excellence in railway operations.

CHAPTER 1
LITERATURE REVIEW

Paper1: Automated Ticketing Systems

Inference: Automated ticketing has become a fundamental part of modern transportation systems, reducing the need for physical ticket checks and improving boarding efficiency. QR codes and RFID are the most commonly implemented ticketing methods due to their reliability, speed and ease of use. Gao et al. (2019) demonstrated that QR code and RF ID-based ticketing systems reduce congestion and improve passenger flow at entry points, which is especially valuable in high-traffic settings like railway stations. QR code technology offers a digital ticketing option through mobile devices, while RF ID-enabled smart cards support rapid, contact less entry (Chaudhary & Desai, 2020). Mobile ticketing has gained popularity for its convenience, allowing passengers to validate their tickets on smart phones via QR codes or NFC (Near Field Communication). Studies by Sharma & Kumar (2018) highlight the adoption of mobile ticketing as a sustainable solution, which not only reduces paper ticketing but also simplifies the user experience by reducing physical contact. These systems also make data collection more efficient, enabling transit operators to monitor passenger flow and detect anomalies in real-time.

Paper2: Monitoring Systems in Railways

Inference: The role of Surveillance Technologies in public transport is well-documented. Studies show that advanced CCTV systems, integrated with AI-based motion detection, enhance security. IoT sensors, such as infrared and ultrasonic detectors, are increasingly used to monitor seat occupancy. Such systems are already in use in European railways for capacity optimization.

Paper3: AI-Driven Video Analytic and Real-Time Monitoring

Inference: Real-time monitoring and passenger tracking are increasingly being implemented in train systems to enhance security and operational efficiency. AI-driven video analytic are used to monitor passenger movement within train stations and on board the trains, helping to detect anomalies and improve resource allocation. Li and Z hang (2019) describe how AI-powered surveillance can detect suspicious behavior or overcrowding and notify security teams instantly. This functionality is valuable in preventing security incidents and ensuring passenger safety.

In addition, AI can analyse passenger flow data, providing insights into peak times and aiding in the optimization of train schedules and resource deployment. According to Kim et al. (2020), video analytic combined with machine learning algorithms can predict travel patterns, which helps rail operators adjust services based on demand, ultimately improving the passenger experience and minimizing wait times.

Paper4: Future Directions

Inference: The use of AI and Machine Learning will helps to predict the future systems will leverage machine learning to adapt dynamically to changes in passenger behaviour and optimize boarding processes. Block chain technology can ensure secure, tamper-proof e-ticketing systems. Energy-efficient turnstiles and IoT devices can align with sustainability goals.

CHAPTER 2

PROPOSED METHOLOGY

2.1 BLOCK DIAGRAM

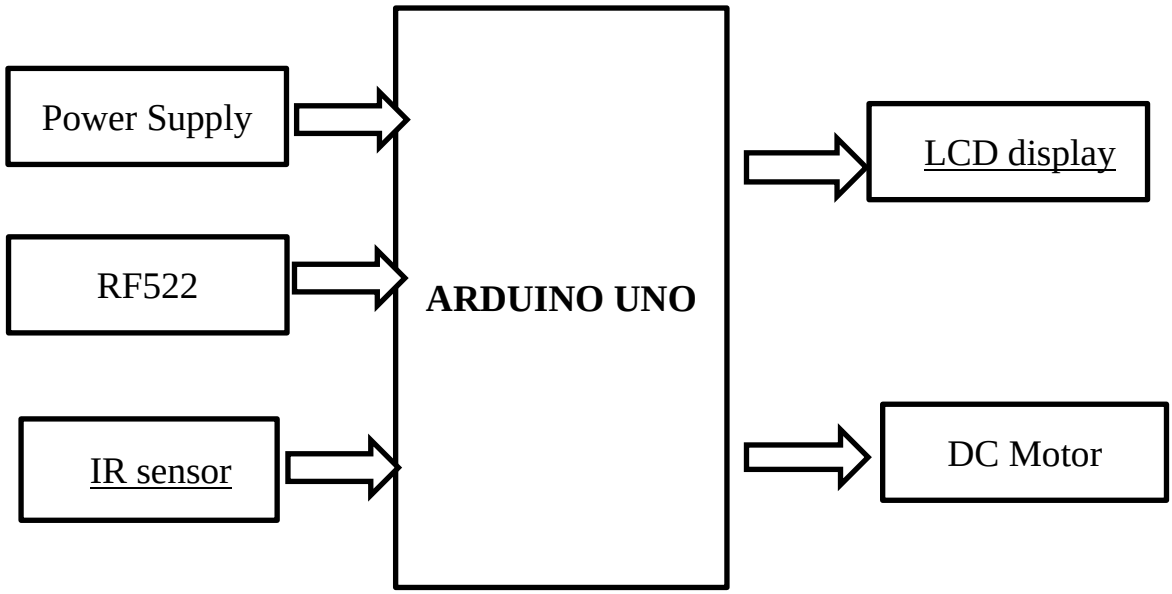

Fig:2.1 Block Diagram

2.2 DISCRIPTION

This project is an innovative solution designed to improve passenger safety, reduce fare evasion and enhance operational efficiency in train travel. The system integrates advanced technologies, including biometric identification and RFID (Radio Frequency Identification) to create a seamless and secure boarding process. Passengers can validate their tickets using various methods, such as QR codes, smart cards or biometric scans, offering flexibility and convenience. Upon validation, the system immediately verifies ticket details against the train's passenger list, flagging any discrepancies and alerting onboard or remote security personnel in real time. This ensures that only authorized passengers gain access, significantly enhancing security. To monitor passengers throughout their journey, the system employs high-definition cameras and AI-driven video analytics for continuous surveillance. These tools detect unauthorized access or suspicious behaviour, providing real-time insights to security teams. The system also collects anonymized data on passenger movement patterns, offering valuable information for resource planning and operational optimization. By minimizing the need for manual ticket checks, the system expedites boarding, reduces delays and frees up staff for other critical tasks. Its contactless ticketing and monitoring capabilities align with modern health and safety expectations, ensuring a safer and more convenient travel experience. This scalable solution is ideal for various rail networks, including urban transit systems, high-speed trains and cross-border railways. Beyond improving security, it enhances passenger satisfaction and streamlines operations, paving the way for smarter, more efficient and future-ready railway systems. With its focus on security, efficiency and passenger convenience, this system represents a significant advancement in the modernization of train travel.

CHAPTER 3

RESULT AND DISCUSSION

3.1 HARDWARE COMPONENTS DESCRIPTION

ARDUINO BOARD:

The Arduino micro controller acts as the brain of the system. It processes signals from the water flow sensor, executes the logic to detect leaks and controls the servo motor to operate the valve. The Arduino is programmable, allowing for customization of thresholds and responses based on specific requirements.

Fig 3.1.1 ARDUINO BOARD UNO

RFID CARD AND RFID READER

An RFID reader is a radio frequency device that emits a signal through an antenna. This signal is received by RFID tags that respond to interrogation by the reader. Responses are read by the reader and through a variety of protocols the reader can communicate with all the RFID tags in its field.

Fig 3.1.2 RFID CARD AND RFID READER

IR SENSOR:

The IR sensor works as a trigger mechanism to detect passenger presence. When someone approaches the train entry, the IR sensor detects the motion and activates the ticket validation process, allowing for efficient, contact less monitoring. This setup also supports real-time entry tracking, providing accurate, immediate detection to enhance both security and passenger flow.

Fig 3.1.3 IR SENSOR

RELAY:

A keyboard is an input device that allows users to enter text and commands into a computer or other electronic devices. It consists of a set of keys each representing a specific character, number or function, organized in a standard layout. Keyboards can be mechanical, membrane, or virtual with varying features such as back lighting and customization keys. They serve as essential tools for typing, gaming and controlling software applications, enabling efficient interaction with computers and other technology.

Fig 3.1.4 RELAY

3.2 HARDWARE KIT

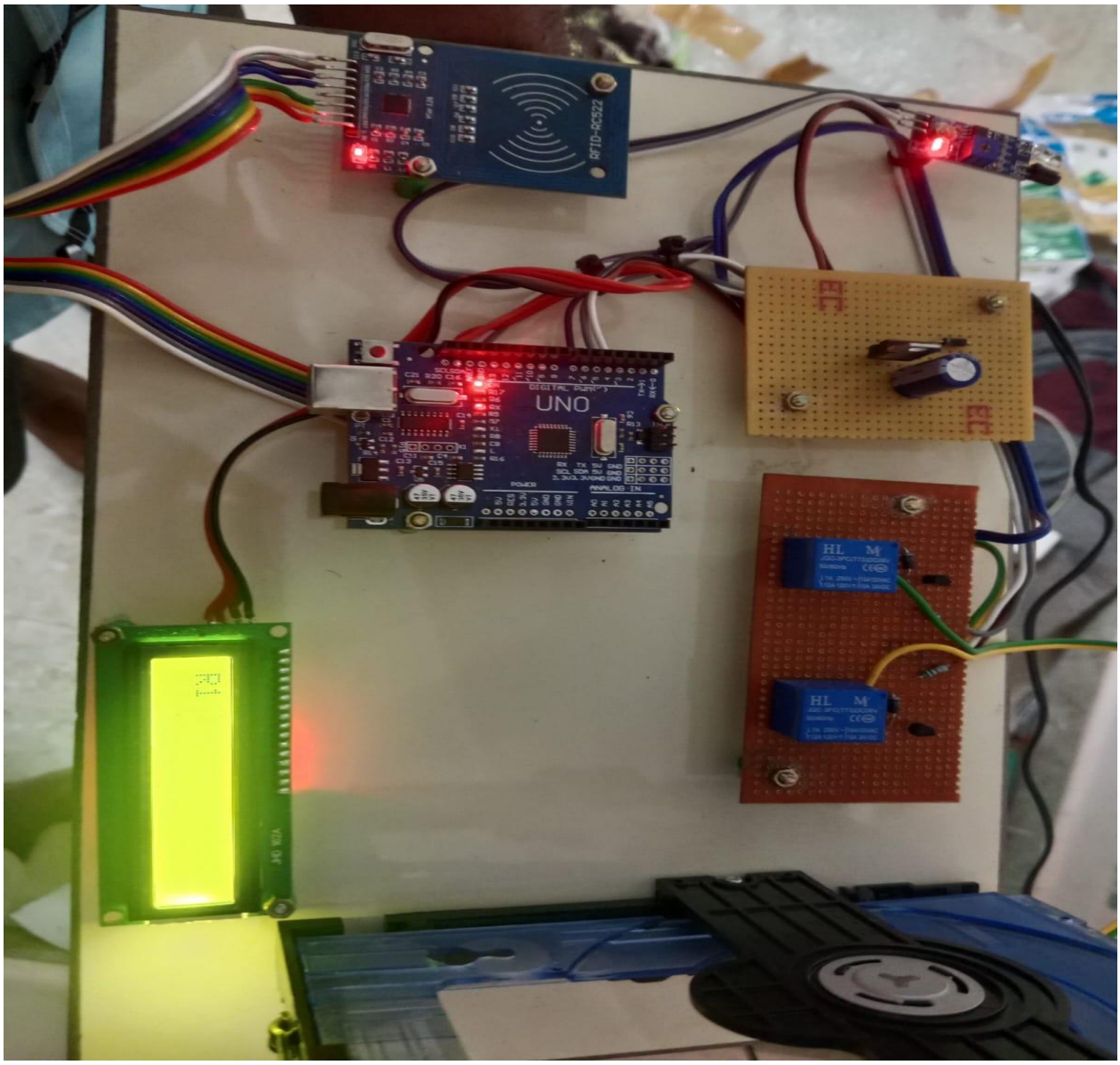

Fig 3.2 HARDWARE KIT

3.3 WORKING PRINCIPLE

The automated passenger entry validation and monitoring system is designed to enhance train security and streamline the boarding process. The system validates passengers using QR codes, RFID smart cards or bio-metrics and continuously monitors entry points to prevent unauthorized access. Here's an overview of the system's working process:

i. Passenger Approaches Entry Point

As a passenger approaches the train's entry, IR sensors detect their presence. This triggers the system to initiate the ticket validation process.

ii. Ticket Validation Options

The system offers multiple ticketing options:

QR Code Scanning: Passengers can scan a QR code ticket using a scanner at the entry gate. The QR code contains encrypted information about the passenger and ticket details.

RFID Smart Card Scanning: If a passenger holds an RF ID-enabled ticket (e.g., a smart card) they can tap it on the RFID reader, which quickly verifies ticket details.

Biometric Verification (Optional): For systems with added security, a biometric sensor can scan a fingerprint or facial recognition data to confirm the passenger's identity against per-registered data.

iii. Real-Time Verification

The ticket data received from the scanner is transmitted to the **central database** or cloud system for validation. The system cross-references the scanned ticket data with the passenger list for that specific train. If the ticket data matches a valid entry on the list, the passenger is granted access.

iv. Passenger Monitoring and Tracking

Once it can validated, high-definition cameras are equipped with AI-driven video analytic monitor the movement of passengers with in the train. AI algorithms analyse video feeds in real-time, ensuring that passengers remain in authorized areas and detecting any suspicious behaviour. The system logs entry and exit points and anonymize data on passenger movement is stored for future analysis and resource planning.

v. Data Logging and Analysis

The system logs data on passenger entry and movement patterns in an anonymize format. This data is later used to improve resource allocation (e.g., adjusting staff and seating arrangements) and optimize train scheduling based on peak and off-peak travel times. This information also aids in understanding usage patterns helping operators make data-driven decisions to enhance service quality.

vi. Real-Time Alerts and Security Monitoring

If the system detects any unauthorized entries, it immediately sends alerts to on board and remote security teams. Security personnel can access live feeds and data to respond promptly to potential issues. This feature is crucial for ensuring safety, reducing fare evasion and addressing security threats in real time.

CHAPTER 4
CONCLUSION

The Automated Passenger Entry Validation and Monitoring System represents a informativeness step in modernizing railway operations, addressing challenges such as inefficiency, overcrowding and security concerns. By integrating advanced technologies like electronic ticketing, biometric authentication, IoT sensors and AI-powered monitoring, the system ensures a seamless, secure and convenient boarding experience for passengers.

This solution not only enhances operational efficiency and passenger satisfaction but also provides valuable insights through data analytic, aiding in better resource allocation and service optimization. The implementation of such systems supports the transition toward smart, sustainable railway networks that align with the goals of urbanization and technological advancement.

While challenges such as infrastructure costs, technical complexities and data privacy concerns exist, phased deployment, robust security measures and user education can overcome these hurdles effectively. Moving forward, innovations in AI, machine learning and block chain technology will further strengthen the system, paving the way for a safer, smarter and more efficient railway ecosystem. This system is a crucial step toward future-proofing railway networks, offering benefits for passengers, operators, and society at large.

PROJECT - TOTAL COST

S.NO	COMPONENT DESCRIPTION	QUANTITY	COST
01	ARDUINO UNO	1	500
02	RF522	1	300
03	IR SENSOR	1	200
04	LCD DISPLAY	1	300
05	DC MOTOR	1	150
06	RELAY	2	200
		TOTAL	1650

Table Project - Total Cost

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