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Smart Railway Pedestrian Crossing and Platform Safety System

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Abstract : **The Smart Train Platform Safety System aims to enhance passenger safety and operational efficiency by preventing accidents during train arrival and departure at railway platforms. Using ultrasonic sensors, the system detects approaching and departing trains. Upon detecting a train's arrival, a camera captures images for surveillance, a green LED signals passengers to board, and automated grill gates controlled by a servo motor open for safe boarding. As the train departs, the system triggers a buzzer to alert passengers and automatically closes the grills to prevent track access. This integrated approach ensures a secure environment for passengers while enabling real-time monitoring and data collection for railway operations.**

The Smart Railway Pedestrian Crossing System is designed to ensure the safety of individuals crossing railway tracks at platforms without staircases or overbridges. The system employs ultrasonic sensors, cameras, and automated barriers to regulate pedestrian movement and prevent unauthorized crossing. When an approaching train is detected, the system activates visual (LEDs) and audible (buzzer/speaker) warnings while Loring automated barriers to restrict track access. Once the train departs, the barriers open, allowing safe pedestrian crossing. An optional sliding bridge can be deployed for enhanced safety.

It ensures passenger safety by leveraging sensors, cameras, automated barriers, and alert mechanisms to prevent accidents during train arrivals, departures, and track crossings. This cost-effective and scalable solution modernizes railway safety infrastructure, enhancing efficiency and reducing risks in densely populated railway networks.

INTRODUCTION

Railway transportation remains one of the most vital and widely used modes of travel and freight movement across the globe. However, the safety of pedestrians at railway crossings and passengers on platforms continues to be a critical concern. Conventional crossing systems often rely on manual operation or outdated signaling, which can result in accidents due to human error, lack of awareness, or inadequate safety measures.

This project, titled "Smart Railway Pedestrian Crossing and Platform Safety," aims to address these challenges by leveraging modern technologies such as sensors, microcontrollers, and automated alert systems to enhance safety and efficiency. The primary objective is to develop a smart system that can detect incoming trains and automatically manage pedestrian crossings while simultaneously monitoring platform activity to prevent unsafe behavior, such as crossing the yellow line or falling onto the tracks.

By integrating intelligent control mechanisms and real-time monitoring, this project contributes to building a safer railway environment. It not only minimizes the risk of accidents but also supports the broader goal of creating smarter, more responsive transportation infrastructure. The solution is designed to be cost-effective, scalable, and adaptable to both urban and rural railway settings.

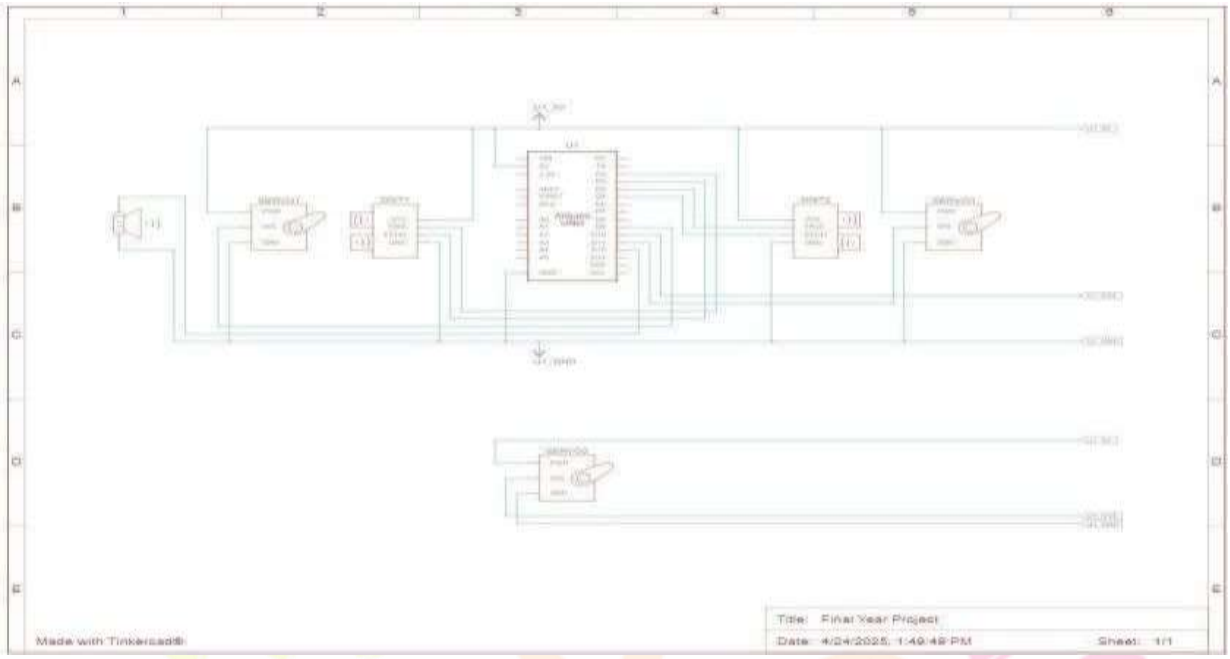
LITERATURE SURVEY.

Acy M. Kottalil, Abhijith S, Ajmal M M, Abhilash L J, Ajith Babu [1]. The research work carried out by above mentioned authors mainly focus on preventing of skilled worker to operate railway gate near Level crossings by establishing AT mega 16A microcontroller and IR sensors-based systems to control gate opening and closing by receiving the signals accordingly J. Banuchandar, V.kaliraj, P.Balasubramanian, N.Thamilarsi [2]. The paper written by these authors mainly put a spot light on two things; one is the reduction of time for which the gate is being kept closed. And secondly, provide a safety to the road users to reduce the accidents by using unmanned way of opening the railway gate. Hnin Ngwe Yee Pwint, Zaw Myo Tun, Hla Myo Tun [3]. The paper describes automatic railway gate systems by using PIC 16F877A Microcontroller for saving precious Haman lives. Here Inductive and IR sensors used as input components while buzzer, light indicator, DC motor and LCD display are the output components Krishna, Shashi Yadav, and Nidhi [4]. The paper deals with control the railway track by using an anti-collision technique, the entire system is modeled and controlled by 8952 microcontrollers to avoid the railway accidents.

SYSTEM ARCHITECTURE.

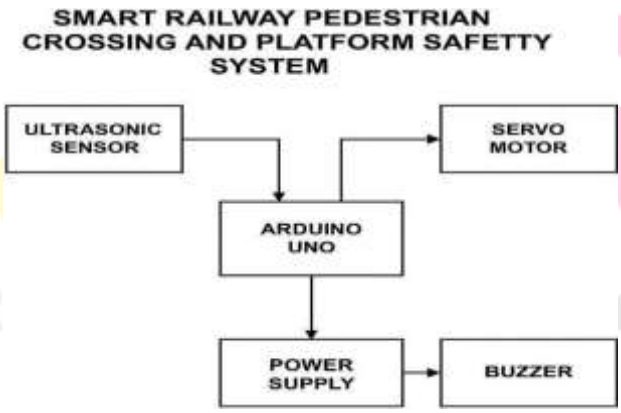
Block Diagram:

The block diagram shows connections between the Ultrasonic Sensors, Arduino microcontroller, servo motor, buzzer, and power supply. It visualizes the flow of data and control signals.



WORKING PRINCIPLE.

The **Smart Railway Pedestrian Crossing and Platform Safety System** operates as an automated safety solution designed to prevent accidents by detecting train movements and controlling pedestrian access. The system uses ultrasonic sensors placed near the platform or pedestrian crossing to detect the arrival and departure of trains by measuring the distance between the sensor and the moving train. When a train approaches and the distance falls below a predefined threshold, the sensor sends a signal to the Arduino UNO microcontroller, which acts as the central control unit. The Arduino processes this input and activate a servo motor to lower a gate or barrier, preventing pedestrians from crossing. Simultaneously, a buzzer is triggered to emit an audible warning, alerting nearby individuals of the approaching train. Once the train departs and the sensor detects that the distance has increased beyond the threshold, the microcontroller deactivates the buzzer and raises the gate using the servo motor, allowing safe pedestrian movement.

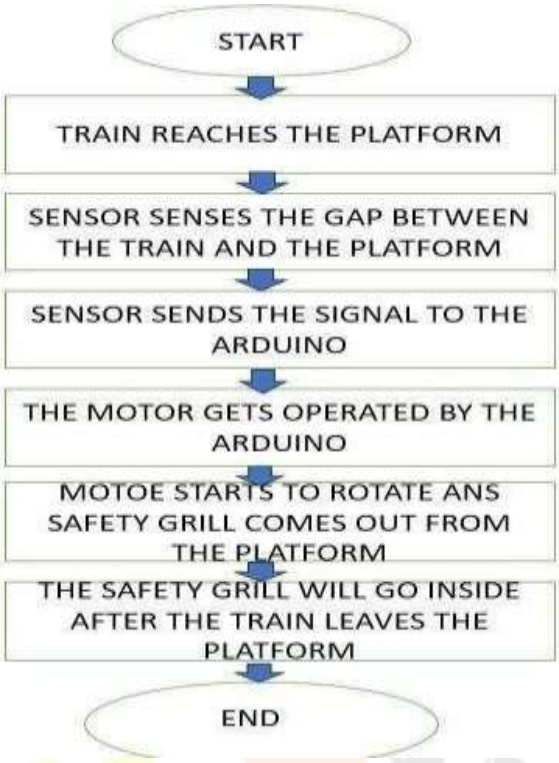


The system is powered by a regulated power supply to ensure stable operation of all electronic components, including sensors, motors, and alarms. This fully automated mechanism enhances platform and crossing safety by providing timely alerts and physical barriers, minimizing the risk of accidents and reducing the dependency on manual monitoring. Furthermore, the integration of such intelligent systems promotes efficient railway traffic management and demonstrates the potential of embedded systems in improving public safety.

SYSTEM FLOWCHART:

The flowchart includes:

- Start
- Ultrasonic sensor detection
- If train detected → activate servo & buzzer
- If not detected → remain idle
- Reset after train pass.



RESULT.

The circuit system is considered ready for use once all components are correctly connected, the Arduino code is successfully uploaded without errors, and the simulation in Tinker cad runs as expected. Upon powering the circuit, each component performs its assigned function based on the programmed logic.

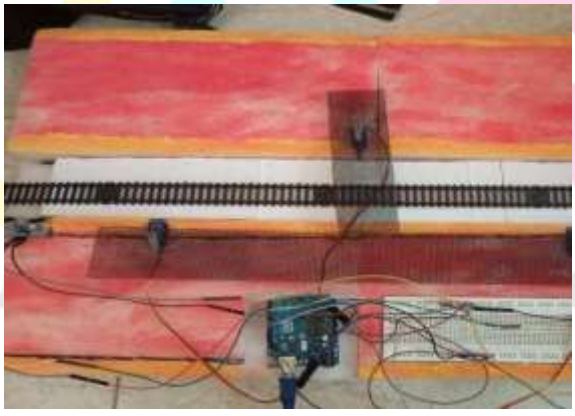


Fig (6.1) (*Safety grills OFF and Pedestrian crossing bridge open ON*)

We can observe that in Fig (6.1) the bridge came in between platforms and the safety grills are in off position when there is no train so that the passengers can easily cross the platforms.

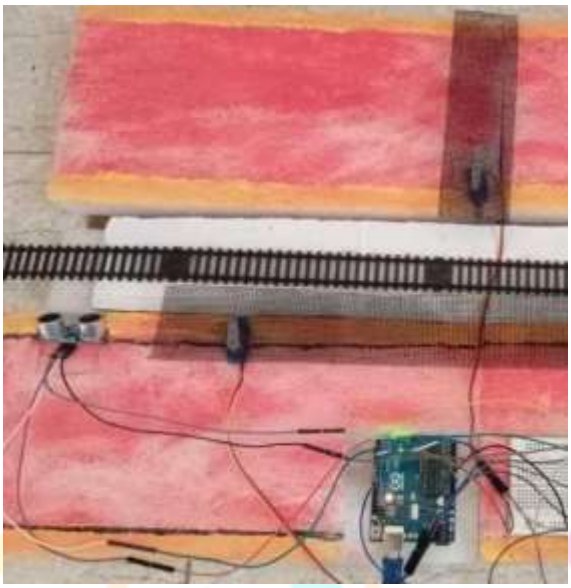


Fig 6.2(*Safety grills ON and Pedestrian crossing bridge open OFF*)

In fig (6.2) We can observe that the train arrived to the station, the ultrasonic sensors detect the train and the grills get open to fill the platform gap with the help of servo motor.

CONCLUSION

The "Smart Railway Pedestrian Crossing and Platform Safety System" provides a significant step toward ensuring commuter safety. The integration of simple, low-cost components with effective programming ensures high performance. The system proves to be a practical solution for both developing and developed regions.

This project signifies a transformative approach to railway safety, emphasizing automation, efficiency, and cost-effectiveness. With the implementation of advanced technologies like Ultrasonic Sensors, microcontrollers, and automated alert mechanisms, the proposed system directly addresses long- standing safety concerns at railway crossings and platforms. The solution not only minimizes human error but also offers scalability and flexibility for deployment across varied locations, from rural crossings to urban stations. This Arduino- based system is further reinforced by IoT principles, where components interact intelligently to minimize human dependency and error.

The system not only automates the safety mechanism but also allows for reliable and responsive operation in dynamic railway environments. Simulations conducted using Tinker cad confirm the system's functional accuracy and validate its performance under various scenarios including simultaneous sensor activation and false signal filtering.

Moreover, the system encourages the use of smart infrastructure within the railway sector, paving the way for further innovations such as AI-based behavior prediction, cloud monitoring, and integration with national transportation grids. In essence, this project demonstrates how Arduino-based IoT technology can be effectively harnessed to build a low-cost, scalable, and impactful railway safety system. As railway networks modernize, such intelligent systems will play a vital role in reducing accidents, improvin g commuter confidence, and contributing to the development of smart, sustainable cities.

In conclusion, this project is a forward- looking initiative that aligns with the vision of smart cities and digital transformation in public infrastructure. It holds immense potential to revolutionize railway safety management by replacing outdated manual systems with intelligent, automated solutions. The implementation of such systems can drastically reduce fatalities, ensure smoother operations, and enhance the commuter experience across the country.

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