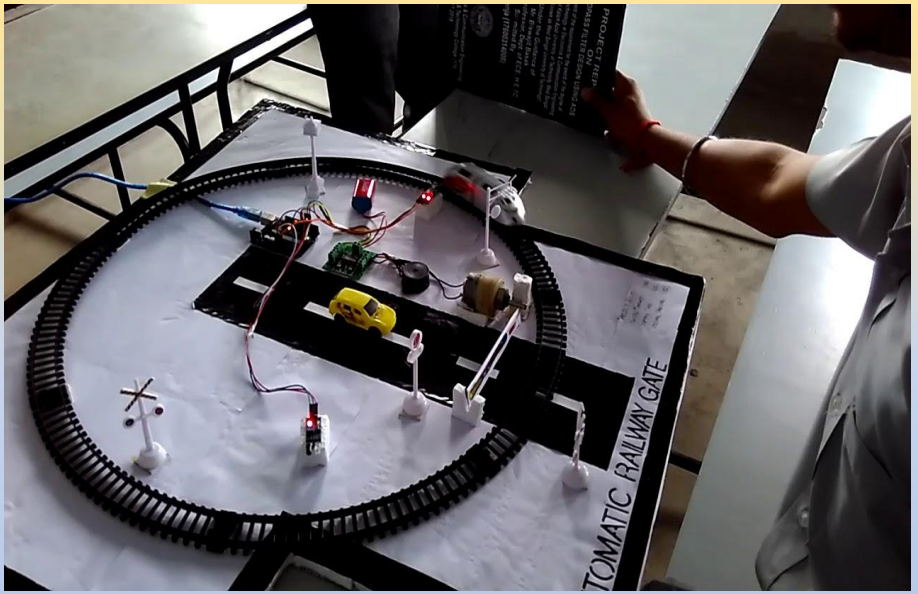
DAV INSTITUTE OF ENGINEERING AND TECHNOLOGY, PALAMU

Automatic Railway Gate Control System

B.Tech Final Year Project
Department of Electronics and Communication Engineering

Submitted By: Group ElectroMinds

Guided By: Mr. Deepak Sir



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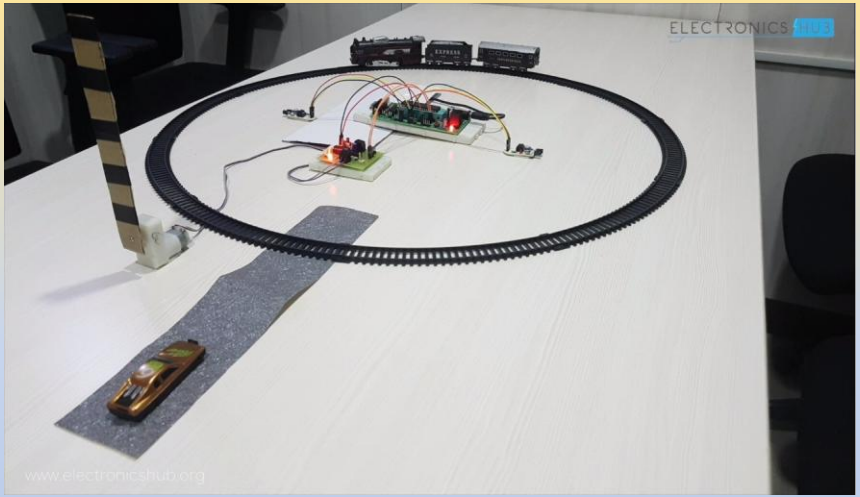
INTRODUCTION

- **Railway crossings are high-risk zones where safety is crucial.**
- Manual gate operations often lead to delays and accidents
- To address this, our project presents a **cost-effective, intelligent automated railway gate control system**.
- It uses **ultrasonic sensors, Arduino, and servo motors** to detect trains and control gate movements automatically, enhancing both **safety and traffic flow** at crossings.



PROBLEM STATEMENT

- Manual railway gate operations are still common, especially in rural and semi-urban areas.
- These systems are prone to **human error, delayed responses, and poor visibility**, leading to accidents.
- **In 2024**, India saw **40 train accidents** and **313 passenger deaths** (highest in a decade).
- **335 fatalities** reported in **ECR zone (Jan–Apr 2025)** due to trespassing.
- Existing automated systems are often **costly and complex**.

OBJECTIVES OF THE PROJECT

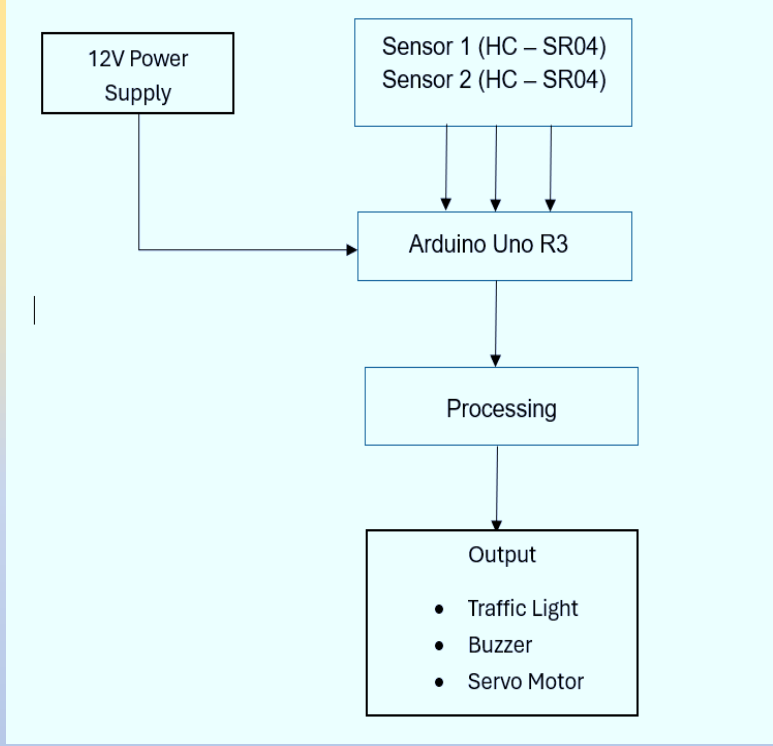
- Develop an Arduino Uno-based automated gate control system for unmanned railway crossings.
- Use ultrasonic sensors to detect train approach and departure with high accuracy.
- Automate gate movement using servo motors to ensure timely closure and opening.
- Integrate audio-visual alerts (buzzers, red/yellow/green LEDs) for public safety.
- Design a cost-effective, scalable system for rural and semi-urban deployment.

LITERATURE REVIEW

- Previous systems used IR sensors or manual operations, which lacked accuracy and reliability.
- Research highlights microcontroller-based automation, but many setups were costly or complex.
- Ultrasonic sensors proved more effective for train detection.
- Existing models lacked real-time alerts and scalability.
- Our system bridges this gap using Arduino, ultrasonic sensors, servo motors, and audio-visual signals for a low-cost, reliable solution.

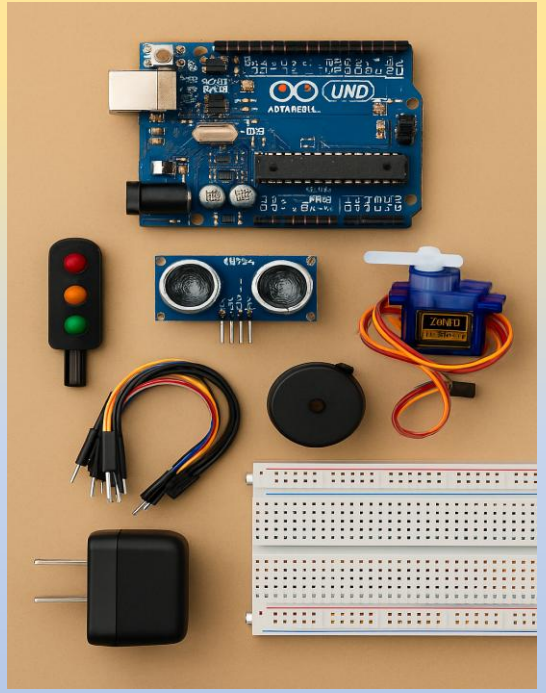
SYSTEM ARCHITECTURE OVERVIEW

- The system is powered by a 12V supply and uses two ultrasonic sensors (HC-SR04) to detect the train's approach and departure.
- These inputs are processed by an Arduino Uno R3, which acts as the control unit.
- Based on sensor data, the Arduino triggers outputs including a traffic light module, buzzer, and servo motors to automatically manage gate operation and safety alerts.



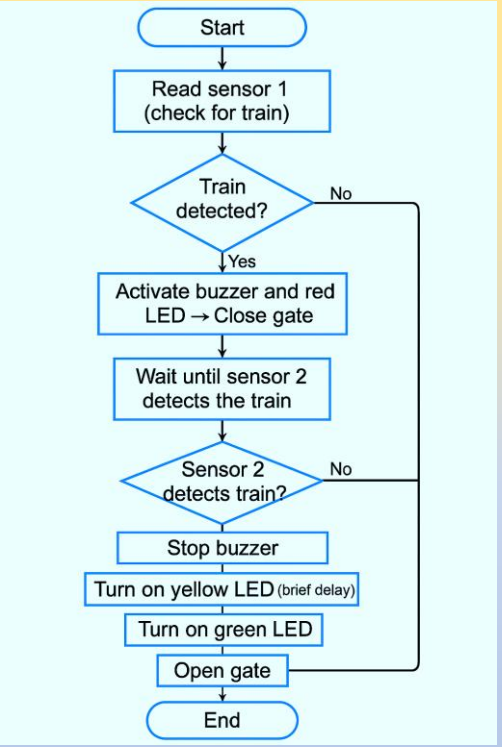
COMPONENTS USED

- **Arduino Uno R3** – Main microcontroller for processing sensor inputs and controlling outputs.
- **Ultrasonic Sensors (HC-SR04)** – Detect approaching and departing trains.
- **Servo Motors (SG90)** – Open and close the railway gate automatically.
- **Traffic Light LED Module** – Signals red, yellow, or green based on train status.
- **Buzzer** – Provides audio alerts for nearby vehicles and pedestrians.
- **Power Supply (12V Adapter)** – Powers the entire circuit.
- **Jumper Wires & Breadboard** – For circuit connections and prototyping.



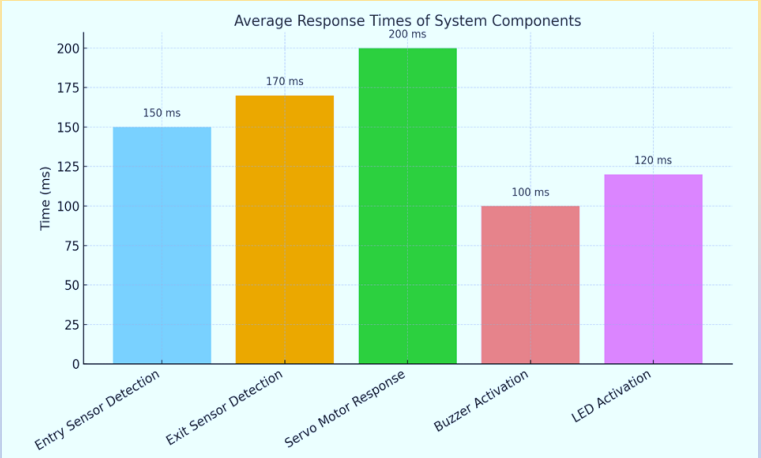
WORKING MECHANISM

- **Train Detection:** Ultrasonic sensors detect the train's presence at a predefined distance.
- **Signal Processing:** Sensor data is sent to the Arduino Uno, which processes the input.
- **Gate Control:** The Arduino triggers servo motors to close the gate when the train is near and reopen it once the train passes.
- **Alerts:** Traffic lights and a buzzer activate to warn pedestrians and vehicles during gate operation.



TESTING AND RESULTS

- The system responded within seconds to train detection.
- Gate opened and closed smoothly, synchronized with train movement.
- No false triggers or missed detections were recorded.
- Audio-Visuals alerts activated correctly during each text.
- Performance remained stable in repeated trails under varying conditions.
- Average Response for the system was 150ms.



BENEFITS OF PROPOSED SOLUTION

- Enhances safety by automating railway gate operations.
- Minimizes human error and manual dependency.
- Provides timely gate control with real-time train detection.
- Incorporates audio-visual alerts for public awareness.
- Cost-effective and suitable for rural and semi-urban crossings.

CHALLENGES FACED

- Sensor calibration was essential for reliable train detection.
- Unstable power supply initially caused inconsistent performance.
- Component integration needed careful planning to avoid timing issues.
- Servo motor angle had to be fine-tuned for smooth gate movement.
- Managing wire connections was challenging in the compact setup.

FUTURE SCOPE

- Integrate **wireless communication (e.g., GSM, IoT)** for remote monitoring.
- Connect with **existing railway signaling systems** for better coordination.
- Use **advanced sensors like LIDAR** for precise and long-range train detection.
- Implement **solar-powered operation** for energy efficiency in remote areas.
- Add **AI-based anomaly detection** to enhance system intelligence and safety.

CONCLUSION

- Successfully implemented an automated railway gate control system.
- Demonstrated accurate train detection using ultrasonic sensors.
- Automated gate operation reduced reliance on manual control.
- Improved safety and traffic management at crossings.
- Future enhancements can increase scalability and robustness.

THANK YOU!