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An Unmanned Level Crossing Controller with Real Time Monitoring Based on Microcontroller Elements

Angel Dixon, Muhammed Ashiq k, Sreenika V Nair, Assistant Professor MS. Sayana M
Department of Engineering
Jawaharlal College of Engineering and Technology, Palakkad, India

Abstract- The Automatic Railway Gate Control (ARGC)system is designed to overcome the limitations and inefficiencies associated with traditional manually operated railway crossing gates. This innovative system employs sensors and microcontroller technologies to manage and control the operation of railway gates automatically, thereby enhancing the safety and efficiency of rail and road traffic.

Index Terms- Railway gate, level crossing.

I. INTRODUCTION

Railway transportation has served as a fundamental backbone of global infrastructure for centuries, facilitating the movement of people and goods across vast distances with unmatched efficiency and reliability. As urbanization accelerates and economies expand, the demand for transportation services continues to escalate, placing immense pressure on existing railway networks to accommodate growing traffic volumes while ensuring safety, reliability, and sustainability. In response to these evolving challenges, the integration of advanced control systems has emerged as a pivotal strategy to modernize and optimize railway operations, promising to revolutionize the management and efficiency of railway infrastructures worldwide. Against this backdrop, this paper presents a comprehensive exploration of a novel approach to railway control systems, leveraging the capabilities of the PIC16F877A microcontroller to design and implement an intelligent, adaptable, and resilient control system tailored specifically for contemporary railway networks.

II. LITERATURE REVIEW

1. Real-Time Monitoring and Control of Railway Gates Using Plc by Sharma Et Al. (2022)
The objective of this paper is to provide an automatic railway gate at a level crossing replacing the gates operated by the gatekeeper. It deals with two things. Firstly, it deals with the reduction of time for which the gate is being kept closed, and secondly, to provide safety to the road users by reducing the accidents. By the presently existing system once the train leaves the station, the stationmaster informs the gatekeeper about the arrival of the train through the telephone. Once the gatekeeper receives the information, closes the gate depending on the timing at which the train arrives. Hence, if the train is late due to certain reasons, then gate remain closed for a long-time causing traffic near the gates. By employing the automatic railway gate control at the level crossing the arrival of the train is detected by the sensor placed near to the gate. Hence, the time for which it is closed is less compared to the manually operated gates and also reduces the human labour. This type of gates can be employed in an unmanned level crossing where the chances of accidents are higher and reliable operation is required. Since, the operation is automatic; error due to manual operation is prevented. Automatic railway gate control is highly economical microcontroller-based arrangement, designed for use in almost all the unmanned level crossings in the country.

2. Automatic Railway Gate Control System Using Arduino and Ultrasonic Sensor by Chandrahasan Et Al. (2019)
This study presents an innovative approach to railway gate control using Arduino microcontrollers and ultrasonic sensors. The system demonstrates effective train detection and gate operation, highlighting the potential for cost- effective and reliable automation in railway safety.

3. Design and Implementation of Automatic Railway Gate Control System Using Gsm by Jain and Bhati (2018)
This research explores the integration of GSM (Global System for Mobile Communications) technology with automatic railway gate systems. By incorporating remote monitoring and control capabilities, the study enhances the efficiency and responsiveness of gate operations, contributing to improved safety and operational management.

4. Real-Time Monitoring and Control of Railway Gates Using Iot and Cloud Computing by Singh Et Al. (2020)
This literature review discusses the application of Internet of Things (IoT) and cloud computing in real- time monitoring and control of railway gates. The study emphasizes data-driven decision-making and predictive maintenance,

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showcasing how advanced technologies can optimize railway gate systems for enhanced safety and reliability.

5. Safety and Efficiency Assessment Of Automatic Railway Gate Systems: A Comparative Study by Gupta Et Al. (2021)

This comparative study reviews various automatic railway gate systems deployed globally, analyzing their safety features, operational efficiency, and technological advancements. By comparing different system architectures and implementations, the research provides valuable insights into best practices and areas for further improvement in railway safety infrastructure.

III. METHODOLOGY

To create an automatic railway gate ,first we need to identify system requirements including safety, efficiency, and scalability. Design hardware and software components including sensors, microcontrollers, and control algorithms. Choose appropriate sensors for train detection (proximity, infrared, RFID).Select a suitable microcontroller based on system complexity, develop algorithms for train detection, gate control, and emergency stop. Assemble and integrate sensors, microcontrollers, and actuators (gate motors)Write code to implement algorithms and control gate operation Conduct thorough testing under various scenarios to ensure reliability and safety. Optionally integrate communication systems for remote monitoring and control. Ensure compliance with safety standards and implement safety features. Install the system, provide operator training, and establish a maintenance schedule.

Key Componenets

- PIC16F877A
- IR Sensor
- Servo Motor
- LED
- Connecting Wire

Circuit Diagram

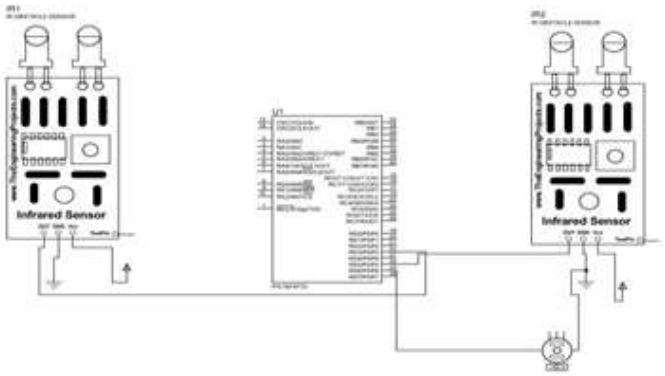

Figure 1: Circuit Diagram

IV. WORKING

Sensors such as infrared sensors, magnetic sensors, or radar sensors are installed near the railway tracks to detect the presence of an approaching train. The signals from the sensors are processed by a microcontroller or a dedicated control unit. Upon detection of an approaching train, the control unit activates the mechanism to close the railway gate automatically. The gate barrier is lowered to block vehicles from crossing the railway tracks. After the train has passed the sensors detect its absence, and the control unit triggers the opening of the gate barrier. The system may incorporate additional safety features such as warning lights, bells, or barriers on both sides of the railway crossing to alert pedestrians and vehicle. Regular monitoring and maintenance ensure the proper functioning of the automatic railway gate system to prevent accidents and ensure safety at railway crossings.

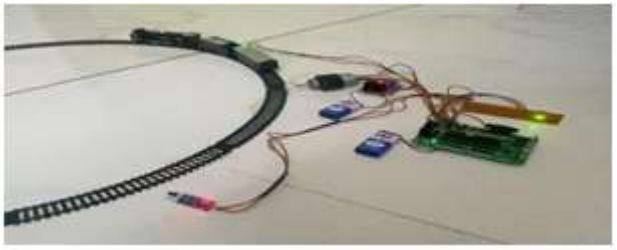

Figure 2: Working Model

V. CONCLUSION

In conclusion, the automatic railway gate system significantly enhances safety at railroad crossings by using technology to control the movement of crossing barriers based on sensor input. This automation not only reduces the possibility of human error but also improves the efficiency of train and vehicular traffic management. It minimizes the waiting time for vehicles, reduces congestion near railway crossings, and increases overall safety by preventing collisions between trains and vehicles or pedestrians. As technology advances, further integration of more sophisticated sensors and communication technologies can be anticipated, leading to even greater safety and efficiency improvements in railway gate operations.

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