Sensor-Based Railway gate Operation System

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# *Abstract*—Railway gate is very essential for security purposes. If there is any defect in the system it will damage one or more life. Every year thousands of accidents occur on railway crossings and thousands of people are dying. The objective of this project 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. Hence, if the train is late due to certain reasons, then gate remain closed for a longtime causing traffic near the gates. Hence, the time for which it is closed is less compared to the manually operated gates and also reduces the human labour. As the system is completely automated, it avoids manual errors and thus provides ultimate safety to road users .By this mechanism, presence of a gate keeper is not necessary and automatic operation of the gate through the motor action is achieved..

INTRODUCTION

In India, the major ways of transportation used are roads and railways, many a times the both are crossing over. And in some places there are gates provided for controlling the crossover of both and other major cases none is provided that lead to accidents.In a big populated country like India, accidents are a daily crisis that is being faced by the people.Most of these accidents are Road accidents few percentages of these accidents occurs the railway level crossings. To prevent these accidents on the railway level

crossing the automated system is proposed.[3]

The arrival and departure of trains is done by the sensors set. The automatic railway gate has two main advantages :

1. The reduction of time for which the gate is Being kept closed.
2. To provide safety for the roads users by reducing the accidents as there is no scope of human errors in this case

The safety and efficiency of railway systems are crucial, especially at level crossings where roads intersect with railway tracks. Traditional railway gate operation systems often rely on manual control or basic automated systems that are prone to human error and technical failures. A sensor- based railway gate operation system aims to enhance safety and operational efficiency by utilizing advanced sensors and automation technologies to control railway gates. This project involves designing and implementing a system that can automatically detect approaching trains and operate the gates to ensure safe and timely closure and reopening, reducing the risk of accidents.

# Objective

* + Develop an automated railway gate control system that uses sensors to detect approaching trains and control the opening and closing of gates at level crossings.
  + Enhance safety for both railway and road users.
  + Minimize human intervention and error in gate operation.

This project aims to develop a sensor-based railway gate operation system designed to enhance safety and efficiency at level crossings. Traditional manual and semi-automated systems are susceptible to human error and operational delays, posing significant risks. The proposed system employs advanced sensors, such as infrared and ultrasonic sensors, to detect approaching trains and automatically control the opening and closing of railway gates. An arduino sensor data to manage gate operations, ensuring timely closure and reopening.

Additional features include communication modules for remote monitoring and emergency override mechanisms for added safety. By automating gate control, the system aims to reduce accidents, improve operational efficiency, and minimize human intervention. The project addresses challenges related to sensor accuracy,

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system reliability, integration with existing infrastructure, and cost. Ultimately, this sensor-based solution represents a significant step forward in modernizing railway safety protocols.[6]. The figure1 shows the sensor based monitoring of railway gate in traditional manner

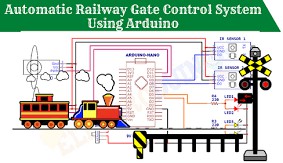


Fig1:abstract view of railway control

The existing solution for an automatic railway gate system typically involves sensors placed near the railway tracks to detect the presence of an approaching train. When a train is detected, the gate is automatically closed to prevent vehicles or pedestrians from crossing the tracks. Once the train has passed, the gate is opened again. It also uses only IR sensors to monitor the process[5]. This is depicted in the figure2

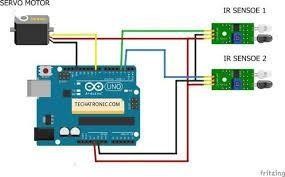
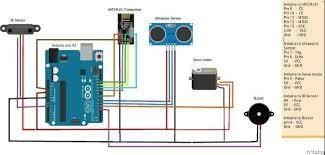


Fig2:Exsisting architecture



While infrared (IR) sensors offer several advantages, they also have limitations that should be considered when choosing them for a sensor-based railway gate operation system:IR sensors may be affected by sunlight, especially in outdoor environments, leading to false readings or reduced accuracy.Extreme weather conditions such as fog, rain, or snow can interfere with IR sensor performance, affecting their reliability**.** Accumulation of dust, dirt, or debris on the sensor's surface can obstruct the infrared beam, leading to inaccurate readings or sensor failure. IR sensors typically have a limited detection range compared to other sensors like ultrasonic sensors.[1][5]

This limitation may require more sensors to cover a larger area effectively, increasing system complexity and cost. IR sensors rely on detecting reflections from objects. They may struggle to detect non-reflective or transparent objects, leading to incomplete or inaccurate detection.IR sensors require a clear line of sight between the emitter and the receiver. Any obstruction between them, such as vegetation, structures, or vehicles, can hinder detection accuracy and reliability.

Objects casting shadows on the sensor or blocking the infrared beam can cause false readings or missed detections, particularly in complex or cluttered environments.IR sensors may experience interference from other infrared sources, such as heat sources or nearby electronic devices, leading to false readings.In systems with multiple IR sensors, crosstalk between sensors can occur, where signals from one sensor affect the readings of another, complicating data interpretation and potentially leading to errors.

Extreme temperatures can affect the performance and reliability of IR sensors, potentially leading to drift in readings or sensor malfunction. High humidity levels may impact the accuracy of IR sensors, especially if moisture accumulates on the sensor's surface, affecting its ability to emit and detect infrared radiation.Some IR sensors consume relatively high power, especially when actively emitting and receiving infrared radiation. This can affect the overall power consumption of the system and may require adequate power supply provisions.Continuous operation and exposure to environmental factors can degrade the performance and lifespan of IR sensors over time, necessitating periodic maintenance or replacement.

While IR sensors offer advantages such as simplicity,

cost-effectiveness, and suitability for certain applications, it's essential to consider their limitations, particularly regarding environmental sensitivity, detection range, line-of-sight requirements, interference, and lifespan. Evaluating these factors against the specific requirements and operating conditions of the railway gate operation system will help ensure an appropriate sensor selection that balances performance, reliability, and cost-effectiveness.

Figure3 describes the ultrasonic arrangement. In our system, we are placing ultrasonic sensors near the railway tracks. Ultrasonic sensors are used in this system, because it has a very high range . At a certain distance before the level crossing and after the level crossing, these ultrasonic sensors are placed.[9][1]

Fig3:Proposed solutions architecture using UV sensors

# Reason to choose Ultrasonic sSensors in a Sensor- Based Railway Gate Operation System

Ultrasonic sensors are highly suitable for a sensor-based railway gate operation system due to their unique advantages and features. Here are the key reasons for choosing ultrasonic sensors for this application:

Ultrasonic sensors operate without physical contact with the object being detected. This reduces wear and tear on the sensor and ensures a longer lifespan compared to contact- based sensors. They can be placed at a distance from the railway track, minimizing the risk of damage from passing trains or other environmental factors.Ultrasonic sensors provide accurate distance measurements, essential for determining the exact location and speed of an approaching train. They also offer reliable and consistent performance, ensuring precise detection and timing for gate operations.

Ultrasonic sensors are relatively unaffected by environmental conditions such as fog, rain, dust, and varying light conditions. This makes them highly reliable for outdoor applications.They function effectively across a broad range of temperatures and weather conditions, ensuring year-round reliability. Ultrasonic sensors can detect objects at long distances, which is crucial for early detection of approaching trains, allowing sufficient time for gate operations.

They can cover wide areas and are capable of detecting large objects, such as trains, over significant distances.Ultrasonic sensors can be easily integrated into various system configurations and can be used alongside other types of sensors to enhance detection accuracy and reliability. They are versatile and can be used for different aspects of the railway gate operation system, such as train detection, speed measurement, and obstacle detection.

Ultrasonic sensors are designed to withstand harsh conditions, requiring minimal maintenance.

This reduces operational costs and ensures long-term reliability.Many ultrasonic sensors have self-cleaning capabilities, preventing dust and debris from affecting their performance.. Multiple ultrasonic sensors can be used to provide redundancy, ensuring that the system remains operational even if one sensor fails.They enable real-time monitoring and quick response to changes, enhancing the safety and reliability of the gate operation system[2].

II. RELATED WORKS

This study proposes an automated railway gate system using Arduino microcontrollers. The system uses ultrasonic sensors to detect approaching trains and control gate operations, aiming to reduce accidents and enhance safety at railway crossings. It demonstrates the feasibility of using microcontrollers for real-time gate operation and highlights the benefits of automation in railway safety.

This paper presents an automatic railway gate control system utilizing Ultrasonic sensors and a microcontroller unit to automate the gate operations. The focus is on minimizing human intervention and improving the reliability of gate operations. The system is tested for various scenarios, demonstrating significant improvements in safety and efficiency.

Safety is a critical component of any railway gate operation system. In a sensor-based railway gate operation system, several strategies and technologies are employed to ensure the safety of both railway and road users. Here are the key mechanisms through which safety is achievedUsing a combination of sensors, such as infrared (IR), ultrasonic, and UV sensors, enhances the accuracy of train detection. Multiple sensors provide redundancy, ensuring that the system can reliably detect an approaching train even if one sensor fails or gives false readings. Sensors with a long detection range allow the system to detect trains well in advance, providing ample time to safely close the gates.[8][7]

Automated control reduces human error. The microcontroller processes sensor data and operates the gates automatically, ensuring timely closure and opening. Using reliable motors or servomechanisms for gate operation ensures consistent and efficient performance. Providing a manual override option allows gate operators to intervene in case of system failure or emergencies, ensuring the gates can still be operated safely. The system can send real-time alerts to both railway and road users, informing them of an approaching train and the status of the gates, enhancing situational awareness. Ensuring that the system has a battery backup maintains operation during power outages, preventing gate failures that could lead to accidents. Implementing self- diagnostic capabilities allows the system to check its components and functionality regularly, identifying and addressing potential issues before they lead to failures. Using sensors that are less affected by adverse weather conditions, such as UV sensors, ensures reliable operation in fog, rain, or dust.[4]

Scheduled inspections and maintenance routines ensure that all components of the system are functioning correctly and any wear and tear is addressed promptly. Keeping logs of system operations and sensor readings helps in analyzing performance over time and identifying patterns that might indicate impending failuresEnsuring that the system complies with relevant safety standards and regulations for railway operations guarantees that it meets established safety criteria. Training personnel on the operation and maintenance of the system ensures that they can effectively manage and troubleshoot the system, further enhancing safety.[4]

Safety in a sensor-based railway gate operation system is achieved through a combination of accurate detection, reliable gate control, emergency mechanisms, robust communication, failsafe design, environmental adaptability, preventive maintenance, and adherence to safety protocols. By integrating these elements, the system provides a comprehensive solution that significantly enhances the safety of railway crossings, protecting both railway and road users.

Ultrasonic sensors are widely used in various applications for distance measurement and object detection due to their reliability and precision. Here’s a detailed explanation of how ultrasonic sensors work

# Basic Principle

Ultrasonic sensors operate on the principle of echolocation, similar to how bats navigate. They emit ultrasonic sound waves, which are sound waves with frequencies higher than the human audible range (typically above 20 kHz). These waves travel through the air and reflect back when they hit an object. The sensor measures the time it takes for the waves to return, and this time interval is used to calculate the distance to the object.

# Components of an Ultrasonic Sensor

* + **Transmitter (Emitter):** Converts electrical signals into ultrasonic sound waves and emits them.
  + **Receiver:** Detects the ultrasonic waves that are reflected back from an object and converts them back into electrical signals.
  + **Control Circuit:** Processes the signals, calculates the time interval between emission and reception, and computes the distance.

# Operation Steps

1. **Emission of Ultrasonic Waves:**
   * The sensor’s control circuit sends an electrical signal to the transmitter, which generates an ultrasonic pulse (sound wave) and emits it into the surrounding environment.

# Propagation of Waves:

* + The emitted ultrasonic waves travel through the air at the speed of sound (approximately 343 meters per second in air at room temperature).

# Reflection from Object:

* + When the ultrasonic waves encounter an object, they bounce back towards the sensor. This reflected wave is also known as an echo.

# Reception of Echo:

* + The receiver detects the echo and converts it back into an electrical signal.

# Time Measurement:

* + The control circuit measures the time interval (Δt) between the emission of the ultrasonic pulse and the reception of the echo.

# Distance Calculation:

* + The distance (D) to the object is calculated using the formula:

D=Speed of Sound×Δt2D =

\frac{{\text{Speed of Sound} \times \Delta t}}{2}D=2Speed of Sound×Δt The division by 2 accounts for the round-trip distance (from the sensor to the object and back).

# Advantages of Ultrasonic Sensors

* + **Non-contact Measurement:** Ultrasonic sensors can measure distances without physical contact with the object, making them ideal for applications where contact is not feasible or could cause damage.
  + **Versatility:** They can detect a wide range of materials, including solids, liquids, and granular substances.
  + **Environmental Robustness:** Ultrasonic sensors are relatively unaffected by dust, smoke, and lighting conditions, ensuring reliable operation in various environments.
  + **High Precision:** They offer high accuracy in distance measurement, typically within a few millimeters.

# Application in Railway Gate Operation Systems

In a sensor-based railway gate operation system, ultrasonic sensors can be used for detecting the presence and position of trains. Here’s how they would work in this context:

# Installation:

* + Ultrasonic sensors are installed along the railway tracks at strategic points before and after the level crossing. Multiple sensors ensure continuous monitoring and redundancy.

# Train Detection:

* + When a train approaches, the ultrasonic sensors emit sound waves. These waves reflect back from the train's surface and are detected by the sensors.

# Distance Measurement:

* + The time interval between the emission and reception of the sound waves is measured. The control circuit calculates the distance to the train using the speed of sound.

# Data Processing:

* + The measured distances are sent to a central microcontroller, which processes the data to determine the train's speed and proximity to the crossing.

# Gate Control:

* + When the train is detected within a certain range, the microcontroller signals the gate actuators to close the gates. Once the train has passed, the gates are reopened based on signals from sensors placed after the crossing.

# Safety and Reliability:

* + The use of ultrasonic sensors ensures accurate and reliable detection of trains, reducing the risk of accidents at level crossings. Their robustness to environmental conditions further enhances the safety and reliability of the system.

Ultrasonic sensors operate by emitting sound waves and measuring the time taken for the echoes to return from objects. This time interval is used to calculate the distance to the object, providing accurate and non-contact measurement. In a railway gate operation system, ultrasonic sensors play a crucial role in detecting trains, ensuring timely gate operation, and enhancing overall safety at level crossings.Ultrasonic is shown in the figure4



Fig4:Ultrasonic sensor

***HARDWARE AND SOFTWARE REQUIREMENTS***

# 1] ARDUINO IDE SOFTWARE :

* Arduino is a prototype platform (open -source) based on an easy-to-use hardware and software.
* It consists of a circuit board, which can be programed and a ready-made software called Arduino IDE (Integrated Development Environment),which is used to write and upload the computer code to the physical board
* When a user writes code and compiles, the IDE will generate a Hex file for the code. (Hex file are Hexadecimal files which are understood by Arduino) and then sent to the board using a USB cable. This is shown in figure5

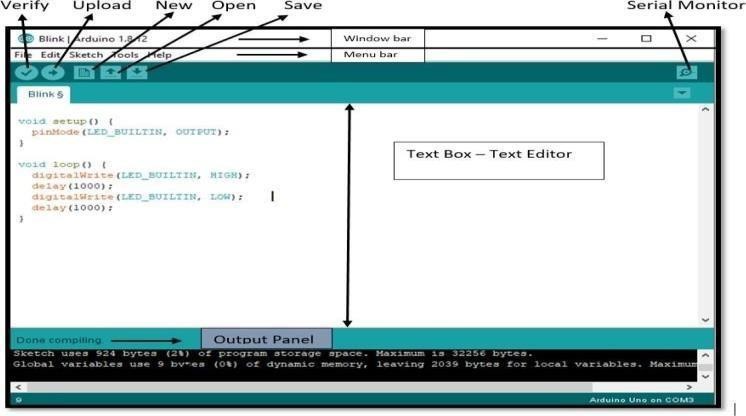


Fig5: Arduino software

To implement the **Automatic Railway Gate Opening System** using **Python**, we will communicate with the **Arduino** via **serial communication** using the pyserial library. The Python script will read the distance data from the ultrasonic sensors and trigger the gate-opening or closing mechanism accordingly.

### **Steps to Implement the Python Code**

1. **Arduino will read** the distance from two ultrasonic sensors (trigPin1, echoPin1 and trigPin2, echoPin2).
2. **Arduino sends the distance data** to the computer via **Serial Communication** (USB).
3. **Python reads the data** and checks if the train is detected within the detectionRange.
4. If a train is detected, Python sends a command to **close the gates**; otherwise, it **opens the gates**.

### **How It Works:**

1. **Python Code (PC Side)**
   * Reads **ultrasonic sensor** data from Arduino.
   * Sends commands to **open/close the gate** based on train distance.
   * Displays real-time train detection messages.
2. **Arduino Code (Hardware Side)**
   * Uses **HC-SR04 ultrasonic sensor** to detect train distance.
   * Controls the **servo motor** to open/close the gate.
   * Activates a **buzzer and LED** when the gate is closing

**HARDWARE:**

A light-emitting diode (LED) is a semiconductor device that emits light when an electric current flows through it. When current passes through an LED, the electrons recombine with holes emitting light in the process.LCDs are characterized by their ability to produce sharp and vibrant images with excellent color reproduction. The display resolution, expressed in terms of pixels, determines the level of detail that can be presented.

# SERVO MOTOR

A servo motor is a self-contained electrical device that moves parts of a machine with high efficiency and great precision. In simpler terms, a servo motor is a BLDC motor with a sensor for positional feedback. This allows the output shaft to be moved to a particular angle, position, and velocity that a regular motor cannot do. However, a servo motor is only one part of a closed-loop motion control system.

# Buzzer

A buzzer or beeper is an audio signaling device, which may be mechanical, electromechanical, or piezoelectric. A buzzer is a small yet efficient component to add sound features to our project/system. It is very small and compact 2- pin structure hence can be easily used on breadboard, Perf Board and even on PCBs which makes this a widely used component in most electronic applications.

# Ultrasonic sensor

An ultrasonic sensor is an instrument that measures the distance to an object using ultrasonic sound waves. An ultrasonic sensor uses a transducer to send and receive ultrasonic pulses that relay back information about an object's proximity.

Ultrasonic sensors play a crucial role in ensuring the safety and efficiency of a sensor-based railway gate operation system. Here's a detailed explanation of how they function within this project

Figure6 emphasizes the connection of hardware and software as a block diagram reprsentation



Fig6:block diagram representation

# System Setup and Components

* + **Ultrasonic Sensors:** Installed at strategic locations along the railway track before and after the level crossing.
  + **Microcontroller:** Central unit that processes the data from the ultrasonic sensors and controls the gate mechanism.
  + **Gate Actuators:** Motors or servo mechanisms that open and close the railway gates.
  + **Power Supply:** Ensures continuous operation of sensors and other components.

# Detection Mechanism

1. **Emission of Ultrasonic Waves:**
   * The ultrasonic sensors emit a series of ultrasonic pulses at regular intervals. These sound waves are above the range of human hearing, typically around 40 kHz.

# Wave Propagation:

* + The emitted ultrasonic waves travel through the air and propagate along the railway track.

# Reflection from Train:

* + When a train approaches, the ultrasonic waves hit the surface of the train and are reflected back towards the sensor.

# Reception of Echo:

* + The ultrasonic sensor receives the reflected waves (echo) and converts them back into electrical signals.

# Data Processing and Distance Calculation

1. **Time Measurement:**
   * The microcontroller measures the time interval (Δt) between the emission of the ultrasonic pulse and the reception of the echo.

# Distance Calculation:

* + Using the speed of sound (approximately 343 meters per second at room temperature), the microcontroller calculates the distance (D) to the train with the formula: D=Speed of Sound×Δt2D =

\frac{{\text{Speed of Sound} \times \Delta t}}{2}D=2Speed of Sound×Δt

* + The division by 2 accounts for the round- trip distance (from the sensor to the train and back).

# Speed and Proximity Determination:

* + By continuously measuring the distance at regular intervals, the microcontroller can determine the speed of the approaching train.
  + The system can calculate the train’s proximity to the level crossing, ensuring timely operation of the gates.

# Gate Operation

1. **Triggering Gate Closure:**
   * When the calculated distance indicates that the train is within a predefined range from the crossing, the microcontroller sends a signal to the gate actuators to close the gates.
   * The system ensures the gates are closed well before the train reaches the crossing, providing ample time for vehicles and pedestrians to clear the area.

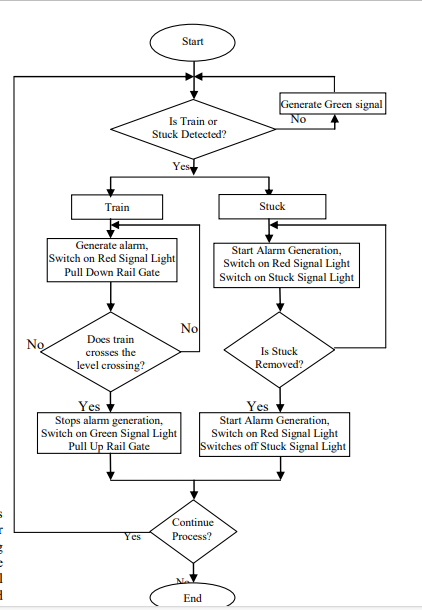
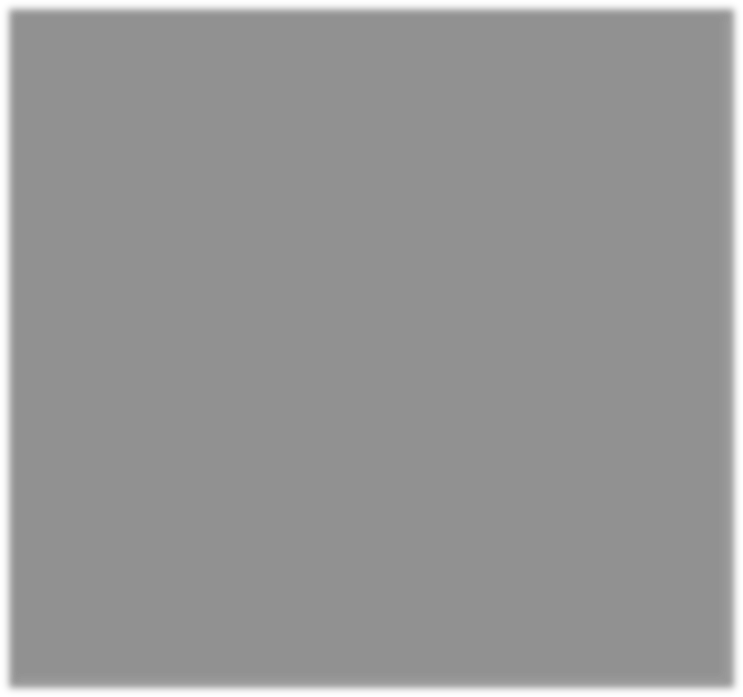
# Monitoring Train Passage:

* + Ultrasonic sensors continue to monitor the train's position as it moves through the crossing. Sensors placed after the crossing detect when the train has completely passed.

# Triggering Gate Opening:

* + Once the train has passed and the crossing is clear, the microcontroller signals the gate actuators to open the gates.
  + This minimizes disruption to road traffic and ensures efficient operation.

# Safety Enhancements



1. **Redundancy and Reliability:**
   * Multiple ultrasonic sensors are used to provide redundancy, ensuring reliable detection even if one sensor fails or gives inaccurate readings.
   * The sensors’ ability to function in various environmental conditions, such as rain, fog, and dust, enhances the system’s reliability.

# Real-Time Monitoring:

* + The microcontroller continuously monitors sensor data in real-time, allowing for immediate response to any changes or anomalies.
  + In case of an emergency or malfunction, manual override options are available for gate operation.

# Preventive Maintenance:

* + Regular system diagnostics and maintenance routines ensure that the sensors and other components functionin.

Ultrasonic sensors in a sensor-based railway gate operation system function by emitting ultrasonic pulses and measuring the time it takes for the echoes to return after reflecting off an approaching train. This data is processed to calculate the distance and speed of the train, enabling the microcontroller to operate the gates safely and efficiently. The robustness and reliability of ultrasonic sensors ensure accurate detection and timely gate operation, significantly enhancing the safety of railway crossings.

Fig7: flowchart

Above figure7 describes the whole work as a flowchart

CONCLUSION :

By implementing our system, train collisions can be predicted beforehand and necessary precautions could be taken in order to avoid any accidents. Derailments caused by excessive speeds could also be prevented as speeds of trains are always monitored.Automatic train detection and obstacle detection at level crossings would play a major role and guarantee a comprehensive amount of safety in the level crossings.

FUTURE SCOPE :

The accidents due to railway level crossing and the obstacle can be avoided in real time by implementing this system and the whole process is completely automatic. In future the features like wireless system can be implemented in the real time operation. Integrating multiple sensor types, such as ultrasonic, infrared, UV, LiDAR, and radar sensors, can provide redundant and complementary detection capabilities, improving accuracy and reliability. Leveraging high-speed 5G networks and edge computing capabilities can enable faster data processing, reduced latency, and enhanced responsiveness for critical operations.

Exploring energy harvesting technologies such as kinetic energy recovery or piezoelectric systems to capture and utilize energy from train movements or environmental vibrations can supplement power sources and increase system resilience. The future scope for a sensor-based railway gate operation system is vast, with opportunities for innovation and advancement in sensor technologies, connectivity, automation, safety features, sustainability, and

user-centric design. By embracing emerging technologies and collaborative approaches, railway gate operation systems can evolve to meet evolving transportation needs while prioritizing safety, efficiency, and accessibility for all users.[1]

# REFERNCES:

1. Meheniger Alam , Alimul Rajee (Volume 4 Issue 2, 5th june ,2023),“Sensor Based Automatic Control of Railway Gates” ; International Journal of Advanced Research in Computer Engineering & Technology (IJARCET);
2. “Automatic Railway Gate Controller”; Website Link: https:/[/www.electronicshub.org/automaticrailway-gate-](http://www.electronicshub.org/automaticrailway-gate-) controller/ ; Access/ Retrieval Date: August 9th ,2021.
3. Karthik Krishnamurthi, Monica Bobby, Vidya V, Edwin Baby (Volume 4 Issue 2, February 2015); “Sensor Based Automatic Control of Railway Gates” ; International Journal of Advanced Research in Computer Engineering & Technology (IJARCET); Website Link: https:/[/www.academia.edu/36138151/IJARCET\_VOL\_4\_IS](http://www.academia.edu/36138151/IJARCET_VOL_4_IS) SUE
4. Saifuddin Mahmud, Ishtiaq Reza Emon, Md. Mohaimin Billah (Volume 27, November 1-September 2015); “Automated Railway Gate Controlling System”; International Journal of Computer Trends and Technology (IJCTT); DOI: https://doi//10.14445/22312803/IJCTT-V27P101 ;Website Link:https:/[/www.researchgate.net/publication/285604396\_](http://www.researchgate.net/publication/285604396_) Automated\_Railway\_Gate\_Controlling\_Sys tem
5. Masharul Bin Mahfuz, Zohair Mehtab Ali, Md. Shakhawat Hossain, Avijit Das (November 5-8, 2017); “Development of a Smart Railway System for Bangladesh”; Proc. Of the 2017 IEEE Region 10 Conference (TENCON); DOI: https://doi//10.1109/TENCON.2017.8227947 ; Website Link:https:/[/www.researchgate.net/publication/322214181\_](http://www.researchgate.net/publication/322214181_) Development\_of\_a\_smart\_railway\_system\_ for\_Bangladesh

[6]G.Madhu, M.Yohan (Volume 6 Issue 2, June, 2019); “Solar Operated Automatic Crack Detection System For Railway Track”; International Journal of Machine and Construction Engineering; Website Link: <http://www.bonfayjournals.com/ijmce/papers/2019/june19/IJ> MCEjune26.pdf ICT-506|| Project Group- F “Automatic Railway Gate Control & Hydraulic Road System Using Arduino UNO” 15 View publication stats

[7]Ms. Nida Aafreen Aslam Khan, Ms. Komal Sunil Pise ( Volume:07 Issue:03,March 2020) “Hydraulic Jack System Installed in Footpath for Reducing Traffic in Case of Emergency, Automatic Street Light Control System Based On LDR (Light Dependent Resistor) For Minimize the Electricity Consumption”; International Research Journal of Engineering and Technology (IRJET);Website Link: https:/[/www.irjet.net/archives/V7/i3/IRJET-V7I3595.pdf](http://www.irjet.net/archives/V7/i3/IRJET-V7I3595.pdf) [8]https:/[/www.academia.edu/44846881/Effective\_Traffic\_](http://www.academia.edu/44846881/Effective_Traffic_) Management\_System\_By\_Using\_Hydrau lic\_Footpath

[9] Deva Rajan (May 17th,2021); “Automatic Railway Gate Control System Using Arduino Controller; Research Square”; DOI: https://doi.org/10.21203/rs.3.rs-529956/v ; Website Link:https://assets.researchsquare.com/files/rs- 529956/v1/22cc6008-3738-4148-b607-

23ac25333022.pdf?c=1631883027 Ranu Rawat, Roshni Ambulkar, Reena Chilhate, Ashish Chokikar, Nilesh Mishra (Volume 4 Issue: 03 , March,2022); “Automatic Railway Gate Control System By Using Arduino”; International Research Journal of Modernization in Engineering Technology and Science;WebsiteLink:https:/[/www.irjmets.com/uploadedfiles](http://www.irjmets.com/uploadedfiles)

/paper/issue\_3\_march\_2022/19919/final/fin\_irjmets164760 4977.pdf “Arduino Board Description”; tutorialspoint; WebsiteLink:https:/[/www.tutorialspoint.com/arduino/arduin](http://www.tutorialspoint.com/arduino/arduin) o\_board\_description.htm R9 “What is an IR Sensor; Circuit Diagram & Its Working” ; EL-PRO-CUS; Website Link: https:/[/www.elprocus.com/infrared-ir-sensor-circuit-and-](http://www.elprocus.com/infrared-ir-sensor-circuit-and-) working/ Jignesh Sabhadiya ;“What Is Servo Motor?- Definition, Working And Types”; ENGINEERING CHOICE

;Website Link: https:/[/www.engineeringchoice.com/servo-](http://www.engineeringchoice.com/servo-) motor/ “What Is the function of Connecting Wires?” ; Reference;WebsiteLink:https:/[/www.reference.com/science/f](http://www.reference.com/science/f) unction-connecting-wires-c7b22ee3838e0a17 ; Access/ Retrieval Date: March 28, 2020