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Control of Railway Gate Automation System using IOT

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ABSTRACT: The goal of this project is to streamline unmanned railroads and level crossing gates. This technology is utilized to prevent accidents occurring between road users. Many mishaps occur when manual controlling is done by untrained laborers who lack awareness and experience. Therefore, in order to be able to prevent such mishaps and preserve lives. This project aims to automate railway gate control and prevent accidents using Arduino and sensors. The Arduino Uno board is microcontroller based on the AT mega 328. The key sensor that we employ to measure an object's distance is the ultrasonic sensor. Arduino sensors are used in the circuits that regulate the releasing and shutting of the rail crossing gate system. RFID retrieves data from railway stations, relaying it to registered users, while an infrared radiation transmitter transmits train arrival information to a microcontroller.

KEYWORDS: Arduino UNO Micro-controller, Ultra-sonic sensor, Servomotors, Breadboard.

I.INTRODUCTION

The planning and execution of considerations for an auto- mated railway gate control system are presented in this study. The system detects trains and obstacles by analyzing reflected waves activates an alarm, and manages the light signal and gate operation. Once the train completely passes the level crossing the gate reopens the alarm ceases, and the indicator light switches to green. If an obstacle is detected on the the stuck signal is activated upon level crossing. The reduced equipment, lower cost, simpler design, and high efficiency of the proposed system demonstrate its effectiveness compared to existing solutions. A new IOT based automatic railway crossing system aims to eliminate human errors in operating gates, addressing the issue of extended waiting times for vehicles at railway crossing. This automated solution minimizes delays and prevents accidents, ensuring safer and faster trans- portation. Traditional railway crossing mechanisms, prone to errors and accidents, require innovative solutions to automate gate control and improve safety at level crossings, addressing the increasing volume of traffic and modern infrastructure demands. The Internet of Things (IOT) offers a promising solution for railway operations by integrating interconnected devices with sensors, enabling automation, Real-time communication, and detection of approaching trains. The paper discusses the development and implementation of an IOT-based control system for railway gates that operates automatically, aiming to reduce manual gate operation risks, accidents, and enhance efficiency and safety in railway transportation To prevent accidents at railway crossings and reduce delays, we propose a solution that automate the manual operations of the railway crossing system using IOT. Our system offers a smart highly accurate and reliable method for operating railway gates enhancing both safety and efficiency. This paper proposes an intelligent system for controlling railway gates to prevent accidents at level intersections. The system uses the Internet of Things (IOT) to enable seamless communication and operation without human intervention. It also enhances driver convenience by allowing them to monitor gate status through a mobile application. Utilizing ultrasonic detectors to detect approaching trains and communicates this information to Google Firebase via NodeMCU, triggering gate closure and opening. This cost effective, real-time system improves safety and mitigates risks associated with level crossing accidents.

II. LITERATURE SUREVY

In [1], "Automation of Railway Gate using Internet of Things (IoT)" by, Abinaya, M., and Thenmozhi Vidya uses LED, SERVO motor, IR proximity sensor, Rasbery pi, RFID Reader. This paper talks about the Internet of Things (IoT) and how an Railway Gate Controller used on an Automatic Basis. IoT makes it possible for networked devices with RFID and sensors to do automated tasks via TCP, UDP, and ICMP protocols. The controller's goal aims to automate level crossing railway gate operations, improving safety by cutting down on closing times and lowering

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human error-related incidents. It also provides a passenger notification system, which is affordable, user-friendly, and real-time. Usersregister for arrival alerts via a website.

In [2]," A Secure Railway Crossing System Using IoT" by Reddy, E. Amarantha, et al uses — Railway Gate, Internet of Things, Railway Crossing, Micro Controller, Arduino, Sensors The purpose of this article is to design a microcontroller system prototype for automated railway gate control. When sensors identify a train, a warning signal warns the public that the entrance is going to close. Afterwards, the control module comes on and uses DC motors to close the gates on either sideof the track. The module raises the gates automatically once the train passes. The system makes use of an 8051-family microcontroller (AT89C52) coupled with a Raspberry Pi. It is coded in Embedded C. Testing validated the prototype's abilityto promptly close gates upon train arrival and lift them again after passage, proving its usefulness in improving railway efficiency and safety.

In [3], "Automatic Control on Railway Gates Using IoT" byDayana, B., Supreeth, A. K. R. N., Somesh, K., Kumar, A. H., and Harinath, N. uses Arduino, DC motor, DC controller, IR sensors LCD display, Siren. To ensure reliable train detection, your system must be implemented with IR sensors placedprecisely, ideally at least three hundred meters far from the railway gate. These sensors use transceivers to provide datato a receiver, which decodes and updates the microcontrollerto cause simultaneous alarms like closing the gate with a DC motor, sounding the siren, and showing the distance and speed at railroad intersection on an LCD screen. A little further from the station, a second infrared sensor verifies train passage and modifies gate operations and alert signals accordingly. For the Purpose to effectively manage numerous tracks and ensure scalable railway crossing management for a varietyof directional traffic, the Arduino board is responsible for controlling these operations depending on the sequence of sensor activations.

In [4], "Prevention of Railway Accidents by Automatic Gate Control and Fire Detection using IoT" by Narayan, Anusha, P. Niveditha, and H. C. Rashmi. Uses IR sensors, Arduino UNO, Mini Servomotor, Node MCU, GPS, IOT platform. The aimof this project's goal is to automate railroad crossing gates, which are now manually operated by gatekeepers who are notified of approaching trains from neighboring stations. For the purpose to reduce communication breakdowns or delays, the system uses infrared sensors to identify when trains are arriving and leaving. Mini servomotors mounted at the gates are controlled by an Arduino UNO, doing away with the need for personal intervention. Additionally, the system combines GPS and Node MCU technology to quickly identify and react to fire occurrences inside train compartments, improving safetyprotocols at railroad crossings.

In [5], "Smart Railway Track and Crossing Gate Security System Based on IoT" by Talpur, Mir Sajjad Hussain, uses Crossing Gate Security, Smart Railway, Internet of things, Track. The railway system is an economical means of trans- portation, but it needs constant observation to avoid mishaps like deaths from mistakes made by hand. It's not feasible to manually manage data across large distances, which puts pedestrians at risk at crossings where gate operations delays can result in mishaps. By employing Light Dependent Resistor(LDR) and laser detectors for accurate fault detection, Force Sensitive Resistor (FSR) detectors for automatic crossing pro- taction, and Sonar sensors for obstacle avoidance, this research seeks to improve railway safety and efficiency. The Arduino UNO microcontroller, which roots the system and is integrated with a GSM module for emergency communication and IoT for remote monitoring, holds great promise for the country's railway infrastructure.

In [6]," AUTOMATED RAILWAY CROSSING SYSTEM USING IoT" by Sunitha, M. Eswar Krishna, D. Deepika, D. Divya, K. Bhargav uses Arduino microcontroller, NodeMcu ESP8266, Servo Motors, Ultrasonic Sensors.
Accidents at rail-road crossings, which are frequently the result of operational mistakes, call for automated solutions like our Internet ofThings technology. Our technology detects train arrivals and departures by using ultrasonic sensors that are strategically placed at distances that are appropriate to train types andspeeds. It uses servo motors to close the gate, activate warningbuzzers, and change the traffic signals from green to red when it senses something. This process continues until the traincrosses the crossing. With the help of an Arduino microcin- troller and a NodeMcu ESP8266, cloud integration updates train statuses in real-time, resulting in a considerable decrease in accidents and a reduction in the amount of labor requiredat crossings.

In [7], "Control of Railway Gate Automation System Using Arduino Controller" by Rajan, Deva. Uses Arduino UNO micro-controller, IR Sensor, LED, Servo Motor, Buzzer, Resist-tors. The automation of railroad level crossing gates—which were once manually operated by gatekeepers who got alerts about train arrivals from neighboring stations—is the main objective of this project. By automating this procedure, delays from human interaction and possible traffic jams brought on by extended gate closures are avoided. For the purpose of managing gates, infrared sensors that

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interface with Arduino are essential for identifying train arrivals and departures. After a third sensor confirms the train's departure, two sensors detect the arrival of the train, alerting oncoming traffic and starting the gate to close. By using sensor-driven technology, this automation guarantees effective gate operations, improving safety and traffic flow at railroad crossings.

In [8]," Automatic Train Junction Gate Control System Based on Arduino-Uno Microcontroller" by Gajbhiye, Sushant M., Raju A. Bondre, and Zen P. Raut uses Train junction, Gate, Automatic control, Arduino-Uno, Microcontroller. Each day is greatly impacted by transportation technology, particularly in the railway industry. However, accidents resulting from manual rail junction gate operations continue to cause concern. In order to solve this problem, an automated system powered by an Arduino Uno is being developed. Sensors will be applied in place of manual procedures to detect trains. The framework makes use of an ESP8266 MCU to detect vibration and ultra- sonic sensors and then uses Telegram to transmit notifications.Testing produced an average gate response time of 344 MS, validating the efficiency of sensor placement. Future plans call for system enhancement and the seamless integration of gate systems for train timetable management.

In [9], "Automated Railway Gate Controlling System" by Saifuddin Ishtiaq and Mahmud Reza Emon, M.D. Muhaimin Billah uses Sensor Ultrasonic, Train Detection, Stuck Detection, Alarm generator, Level Crossing. This work presents an automated level crossing railway gate system that aims to replace manual gate operations with an advanced detection and control system. The system includes modules that use ultrasonic sensors to detect trains and trapped objects. A centralized controller unit operates the gates and generates the necessary alarms. It has alarms and signal lights to alert and warn oncoming cars. The system's cost-effectiveness, depend- ability, and simplicity when compared to existing standardsare demonstrated by the experimental results, which present a viable option for raising railway efficiency and safety.

In [10], "AUTOMATED UNMANNED RAILWAY LEVEL CROSSING SYSTEM" by V. KALI-RAJ, P. BALASUBRA- MANIAN, S. DEEPA, N. BANUCHANDAR, J, N. THAMI-LARASI uses automated railroad gates and unattended level crossings, Railway safety, Sensor-based detection, Microcon- troller automation, Accident reduction Gatekeeper replacementTraffic safety enhancement Gate closure time reduction Technology in transportation. Effective solutions are desperately needed in our nation, where fast development is accompanied by an alarming rise in incidents at unmanned level crossings. Within this research, we propose to replace manually controlled train gates featuring with automatic gatekeeper-operated ones. This tactic aims to lower the number of accidents and increase road user safety by shortening the period that gates close. When a train arrives, sensors at the intersection identify it, which ensures closure times are shortened compared to manual operations. Because The framework is autonomous, human error related to manually carrying outis eliminated. It makes use of microcontroller technology specifically designed for unmanned crossings on the railway network.

III. SYSTEM DESIGN AND ANALYSIS

India's train speed ranges from 91 km/hr.to 59 km/hr., requiring optimal IR sensor placements for arrival and depar- true. The optimal distances ensure gate closure for no more than 10 minutes, ensuring efficient operations. The system uses IR sensors and hardware components to detect trainswithout physical contact, triggering a gate control mechanism powered by a stepper motor. The Raspberry Pi serves as the central controller, connecting the system to LEDs for traffic control and an RFID reader for destination notifications. Additionally, the system includes red and yellow LEDs for visual signals for approaching and departing trains. This integrated system enhances safety at level crossings, improvestrain operations efficiency, and reduces accident risk. It offers a reliable, high performance, and cost-effective solution for both road users and railway passengers. Control of Railway Gate Automation System uses four infrared (IR) sensors to detect train approaches and departures at the intersection of levels. The sensors are strategically placed at 6 km and 7 km distances, based on India's train speeds. The Raspberry pi 2 central controller manages all connected devices and executes control algorithms. The system includes IR sensors, a stepper motor, LED indicators, an RFID reader, a Destination Alert System, stepper motor control, and traffic control LEDs. The RFID reader scans the train's RFID tag, sending train- specific information to a central server. Additionally, the system includes a stepper motor for precise gate opening and shutting of gates, and traffic control LEDs to signal approaching trains and departures. The system aims to improve safety at railway crossings and provide timely notifications to passengers about their destinations.

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IV.PROPOSED SOLUTION

The suggested framework uses IR sensors, RFID readers, LEDs, servo motors, and a Raspberry Pi central processing unit to control railway gates. Sensors detect incoming and departing trains ensuring gates remain closed and minimizing disruption. RFID readers provide destination notifications, enhancing passenger convenience. LED indicators control traffic at crossings, with red signals for closed gates and yellow signals for open ones. The raspberry Pi manages LEDs, while the servo motor operates gates. The system is linked to a central server for real-time communication. This IOT solution enhances safety and operational efficiency at railway level crossings.

a. Component

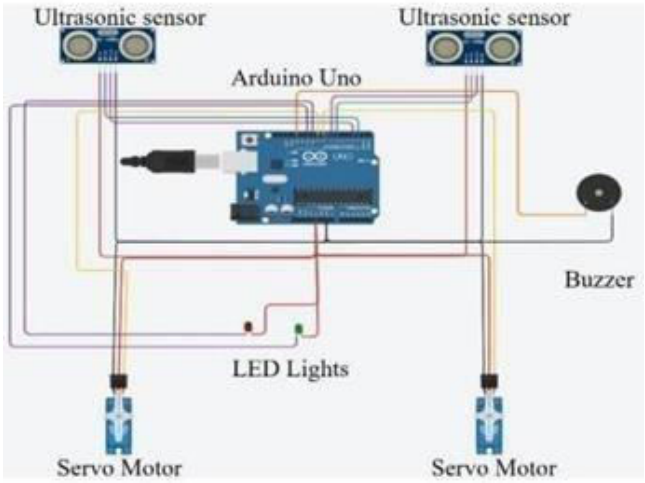

Fig. 1. **Block Diagram of the System**

Arduino UNO micro-controller: The Arduino Uno board is a micro controller according to the AT mega 328. It has 14 digital input and output pins in which 6 is utilized as PWM header, a USB connection, 6 analog inputs, a power jack reset bottom. An open-source microcontroller board called the Arduino Uno is built on the microchip at mega328P microcontroller and developed by Arduino.cc The board is equipped with sets of digital and analog input/output (I/O) pins that may be interfaced to various expansion boards and other circuits.

Ultrasonic Sensor: The ultrasonic detector is the basic sensor that we use to determine the distance of an object. In another way we can say that it is used to measure how far away the object is located from a particular reference point. It has basically 4 pins: 1. Trig pin 2. Echo pin 3.GND pin 4.VCC pin(+5V)

Servo Motor: These are a special kind of motors which are employed for very specific movement at a particular angle. It is a rotary actuator that permits precise control at certain angular positions. Servo motor is not a single entity but a combination of a suitable motor along with a sensor which gives the feedback of the current position of the motor.

LED Light: LED lights are essential in the automatic railway gate control system, serving as visual indicators for train arrival and gate status. Red lights indicate train arrival, while yellow lights indicate gate status. These lights enhance visibility, preventing accidents in low-light environments. They are also energy-efficient, consuming less power than traditional incandescent bulbs, making them ideal for continuous operation. Overall LED lights are crucial for ensuring the effectiveness and safety of the railway gate control system.

Jumper Wire: Jumper wire is essential in an automated railroad gate operator, connecting electronic components and modules. They establish connections between sensors, microcontrollers, motor drivers, and other modules. They are also used for breadboard connections during prototyping and testing, allowing quick iteration and trouble shooting. Jumper wires provide flexibility in circuit design by allowing components to be positioned at different locations, ensuring optimal operations. They also aid in signal routing, ensuring accurate and reliable transmission of data, commands and power.

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B. IMPLEMENTATION

The system involves strategically positioning IR sensors at a safe distance from a railway gate, allowing for the transmission of train-related data. The microcontroller then triggers alerts, such as gate closure, siren activation, and train information display on an LCD screen. If a DC motor malfunctions, an alarm is triggered, and the LCD screen shows the train's distance. An additional IR sensor detects the train's passage and communicates with the transceiver. Each track has its own set of sensors, allowing the Arduino board to adapt its responses. The system uses IR sensors strategically placed along railroad entrances for accurate data detection and transmission, primarily for precautionary measures and operational alerts, triggered by a microcontroller. The microcontroller triggers critical alerts when a train approaches, signaling gate closure, activating sirens, and displaying essential train informationon an LCD screen for station personnel and passengers. The device sends data to a microcontroller by using infrared sensors close to railroad gates to identify trains. When a train approaches, it initiates notifications such as gate closures and siren activations. An LCD panel indicates the train's distance and emits an alarm in the event that a motor fails. With the use of the sensors on each track, the system may be adjusted for efficiency and safety. The system deploys IR sensors near railway gates to detect approaching trains and sends alerts via a microcontroller for gate closure and siren activation, ensuring safety and operational efficiency. The railway safety system uses infrared sensors in the vicinity of gates to identify approaching trains, subsequently alerting a microcontroller to close the gate and activate the siren. It improves operational safety and efficiency at crossings with its LCD distance displayand motor failure notifications.

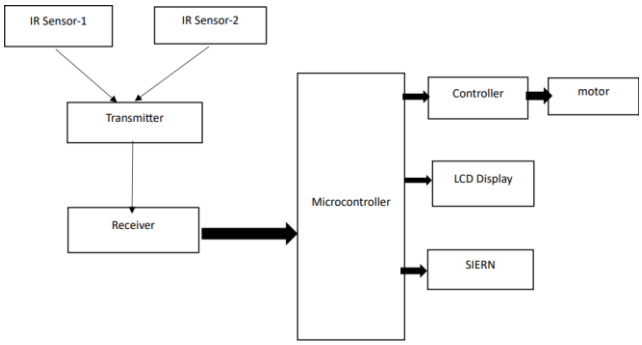

Fig. 2. **System Architecture**

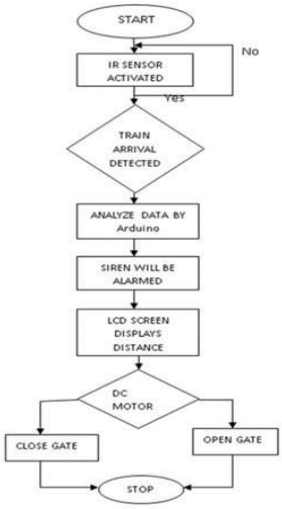

Fig. 3. **Flow Chart**

V. RESULT AND ANALYSIS

A Raspberry Pi, railway station infrastructure, an RFID reader, railway track, three mobile devices, left and right sensors, LEDs, a level crossing mechanism, and a gate con- troller are some of the components that make up the built model. The Raspberry Pi serves as all of these devices' operational coordinator and central control unit. Every gadget is linked to the Raspberry Pi's GPIO pins, serving as the central hub for control and data processing. Moreover, a LAN

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connection allows the Raspberry Pi to be linked to a server or central system, facilitating data sharing and communication. By using sensors to detect oncoming trains and adjusting the gate mechanisms accordingly, this arrangement ensures safe train passage by enabling real-time monitoring and control of the level crossing and railway gate. The approach reduces accidents at train crossings and increases productivity by integrating safety management and railway gate automation components with Raspberry Pi.

VI. CONCLUSION

The IOT based railroad gate control mechanism that operates automatically reduces railway accidents, benefiting road users and railway management. It's suitable for remote areas with no station master. IR sensors detect train arrivals and departures, and a stepper motor automates opening of the gate and closing. Reliable, high-performance, and cost effective. The proposed IOT based gate control mechanism that operates automatically enhances passenger convenience and operational efficiency by providing destination notifications and real-time monitoring. It reduces uncertainty about station arrivals and departures, ensuring prompt responses to train arrivals and departures, this system offers reliability, performance, and cost-effectiveness, promoting safer and more efficient, transportation systems.

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