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Pneumatic Operated Automatic Railway Gate Control

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***Abstract*—This research paper's main objective is to develop automation in order to stop railway accidents from occurring in rural areas. This is the idea behind the project. The occurrence of a railway accident at unattended railway gates is frequently reported in the news media. Almost 40% of train accidents in India involve human error or, occasionally, The absence of the barrier controller from his place of employment. It has been discovered that pneumatic technology can be employed purposefully and has very good results in work as well as being cost-effective. The examination of some research papers this system is the combination of various components is extremely important in the modern industrial world because it allows for the regulation, direction, sense-taking, and self-commanding Processes necessary to produce the intended outcome. The Project tries to create a particular form of pneumatically operated railway gate crossing by taking into account all these factors to prevent any kind mishap. Currently manually controlled railway crossings have several issues, including accidents and delays. Unman level crossings, where there is a higher risk of accidents and a need for reliable operation Can use pneumatically operated automatic railway gate control-type gates. As a result of the operation being automatic, a human mistake is avoided.**

***Keywords*— Smart crossing, Modified railway, barricades, railway review, pneumatic technology etc.**

I. INTRODUCTION

The chip mode has given preference to the railroads over all of the other modes of transportation. The common factor of many rail accident reports appearing in daily newspapers is an unmanned railway crossing. This is primarily due to either negligence in manual operations or simply not having enough personnel. The fix for the issue which was developed in this project, used this simple piece of component and a jaunt was made to automate by control from both ends. The sensor is placed at some distance away from the gate and detects an approaching train and operates the gate. A warning light is also installed to alert drivers of oncoming railway traffic. If this project is implemented in real terms, then it will help to stop railway accidents at the railway gates that have no one to look after them, as well as for many other things. This project uses 2 strong transmitters and 2 strong receivers (where one side of the transmitters and receivers is on the upward side (opposite to the way the incoming train) The other pair is aligned on the other side, fixed and at a height taller than a human, facing exactly the same direction of the train. the amount of time required to send at least one compartment that is the Indian Railways' standard minimum size, which is 8 seconds for this project, is calculated in order to alter the sensor activation time. On either side of the gate, sensors are mounted at a distance of 1 km. Refer to one sensor as being on the fireside of the train and the other as being on the AFT side.

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The gate motor only turns in one direction when the foreside receiver is activated, closing the gate until the train passes through it and comes to rest against the AFT side detectors. When the side receiver is engaged, the motor tops, the gate opens, and the motor rotates in the opposite direction. The gate will close in five seconds after the foreside receiver actuates, giving the driver time to get out of the gate area and prevent the train from becoming stuck between the gates after it has passed.

II. Literature Review

- T. Kartheeswaran Md Amjath An Automated Railway Level Crossing System 2020 International Conference on Image Processing and Robotics (ICIP) Date of Conference: 06-08 March 2020,Date Added to IEEE Xplore: 05 March 2021
  Emerging countries still encounter many issues pertaining to railway level crossings. Accidents at a level crossing can lead to several major risks, such as loss of life, serious injury and damage to vehicles. And all of which hurts a country's economy. This problem can be solved by using IoT based technologies in railway industry.
- Al-Zuhairi, Ahmed salihMahid, Automatic Railway Gate and Crossing Control based Sensors and Microcontroller" IJCTT's Volume 4, Issue 7 article (July 2013)
  He discusses the nature of rail traffic accidents, how to reduce them, and how these kinds of accidents are, overall, more dangerous than the other kinds of accidents in transportation. As a result, more steps must be taken to augment safety. "'On many railway crossings there are no guards, as there is not enough rail workforce to meet demand. Consequently there are often accidents at these crossings, since nobody is present to oversee to the functioning of the railway gate in such instance as a train comes near the crossing.
- Ujjwal Kohli and Anmol Agarwal, Smart unmanned level crossing system in Indian railways research in international journl of recent trends in engineering and research (IJRTER) volume-04, Issue -10, OCT 2016.
  The operation of automatic railway gates is the topic of this paper. By replacing the manually controlled gate at a level crossing with an automatic one, it reduces the amount of time it takes to close the gate and increases road user safety by lowering accident rates. Infrared sensors near the gate are used by the level crossing's automatic railway gate control system to identify when a train is approaching. Errors in manual operations are prevented. In order to collect electricity from piezoelectric plates, a battery was installed for this study. The LED screen timer and IR sensors, which are the main parts of the system, were then connected to the battery. The article addresses how to stop unmanned crossings in our nation.
- M. I. M. Amjath and Kartheeswaran Thangathurai, "An Automated Railway Level Crossing System" International Conference on Image Processing and Robotics (ICIP) 2020
  In order to effectively and efficiently reduce the number of deadly level crossing accidents to almost zero, this study presents a revolutionary approach to address the drawbacks of automated railway gates. This idea will be a fantastic way to subtly improve a country's economy while also effectively lowering the amount of fatal accidents at railway crossings.

III. Selection of Components

The Arduino microcontroller to detect train the train then sent it to LCS because it has sufficient input lines to connect all the necessary sensors and actuators needed. Thanks to the piezoelectric knock sensor, the train should reach the assigned level crossing no later than 5 or 10 minutes after its selection. Now the sensor can be mounted much easier and more sensitive on flat surfaces, such as railway tracks. All are mapped after consideration of reading, track and train length.

Figure 1. A railway track's location of a vibration sensor

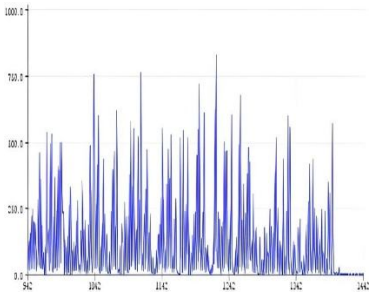

Figure 2. Frequency measurement

Figure 2 shows where the vibration sensor should be placed on the railway track. The Bluetooth module was connected to it via the Arduino microcontroller. The sensor data are displayed and presented in a train's length chart. Figure 3 displays the vibration sensor measurement over time.
The frequency rises to a maximum of 800 kHz as the train's middle compartment passes the vibration sensor. According to the vibration sensor's reading range of 0-900 kHz. The sensor is positioned around the track in various spots and put to the test for measurement. The reading was comparable to what Figure 3 shows. After sufficient measurements have been collected during testing, the vibrations sensor is calibrated.
Figure 3 displays the calibrated frequency line chart.

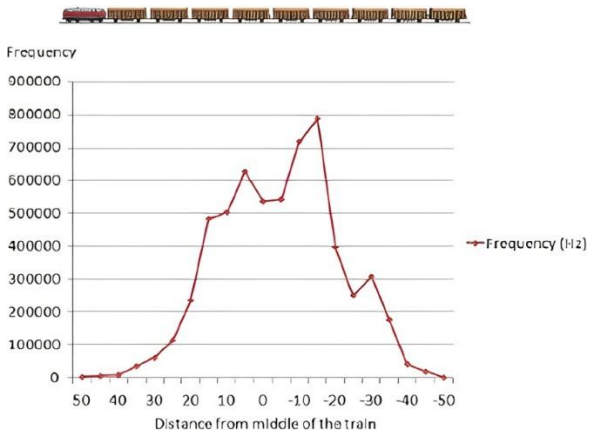

Figure 3. Calibrated frequency measurement

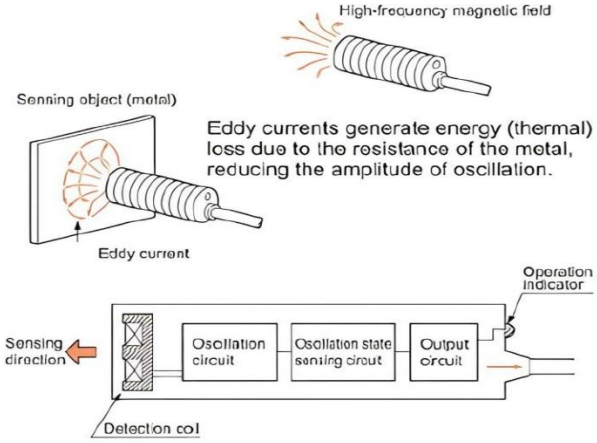

Figure 4. Proximity inductive sensor

To determine when the train will arrive and its direction, two induction proximity sensors are mounted alongside the railway track, spaced 30 cm apart. To reliably detect the existence of a train and its direction, measurements from these sensors are collected each time a train's wheels pass over them. These values are then coupled with signals from a vibration sensor. For this application, the M30 type Induction Proximity sensor was chosen because it is reasonably priced and has a 20mm measurement range. Figure 04's illustration of the induction proximity sensor in action demonstrates how it detects metallic things. Figure 05 depicts the method of mounting inductive proximity sensors.
A radio frequency transmitter is connected to the Arduino microcontroller in order to transfer data from the Train Detection Subsystem (TDS) to the Level Crossing Subsystem (LCS). The RF transmitter transmits signal over a radius of more than two kilometres, addresses the line-of-sight issue and comes at a fair price. When transporting data between the two subsystems, various harmful attempts are thwarted by the Advanced Encryption Standards (AES) algorithm.

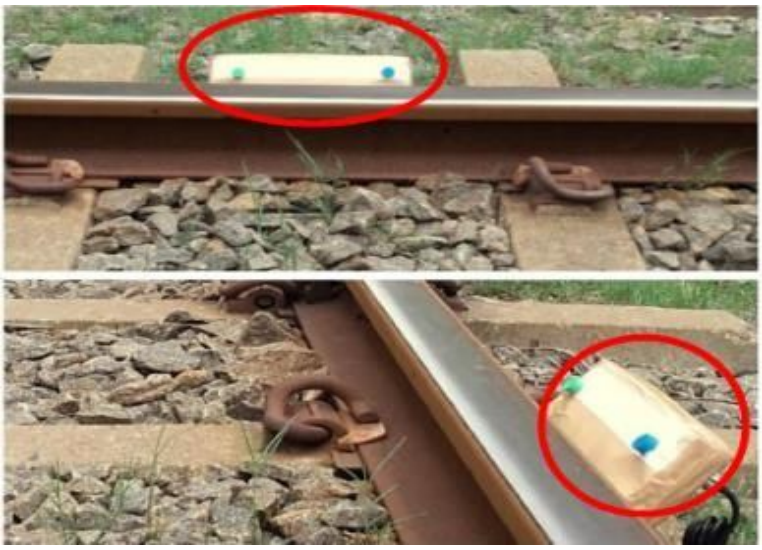

Figure 5. A rail-mounted inductive proximity sensor

IV. METHODOLOGY

In India, the railway operator uses hand-made Railway Crossing stations. The use of the gates in accordance with train arrival and departure is the operator's responsibility. When the train arrives and departs, the gate operator receives the journey information via communication means. Due to the current system's high error rate, accidents at the railway level crossing likely to occur more frequently. Information on trains that are travelling through the system is shared from one crossing station to another. Due to the numerous flaws in the Indian Railways system, level crossings are the site of more than 50% of train accidents. The standard operating procedure for the Indian railway system is unsafe, and as a result, more accidents occur every year.

This paper proposed a reliable approach to reduce both collision occurrence rate at intersections and station-crossing empty waiting time. Our system uses four infrared sensors, two pairs of which detect trains travelling in opposite directions. Sensors detect train movement for both directions. Every day, millions of people in India board various passenger, freight and exhibit trains that travel along thousands of miles of railroads. Maximum train speed is estimated at 97 km/h and minimum train speed at 50 km/h. Considering every train type and the acceleration rates, the optimum distance for sensor trains is approximately 6 to 7 km from the railroad crossing station, which is the same for sensor trains with the ultrasonic sensor too, which is 2 to 3 km away from the crossing of the train. The system consists of Infrared sensors, a servo motor, LED signals; a buzzer, an Arduino Uno, and software developed using the Arduino IDE.

Infrared sensors register the arrival and departure of trains. Now we open and close the railway gates by servo motors i.e. they are electronically gale open and close. LED lights are used as a signal of traffic crossing from the railway tracks on both sites and the buzzer signals used for the drivers to warn them about the train approaching. Using the pneumatic cylinder, the plan aims to get more piston by pushing the other gates pneumatically operated. The door was always open from our campaign. It will come to a stop when the pneumatic operated cylinder has been activated.

The solenoid valve is from the compressed air that comes from the compressor, which determines the direction of airflow to the pneumatic cylinder. The pneumatic cylinder is installed at the initial. The gate is first opened, only then the pneumatic cylinder is in a resting state.The cylinder pushes forward after the solenoid valve supplies pneumatic power. The piston rod attaches to one end of the gate so it will move the gate into a closed position automatically. The new compressed air route is set up to push against the piston rod which in turn activates the mechanical part of the system before returning to its initial locations. The gate is now in the open position. The sole way to ensure gate safety dictates this operating method. Having a pneumatic cylinder decreases the number of workers needed. Present pneumatic procedures move through this process faster compared to traditional systems. Our approach maintains effectiveness due to this precise functioning.

V. DISCUSSION AND CONCLUSION

The automation project was begun by taking into account the drawbacks of the current methods and also by firsthand observing various types of occurrences at the level crossing. The numbers analyzed demonstrate the need for regulation of the level crossing protection system and the installation of appropriate electromechanical systems at every level crossing across the country. Additionally, the majority of these mishaps are caused by human error and carelessness. It is therefore preferable to limit human involvement to the gate. Using existing IoT technologies, machine learning and image processing technologies are combined to create a novel system that prevents level crossing accidents. As a result, the system has undergone extensive testing, with results showing that it provides approximately 70% accuracy with the dataset at hand. Additionally, there is no human intervention in this low-cost automated type of gate or system. The Automated Level Crossing System will lessen accidents by ensuring the safety of vehicles, animals, and Crossing pedestrians at different levels. If it is tested on more real datasets in the future, it can be improved with greater accuracy. The TDS and LCS components can be protected from possible environmental hazards, physical theft, and tampering with the right safety cages. The train's precise arrival time can be predicted using this method in the future and presented to passengers using cutting-edge IoT techniques. It also aids in the analysis of train scheduling by the railway department. All of the Indian Railways' stakeholders will profit from this system in terms of humanitarianism, the economy, and human resources.

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