Automated Railway gate control system using Arduino and Ultrasonic sensors

P Ilampiray ¹, K Deepak ¹, M G Deepak Santhosh ¹, S kishore ¹
¹ Department of Information Technology, Sri Krishna College of Technology, Coimbatore, India
ilampiray.p@skct.edu.in

Abstract. In a country like India, which has a population of about 1.39 Billion depends on its Transportation for its daily living. Transportation plays a main role in India's Economic Development and more than 35% of the lives of people in India depends on its transportation. Railways is the most popular and highly used transportation in India. It is the most effective mode of transportation not only in India, but also all over the World. As like its usage it also leads to a high number of accidents. Like road accidents, there are more accidents happening at railway crossings due to the unmanned level crossings and the carelessness of the road users. According to the National Crime Records Bureau [NCRB], the rate of level crossing accidents is 20% up in 2019 than 2018. However there will be an increase in the percentage of accidents every year but the percentage in the last two years has increased drastically. There were 1788 level crossing accidents in 2019, which include 1762 deaths. "Necessity is the mother of Invention” as like this saying the is a simple system, which automatically closes the level crossing gates during the train's arrival and then the gates are opened automatically when the train passes by. In our system we have used ultrasonic sensors for detecting the departure and arrival of the trains. As soon as the sensor senses the train's arrival it sends a message to the Arduino which will switch on the buzzer, so that the road users will know that the train is nearer, and after that the servo motor which is attached to the gates will close them and it will be opened after the train passes by. And then the buzzer will also be turned off. This is automated, highly effective and cheap. Our system will eliminate the manpower used at the level crossings.

Keywords: Arduino, Ultrasonic sensor, servo motor, buzzer.

1. Introduction

One of the most commonly used transportation nowadays is railways. Which is also a cost-effective transportation mode. Indian Railways is the largest rail network in Asia and second largest in the world. The trains are being continuously operated every single day. So, its nearly impossible to prevent some of the accidents during the train passing [1-3]. As per the survey there are thousands and thousands of people losing their life in train accidents. Most of these accidents are caused due to carelessness of people and unmanned level crossing. In our country it happens often due to the country's vast population, mainly it is happening in rural areas [4-7]. At least 1/3rd of the railway crossings goes unnoticed due to remote placement and less traffic, which results in accidents. Currently present railway crossings are not advanced and safe [8]. Therefore, these accidents cause serious damage to human life. The most common
rail accidents occur due to collision of trains and human errors [9,10]. The level crossing depends on humans for operating the opening and closing of railway gates. Hence for accessing the gates without manpower, a new system is developed using Arduino. So, we are implementing this wherever it is possible to make sure all the people are safe during level crossings with less manpower, which is automated.

2. Related Work
In recent times many automatic railway gate control systems are invented for the railway crossings to prevent the accidents. [11], reduced the accident by concentrating on the unguarded railway crossing. The system is done using microcontroller and IR sensor. In this proposed system the arrival of the train is detected by the IR sensor and sends the signal to the microcontroller. On this basis the gate crossing is controlled by the microcontroller. The drawback of the proposed system is its less consistent. The use of IR sensor is not visible in daylight and open field. [12], this system is proposed by a cost efficient method for enhancing the quality of the railway gate level crossing. The system is proposed of ATmega 16A microcontroller and IR sensor which is placed to notice the coming and leaving of the train through which the opening and closing of the gate is operated. [13], The system is proposed using detectors, GPS and GSM. The GSM and GPS are combined together, the GPS is the tracking system and the GSM is a modem to close the gate at the railway level crossing. The detectors used to detect the coming and leaving of the train and transmit the signal to the upcoming railway level crossings. This system concludes that it is flexible and accurate.[14], this system tries to operate the opening and closing of railway gate at railway level crossing. The system uses IR sensors to notice the coming and leaving of the train and uses a raspberry pi board to control the opening and closing of railway gates. [15], The proposed system presents an automated railway gate controller at railway level crossing to prevent the accidents. The system uses vibration sensors to operate the opening and closing of railway gates. An IR sensor is placed to detect the moving objects on the rail tracks and the status of the rail track will be sent to the control room using wireless communication. The main drawback of the system is it is costly and difficult to implement because of more requirements. [16], This system is proposed for the multiple track railway crossing which has a controller which receives the signals by the train by the sensor. The signals contain the information of the train including its identity. Through the information the railway gates will be opened and closed. The drawback of this system is it is costly.

3. Proposed System
Our Proposed System is a practically working system. Our idea is very simple and effective. The idea is to close the railway level crossing gates automatically and to open them automatically, during the time of train's arrival and departure respectively. Automated concept is to reduce the number of accidents with less manpower. 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 of 4 meters (which is better than other sensors). At a certain distance before the level crossing and after the level crossing, these ultrasonic sensors are placed. The reason for sensor placement is to sense, both the train's arrival and departure correctly and effectively. As soon as the train reaches the 1st sensor which is been placed before the level crossing, senses or detects the train, it sends a message to the Arduino connected, and then the buzzer will be turned on automatically so that the road users will be able to know that the train is nearer to the crossing and they can wait till the train passes by. As soon as the buzzer sound starts, the servo motor connected with the level crossing gates will close them automatically. The reason to use servo motor in our system is that it is working is based on Angular Rotation which means that at first the gates will be at 90° which is open, at then during the time of train's arrival the gates will be at 0° (closed), and after the train passes by it will return its original position which is 90°(opened). The proper working of the level crossing gates are because of the attached servo motor (with angular rotation). In case if we have used
other motors there would have been a problem in opening and closing of gates because they lack angular rotation. This servo motor helps the gates to come back to normal position(90°) from closed position(0°) instead of going into the ground (270°). As soon as the train passes the second sensor, placed at a certain distance after the level crossing gates, buzzer sound will be turned off itself and the gates will open automatically, and then the road users can use the level crossing road safely. The second Ultrasonic sensor is placed a little far, comparatively higher distance than the distance between 1st Ultrasonic sensor and the level crossing gates(because of the train's length). This whole design is connected with the Arduino Nano ATMEGA 328p, which has a code uploaded in it before the whole process. Code is the main key to work the whole system. Though the idea and working of our system is simple, it's usage will be more effective. It will definitely reduce the railway level crossing accidents and will ensure people's safety figure 1 and figure 2.

![Figure 1. Block Diagram](image1)

![Figure 2. Visual representation of our system](image2)

4. Components Required
   1. Arduino Nano
   2. Ultrasonic sensor
   3. Servo motor
   4. Buzzer
   5. LED green
   6. LED red
   7. Toy train
   8. Joining wires
9. Power supply

5. Implementation and Result

Our idea has been used and developed as a working model. A Railway track of diameter 60cm has been fixed. And the level crossing gate is setup containing two gates facing each other with a gap and the gates are fixed with LED lights and the servo motor has been fixed at the gates, an important point is that the tracks should be in between the level crossing setup. The distance between the level crossing gates is 20cm and the length of the road is 19cm. And the Ultrasonic sensors have been placed before and after the level crossing gates at a distance of about 20cm. And sensors are placed at a distance of about 6cm on each side of the track. The whole setup has been connected with the Arduino nano ATMEGA328p. Buzzer is placed near the Arduino. The Arduino has been connected to the external power supply. After the whole setup is ready, a toy train is fixed on the track. Then the toy train starts running with the help of batteries. To start the process, power supply is switched on. After that when we turn on the toy train, it starts running, and when the train comes nearer to the 1st Ultrasonic Sensor, the crossing gates will be closed, and if it reaches the 2nd one the gates will open. The servo motor attached with the gates, which has Angular Rotation, helps the system with both the opening and closing of the gates. Like the gates, Buzzer will also be turned on automatically as soon as the train reaches 1st sensor and will be turned off when the train reaches 2nd one. During the whole process, the power supply should be turned on. And before all these operations the code for the whole process should be uploaded in the Arduino. The code can be transferred to Arduino with the help of Transmission cable, with the help of that the Arduino can be attached to the computer or Laptop easily. The code can be uploaded and reset easily. Arduino IDE software is used to upload the code in the computer to the Arduino Figure 3.

Figure 3. Output (code uploaded in the Arduino)

6. Conclusion

This paper we presented is based on Automated Railway Gate opening system using Arduino. Technologies like these have been already done but still they haven’t implemented yet and in process especially in India and in some other countries. We have studied it thoroughly and made a working model for the same, but with some modifications. We have found that as compared to the existing system which have been made already, our system works much efficiently and it is reliable because the whole system is automated. As far as now from the number of accidents occurred and still counting, a proper, safe and durable system is needed. Therefore, to avoid these kind of accidents in the future, we have implemented a new system with ultrasonic sensors. The system has been tested and it is working perfectly in all atmospheric conditions without any flaws. Finally, we conclude by saying that the number of 4 accidents will be reduced and many innocent people’s lives could be saved by using this system. Our system will be new as we are using a fully automated system and there are further more ideas on which we can develop this system for the future generation.
References

[1] P.K.Kumar and B.S.ShivaShankara, PLC Based Automatic Fault Detection of Railway Track and Accidence Avoidance System, *International Journal of Engineering Research and General Science*, ISSN 2091-2730, 3, Issue 2, March-April 2015.

[2] N.Bhargav, A.Gupta, M.Khirwar, S.Yadav and V.Sahu, Automatic Fault Detection of Railway Track System Based on PLC (ADOR TAST), *International Journal of Recent Research Aspects*, ISSN : 2348-7688, 3, Issue 1, March 2016.

[3] S, D., & H, A. (2019). AODV Route Discovery and Route Maintenance in MANETs. 2019 5th International Conference on Advanced Computing & Communication Systems (ICACCS). doi:10.1109/icaccs.2019.8728456

[4] H. Anandakumar and K. Umamaheswari, An Efficient Optimized Handover in Cognitive Radio Networks using Cooperative Spectrum Sensing, Intelligent Automation & Soft Computing, pp. 1–8, Sep. 2017. doi:10.1080/10798587.2017.1364931

[5] M.Prabhakar and A.Ashok Babu, Sensor Based Train Collision Identification and Avoidance Systems, *International Journal & Magazine of Engineering, Technology, Management and Research*, ISSN : 2348-4845 , 3, Issue 10, October 2016.

[6] T.Dhanabalu, S.Sugumar, S.Surya Prakash and A.VijayAnand, Sensor based identification system for Train Collision Avoidance, *IEEE sponsored 2nd International Conference on Innovations In Information Embedded and Communication Systems (ICIIECS)*, 3, 2015.

[7] M.Ganapathi and G.Priyanka, Smart System for Train Crash Avoidance, *International Journal of Innovative Technologies*, ISSN : 2321- 8665, 4, Issue 11, August 2016.

[8] Naga Hema Kumari.V and China Appala Naidu.R, Train Collision Avoidance by Using Sensors,”International Journal of Advanced Research in Computer Science and Software Engineering, 6, Issue 6, June 2016.

[9] R.Gopinathan and B.Sivashankar, PLC based railway level crossing gate control, *International Journal of Emerging Technology in Computer Science & Electronics (IJETCSE)*. ISSN: 0976-1353, 8 Issue 1–April 2014.

[10] Pradeep Raj, Increasing accidents in the unmanned level crossing of the railways, 2012.

[11] Xishi Wang, Ning Bin, and Cheng Yinhang, A new micro-processor based approach to an automatic control system. *International Symposium on Industrial Electronics*, pp. 842-843, 1992.

[12] Ahmed Salih Mahdi, Al-Zuhairi, Automatic Railway Gate and Crossing Control based Sensors & Microcontroller *International Journal of Computer Trends and Technology (IJCTT)* –4 Issue 7–July 2013

[13] Sheikh Shanawaz Mostafa, Md. Mahbub Hossian, Khondker Jahid Reza, Gazi Manir Rashid, A Radio Based Intelligent Railway Crossing System to Avoid Collision. *IJCSI International Journal in Computer Science Issues, Vol 7*, Issue 6, November 2010. ISSN: 1694-0914.

[14] Acy M. Kottali1, Abhijith S, Ajmal M M, Abhilash L J, Ajith Babu, Automatic Railway Gate Control System, *International Journal in Advanced Research in Electrical, Electronics and Instrumentation Engineering, Vol. 3*, Issue 2, February 2014.

[15] K. Vidyasagar, P. Sekhar Babu, R. RamPrasad, Anti Collision and Secured Level Crossing System. *International Journal of Computer Applications (0975 – 8887)*, 107 – No 3, December 2014.

[16] Karthik Krishnamurthi, Monica Bobby, Vidiya V, Edwin Baby. Sensor Based Automatic Railway Gates Control, *International Journal in Advanced Research in Computer Science Engineering and Technology (IJAR CET)*, 4 Issue 2, and February 2015.