Automatic Safety Grill System for Platform Gap Prevention and Easy Luggage Transport System

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***Abstract*—** This project presents an Automatic Safety Grill System for Platform Gap Prevention integrated with an Easy Luggage Transport System to enhance safety and convenience in railway stations. The safety grill system addresses the hazardous gap between the train and the platform, which poses a risk to passengers. It utilizes an Arduino Uno as the central controller, an ultrasonic sensor to detect an approaching train, and a servo motor to deploy or retract the grill based on proximity. For accurate train detection and alignment, a Node MCU module equipped with IR sensors is installed on the train, ensuring real-time communication with the platform system and activating the grill only when the train is correctly aligned.

Simultaneously, the luggage transport system enables the automated movement of heavy luggage between platforms, reducing physical strain on passengers. It incorporates an Arduino Uno, limit switches, L293D motor driver, DC motors, and a buzzer for operational control and signalling.

Both systems aim to enhance safety, efficiency, and accessibility—especially for elderly or differently-abled passengers—in crowded transit environments.

***Key Words*—**Safety Grill, Servo Motor, Ultra Sonic Sensor, Limit Switches, DC Motors, Buzzer

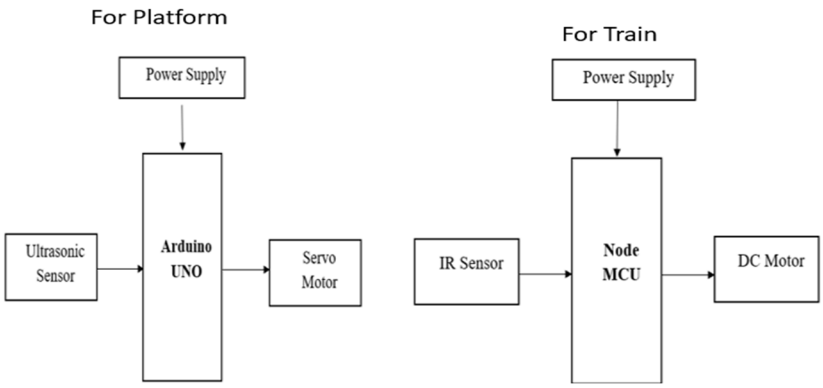
I. INTRODUCTION

The Automatic Safety Grill System for Platform Gap Prevention and Easy Luggage Transport is an innovative solution aimed at enhancing passenger safety and convenience at railway stations. Accidents due to platform gaps, misalignment, or hurried boarding are common and dangerous. This project addresses these issues by automating safety mechanisms at the platform edge and enabling effortless luggage transfer between platforms.

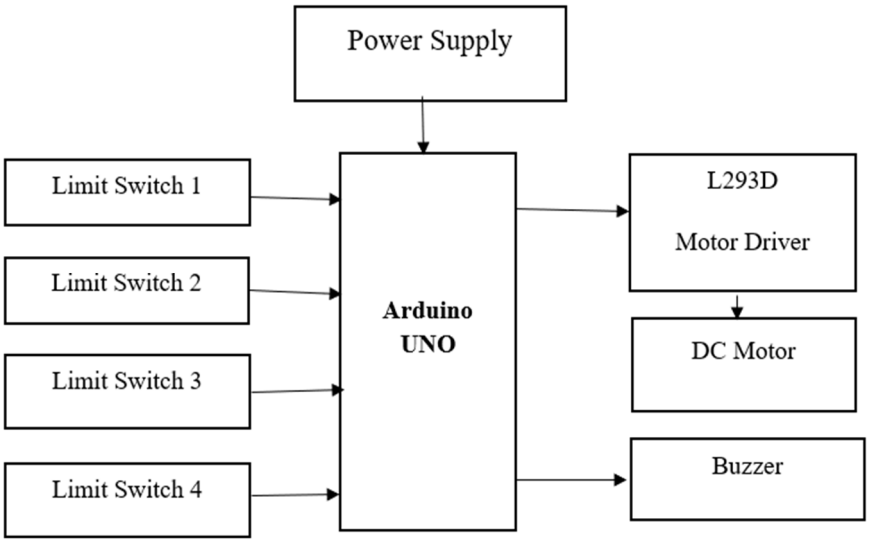
The system integrates Node MCU, IR and ultrasonic sensors, a servo motor, and Arduino UNO to monitor and respond to train movement. When a train approaches, the IR sensor detects its presence and activates a green LED, signalling passengers to board safely. The ultrasonic sensor monitors train distance, while the servo motor opens safety grills automatically, preventing passengers from falling. Once the train departs, the grills close, ensuring safety throughout the process. The Arduino UNO coordinates all these components for smooth operation.

In Stage 2, the system includes a chain-driven crane mechanism for luggage transport between platforms. It uses limit switches, a DC motor, L293D motor driver, buzzer, and Arduino UNO for automation. The limit switches control directional movement, and the buzzer alerts users at start and stop points. This reduces manual labour while improving operational efficiency and passenger safety at stations.

II. PROPOSED SYSTEM



2.1 Block Diagram of Grill System



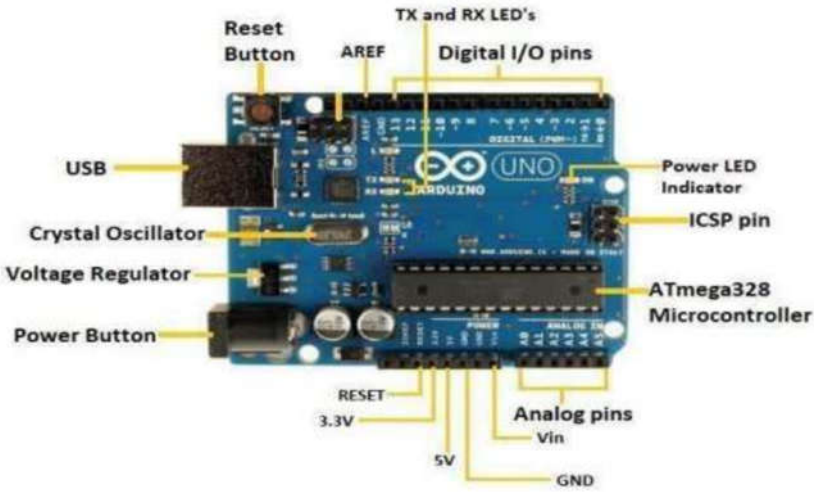
2.2 Block Diagram of Luggage Transport System

The System equipped with Arduino UNO, Ultrasonic Sensor, Servo Motor, IR Sensor, Node MCU and Limit Switches, L293D Motor driver, DC Motors and Buzzer. In automatic Grill System As the train approaches the platform, the IR sensor on the train detects its proximity and sends a signal to the Node MCU (ESP8266). The Node MCU communicates this information to the Arduino UNO on the platform. Upon receiving the signal, the Arduino UNO uses an ultrasonic sensor to measure the train's distance from the platform. If the train is sufficiently close, the Arduino activates the servo motor, which moves the safety grill into position, covering the platform gap to ensure passenger safety. Once the train leaves the platform, the IR sensor on the train detects the absence of the platform and sends a signal to the Node MCU, which communicates with the Arduino UNO. The Arduino UNO, receiving the signal, uses the ultrasonic sensor to confirm the train has moved away from the platform. If the train is no longer nearby, the Arduino activates the servo motor to retract the safety grill, clearing the platform gap and allowing safe passenger movement.

The easy luggage transport system uses a crane mechanism to automate luggage movement between railway platforms, improving efficiency and reducing manual labour. Controlled by an Arduino Uno, the system uses four limit switches to monitor positions and ensure safe operation. A DC motor, powered via an L293D motor driver, moves a trolley along a rail to transport luggage.

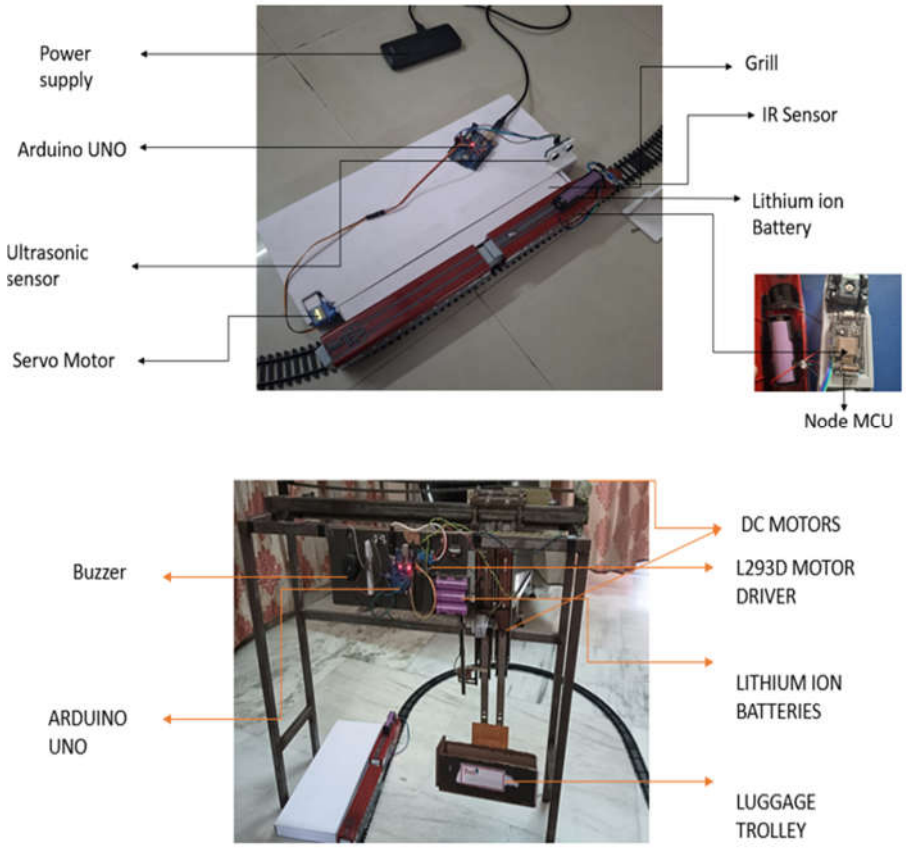
Limit Switch 1 detects the starting position, Switch 2 detects arrival at the top end, Switch 3 helps to move in opposite direction, and Switch 4 acts drop the luggage. A buzzer provides audio alerts at starting and end point. The system offers reliable, safe, and automated operation.

In this System the Arduino UNO T is a standard board of Arduino. Here UNO means 'one' in Italian. It was named as UNO to label the first release of Arduino Software. It was also the first USB board released by Arduino. It is considered as the powerful board used in various projects. Arduino.cc developed the Arduino UNO board. The Arduino UNO includes 6 analog pin inputs, 14 digital pins, a USB connector, a power jack, and an ICSP (In-Circuit Serial Programming) header. It is programmed based on IDE, which stands for Integrated Development Environment. It can run on both online and offline platforms. The figure below depicts the modern chip version of Arduino and labelled the parts.



2.3 Arduino UNO Chip

III. HARDWARE RESULTS



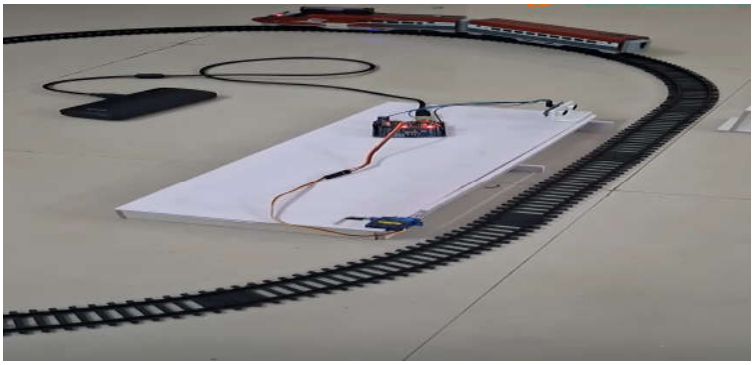
3.1 Hardware Setup

Case I: Grill enters as Train enters Platform

As the train approaches the platform, the IR sensor on the train detects its proximity and sends a signal to the Node MCU (ESP8266). The Node MCU communicates this information to the Arduino UNO on the platform. Upon receiving the signal, the Arduino UNO uses an ultrasonic sensor to measure the train's distance from the platform. If the train is sufficiently close, the Arduino activates the servo motor, which moves the safety grill into position, covering the platform gap to ensure passenger safety.

Case II: Grill retracts as train leaves platform

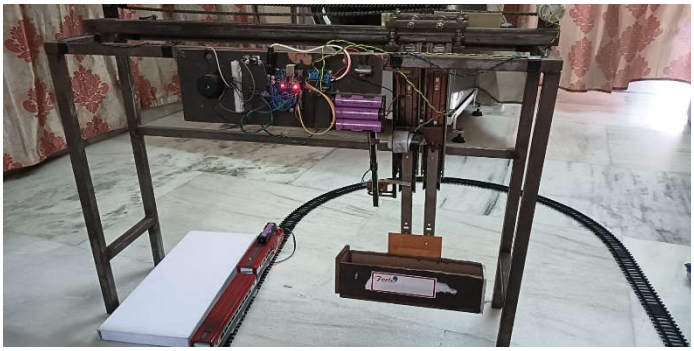
Once the train leaves the platform, the IR sensor on the train detects the absence of the platform and sends a signal to the Node MCU, which communicates with the Arduino UNO. The Arduino UNO, receiving the signal, uses the ultrasonic sensor to confirm the train has moved away from the platform. If the train is no longer nearby, the Arduino activates the servo motor to retract the safety grill, clearing the platform gap and allowing safe passenger movement.



3.2 Grill retracts

Case III: Limit Switch 1 and 2 Activation

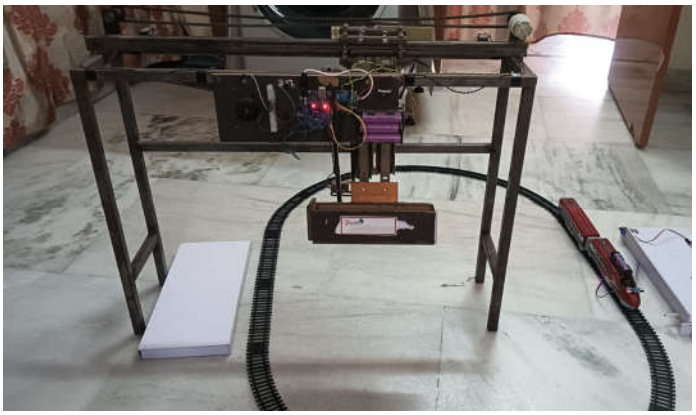
In this case as the start button is pressed the Buzzer produce sound and Limit Switch 1 activates at the start and the luggage trolley start moving upwards, when it reaches top end limit switch stop it and activates limit switch 3.



3.3 Luggage moving upwards

Case IV: Limit Switch 3 Activation

In this case limit switch 3 activates where it helps to move in opposite direction i.e. if trolley is in the left it moves right and vice versa which drives through DC Motor controlled by L293D Motor Driver.



3.4 Horizontal Movement of Luggage

Case V: Limit Switch 4 Activation

In this case limit switch 4 activates where it helps to move luggage downwards at other side of the platform then the buzzer sounds which clears the end of the system. Arduino UNO read signals from limit switches and controls motors and buzzer.

3.5 Dropping down Luggage

IV. CONCLUSION

The automatic safety grill system for platform gap prevention and easy Luggage Transport System provides a highly effective solution to ensure the safety of passengers by addressing the risks posed by the platform gap and reduce manual effort for carrying heavy loads. Coming to Grill System By utilizing a combination of IR sensors, ultrasonic sensors, and servo motors, the system automates the process of detecting the train's proximity and deploying the safety grill only when necessary. The seamless communication between the Node MCU on the train and the Arduino UNO on the platform ensures that real-time data is continuously shared, allowing the system to respond quickly to changes in the train's position. Once the train is detected near the platform, the ultrasonic sensor on the platform confirms the distance and activates the servo motor to deploy the safety grill, covering the gap to prevent accidents. When the train departs, the system automatically retracts the grill, allowing passengers to safely board or exit. This automation not only reduces the need for human intervention but also provides a reliable and efficient means of enhancing platform safety. The system's use of real-time sensor data ensures it is responsive and adaptable, providing a safer and more secure environment for commuters, thereby improving the overall passenger experience while minimizing the risk of accidents at train stations.

The easy luggage transport system with a crane mechanism automates luggage transfer between railway platforms, enhancing efficiency and reducing manual work. An Arduino Uno controls the system using inputs from four limit switches and outputs to a DC motor via an L293D motor driver. The system moves along a track to carry luggage. Limit switches detect start, end, obstacles, and emergencies. A buzzer provides alerts for start and stop event. This reliable and safe system improves luggage handling and operational flow in busy railway environments.

V. REFERENCES

[1] 2015 published by Taylor & Francis in *"Journal of Railway Engineering and Technology*"(JRET) on the title Design of Automatic Platform Safety Barriers to Prevent Passenger Accidents

[2] 2017 published by Elsevier in "*Sensors and Actuators A: Physical" on the title* Development of an Ultrasonic Sensor-Based Safety System for Platform Gap Prevention

[3] 2018 published by Taylor & Francis in "*Journal of Transportation Safety & Security" on the title* IoT-Based Automatic Safety System for Platform Gap Prevention

[4] 2020 published in "*International Journal of Advanced Computer Science and Applications".*

[5] 2021 Li, Y., Wang, Z., Zhang, F. "Sensor-Based Safety Measures for Railway Platforms: A New Era of Smart Train Stations" Safety and Automation Engineering. Journal, Volume: 6, Issue: 2 Pages: 56-68.

[6] 2022 Kumar, A., Das, P., Singh, D. "Development of an IoT-Based Platform Safety Grill System for Train Platforms" Journal of Smart Systems and Technologies. Volume: 7, Issue: 1, Pages: 102-113.

[7] 2023 Lee, H., Chen, W., Tang, X. "Automation and Sensor Integration for Railway Safety: Case Study of Platform Gap Prevention Systems" Journal of Railway Technology and Engineering. Volume: 15, Issue: 3, Pages: 78-90.

[8] 2024 Zhang, L., Patel, R., Kumar, S. "Innovative Platform Gap Management Systems in Railways: A Safety Approach" International Journal of Railway Engineering. Volume: 18, Issue: 4, Pages: 45-58.