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Automatic Operation of Railway Gates

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***Abstract*: The objective of this paper is to automate the operation of railway crossing gates. The basic need of automation of railway gates arises from the fact, that, almost all the Railway gates in India are operated manually. The manual operation of Railway gates leads to a lot of time wastage and accidents also occur at unmanned Railway crossing gates. To curb these two shortcomings of the present, manually operated railway gates, our paper describes a new technique that could eliminate manually operated gates and automate the opening and closing of railway gates by using Arduino Uno(microcontroller), Vibration sensors, Laser sensors and a new device called Tyre killers.**

***Keywords*: Arduino Uno, Crossing gates, Laser sensors, Railway, Tyre Killers, Vibration sensors.**

1. Introduction

Railways is the lifeline of Indian Transport System. It has been in operation for more than 160 years and is spread over a network of more than 64000 kms. This whole network has over 14896 unmanned and 17839 manned level crossings. The year 2012-2013 has witnessed over 448 deaths at these crossings. Thus, the crossings have been a major concern for the Indian Railways. A survey conducted by the Indian Railways showed that, of all the accidents 87.8% were due to human failure. So, in the existing system, the operation of opening and closing of crossing gates takes place manually by telephone. As the train departs from the station, the track operator is informed via telephone and he/she closes the gate. It is observed that the gate is closed very early and people have to wait for a long time. Time is wasted and this system is not foolproof. But, this time can be significantly reduced by using various sensors and our proposed methodology. Basically, sensors placed at a certain distance will signal the presence of a train and the crossing gates will automatically close, and when the train has left, the crossing gates will open thereby reducing the stoppage time.

2. What are tyre killers and why are they used?

A question might arise in the minds of people, that if the automatic operation of traffic gates was so easy, then why was it not performed. One of the main reason behind that is, this system is not full proof. The major drawback of this system is that, while the gates are closing, if any vehicle is present between the gates (on the tracks), then that vehicle will be trapped between the gates and it will collide with the train, thus resulting in an accident. So to overcome this difficulty, it would have to be made sure that when the train is detected, vehicles on either side of the tracks do not attempt to cross the railway line. So a thing called as 'Tyre Killers' will have to be used. Tyre killers are a metal strip that acts as a speed breaker for a person driving on the right side of the road, however it's spikes puncture the tyres of vehicles coming from the wrong side, basically allowing traffic to flow only on one side. So, after the train is detected by sensors, red lights will flash with a buzzer siren, and after a few seconds tyre killers will roll up on either side of the road. These will be placed before the traffic gate. These will be placed such that, if vehicles try to cross the railway line, then their tyres will be punctured, but as they allow one side flow of traffic, if any vehicle is stuck on the railway line, with the tyre killers rolled upwards, then, that vehicle can easily come out and an accident can thus be avoided. So, the use of tyre killers tries to make this system full-proof.

Fig. 1. Tyre killers

3. Working Mechanism

A. System Design

In automatic operation of crossing gates firstly we used vibration sensors to detect the incoming train which is placed around 1Km away from the crossing gate. After the vibration sensor we used laser transmitter and laser receiver placed on either side of the track. Once vibration sensors detects the vibrations from the train the laser sensor is turned ON and the laser beam falls on the laser receiver. When the train passes through the laser beam it restricts the beam from reaching the receiver. Here if the receiver is not able to receive the laser beam for 3 seconds it confirms the presence of train and this 3 seconds delay also eliminates the errors such as a bird flying through the laser beam.

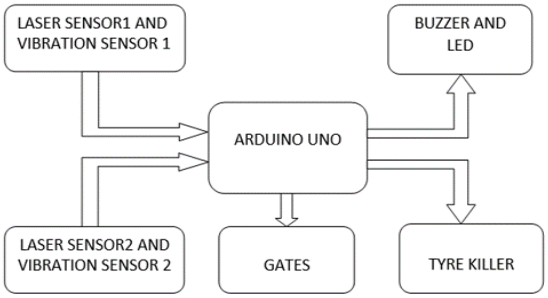

Fig. 2. Block diagram of automatic operation of gates

This confirmation of train is passed to the crossing gates where red Led is turned ON and buzzer sounds. After this the tyre killers are rolled up and crossing gates are closed. Another pair of vibration and laser modules are used near the crossing gates within 200m range for opening of the gate, rolling the tyre killers down and turning the green Led ON.

B. Flowchart

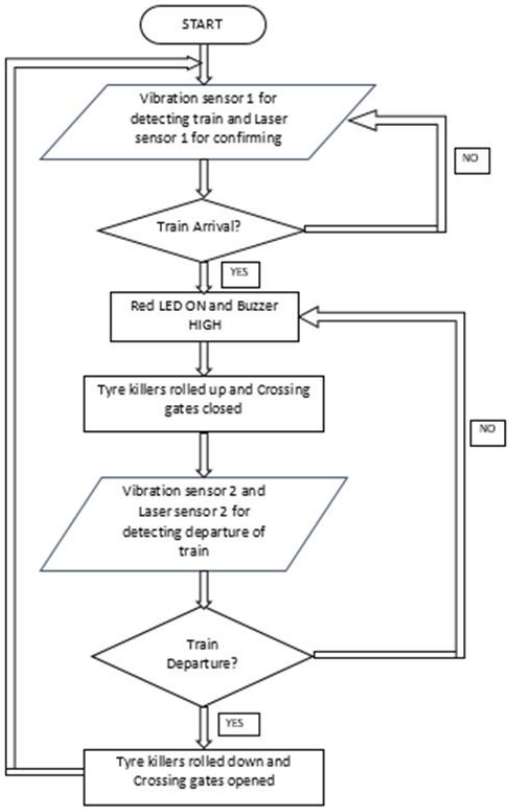

Fig. 3. Flowchart of automatic operation of gates

The following steps takes place as shown in figure 3 and the explanation is given below.

There are two vibration sensor and two laser sensor one on each side of the gate.

Step 1: Start

Step 2: The circuit for Automatic Opening and Closing of gate is initialized.

Step 3: The sensors connected get activated and they start sensing if obstacle is present or not.

Step 4: If the sensors senses the arriving train it sends a high signal to Arduino connected to it.

Step 5: This high signal makes buzzer go high and Tyre killers to come up and closure of gates.

Step 6: If sensor 2 sends high signal and sensor sends low signals Tyre killers go down and gate opens indicating train has departed.

Step 7: If both the sensors at both the ends sends low signal gate is open for crossing.

Step 8: End.

4. Circuit Design

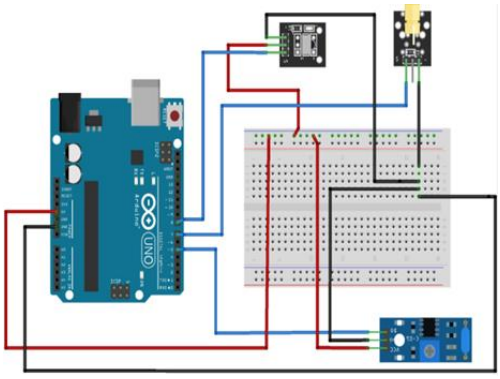

Fig. 4. Schematic diagram of laser and vibartion sensor

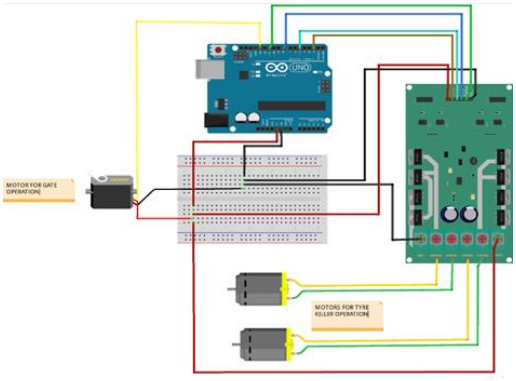

Fig. 5. Schematic diagram of tyre killer and gate operation

5. Results and Discussions

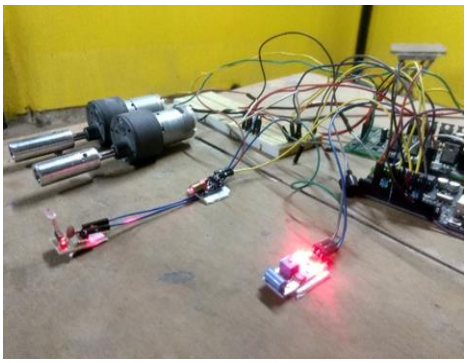

Fig. 6. Hardware model of Vibration, laser module and motors

The figure 6 shows the setup that is implemented to perform the automatic operation of railway gates. Vibration and laser sensors are used to detect the train, and only when both detect, the train is said to be present.

In our model we have taken the distance of the placement of these sensors from the railway crossing gates to be 340cm.

After the train is detected, the buzzer sounds and stop red lights flash. Then tyre killers roll up. Then some time is provided for vehicles that are between the tyre killers to go out.

Then the traffic gates are lowered down.

The time for each step was specified and the following results were obtained.

Table 1
Observation table for time of operations of gates

Sr. No	Operation	Time Required
1	Led lights to flash and buzzer to sound	5 s
2	Tyre killers to roll up	10s
3	Free passage of vehicles between the two tyre killers	5s
	Total time	20s

The train took around 28s to cover the distance of around 340 cm. So as everything is completed in 20 seconds, so there is less time for which people would have to wait and smooth operation took place.

Also that we did not have long tracks, so, time allotted for each step was kept less. In real time applications, the distance at which the sensors will be placed from the tracks will be quite far. So each step can be given more time and the whole process can take place easily.

An example of real time condition,

Sensors are placed at a distance of 2km from the railway gates. The train is travelling at a speed of 50-60kmph.So it will take around 120 seconds to reach the gates. So the above mentioned time for each step may be increased a little bit for real time application and still there will be enough time left so that the operation takes place smoothly.

6. System Advantages

- An Automatic Railway Gate Control is implemented with very simple hardware and easy control.
- No human resource is required. This makes its running cost very low compared to manned gates.
- Automatic railway gate control systems reduce the time for which gate remains closed.
- No continuous monitoring of system is required.
- Help in conserving energy.
- Avoids number of accidents to some extent.
- This type of gates can be employed in an unmanned level crossing where the chances of accidents is higher and reliable operation is required.
- Saves time of the people as they do not have to wait for longer period as in manual operation of gates.

7. Future Work

To make the proposed system more effective a motion sensor camera can be installed at level crossing and if there is no motion at level crossing an alert message can be send to the train device with the images or video capture of the level crossing. The Railway crossing system can further be complemented to provide recording of time when the train arrived at the railway crossing and departed from the railway crossing so that accurate time of arrival can be predicted.

8. Conclusion

In this proposed system we have tried to implement a simple yet effective solution for the level crossing and with the use of the new technology this new system can sustain longer. With this proposed system a way can be made for the more effective modernization of the Indian Railways. Automatic operation of Railway gates at is mainly based on idea of reducing human interference at railway crossing thereby reducing the chances of error which are occurred due to human mistakes. The Automation of Railway gates also ensures that the Opening and Closing of railway gates will be on right time even if there is delay in train schedule which also helps in reducing traffic jam at railway crossing.

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