AUTOMATIC RAILWAY GATE CONTROL USING ARDUINO AND IR SENSORS

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ABSTRACT

In a country like India, which has a population of about 1.39 billion depends on its Transportation forits daily living. Transportation plays a key role in India's Economic Development and more than 40% of the lives of people in India depends on its transportation. Railways is the most popular and used transportation in India. It isthe 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. There were 1,788 level crossing accidents in 2019, up from 1,408 in 2018, according to the latest NCRB data [1]. However, there will be an increasein the percentage of accidents every year but the percentage in the last two years has increased drastically.

The main aim of this paper 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 for which the gate is being kept closed. And secondly, to provide safety to the road users by reducing the accidents. By the presently existing system once the train leaves the station, the stationmaster informs the gatekeeper about the arrival of the train through the telephone. Once the gatekeeper receives the information, he closes the gate depending on the timing at which the train arrives. Hence, if the train is late due to certain reasons, then gate remain closed for along-time causing traffic near the gates.To avoid the human errors that could occur during the operation of gates, the proposed paper introduces the concept of railway gate automation.

INTRODUCTION

The railway system is the most regularly used transportation mode in India. To avoid the human errors that could occur during the operation of gates, the proposed paper introduces the concept of railway gate automation. Level crossings are managed by the gatekeeper and the gatekeeper is instructed the means of telephoneat most of the level cross from the control room. In this 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 Arduino. The drawback of the proposed system is its less consistent. The use of IR sensor is not visible in daylight and open field. This system is proposed by a cost-efficient method for enhancing the quality of the railway gate level crossing. Thepaper thus intends to develop an automatic railway gate control system which is reliable and secured than the existing manual systems. Sensor based railway gate automation system is developed to automate the process of opening and closing of gate at the railway level crosses. The system detects the arrival and the departure of train for the gate operation using different types of sensors. The proposed system uses three infrared sensors to identifythe arrival and departure of trains. The system also implements obstacle sensor which detects any obstacle on the track and controls the operation of the train. Sensors and servo motors are programmed using Arduino micro- controller.

IR sensor: IR sensors detect the train using infra-red receiver and transmitter. Infra-red sensors can detect the presence of an object by sensing the heat being emitted by the object. It emits or detects the radiations to detect the motion of an object surrounding it. The most commonly used sensors for the automatic railway gate system is vibration sensors and IR sensors

LITERATURE SURVEY

Level crossing is that area where the rail line intersects with the road which is used by transportation or other vehicles. To prevent accidents a system named "Level Crossing" hasbeen developed. But in early days all the level crossings are operated by humans. So humaninterference was mandatory. But manual control is not errors free. The railway gate or level crossing is opened or closed by a gateman who was informed from the nearest railway station about the arrival of a train. There are also many level crossings in India which are unmanned. So, they are potentiallydangerous for road users.

In India we must develop a prototype to be implemented to automatically control railway gate upon arrival as well as departure of train. The project should not be too much expensivebut must be reliable. So, we used Arduino uno R3 which is quite reliable as well as affordable. We started to develop our project based upon 8051 microcontroller which is also cheaperthan Arduino. But in terms of of reliability and implementation of future featured we upgraded to Arduino uno.

A level crossing is an intersection where a railway line crosses a road or path at the same level, as opposed to the railway line crossing over or under using a bridge or tunnel. The term also applies when a light railline with separate right-of-way or reserved track crosses aroad in the same fashion. Other names include railway level crossing, grade crossing, road through railroad, railroad crossing, train crossing, and RXR.

The history of level crossings depends on the location, but often early level crossings hada flagman in a nearby booth who would, on the approach of a train, wave a red flag or
lantern to stop all traffic and clear the tracks. Gated crossings became commonplace in manyareas, as they protectedthe railway from people trespassing and livestock, and they protected the users of the crossing when closed by the signalman/gateman. In the second quarter of the 20th century, manual or electrical closable gates that barricaded the roadway started to be introduced, intended to be a complete barrier against intrusion of any road traffic onto therailway. Automatic crossings are now commonplace in some countries as motor vehicles replaced horse-drawn vehicles and the need for animal protection diminished with time. Full, half or no barrier crossings superseded gated crossings, although crossings of older types can still be found in places. New technology is advancing to create new ways of protecting the railway from users of a level crossing, with one of the most recent being obstacledetection scanners fitted to some crossings in Europe.

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 IR sensors near the railway tracks. IR 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 is 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 relates to the Arduino UNO 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 is usage will be more effective. It will reduce the railway level crossingaccidents and will ensure people's safety.

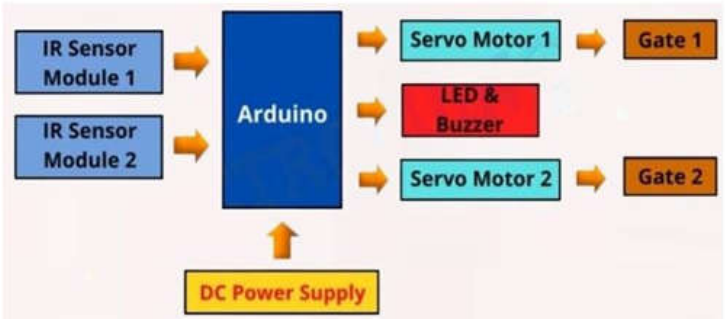

Figure.1 Block Diagram of Automatic Railway Gate Control using Arduino

RESULTS AND IMPLENTATION

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 about 20cm. And sensors are placed at about 6cm on each side of the track. The whole setup has related to the Arduino UNO. 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 IDEsoftware is used to upload the code in the computer to the Arduino.First, we need to place the components correct position for the perfect work of this system. Two IR sensors are placed on both sides of level crossings and the distance between the two IR sensors is dependent on the length of the train. Two Servo motors are placed on both sides of the railway track. When the train comes in front of the IR sensor-1. Then IR sensor-1 detects the arrival ofthe train and produces Low (0) output from its Data Pin. But, on the other side, the IR Sensor-

2 output is HIGH
(1) because this time sensor-2 does not detect the train.

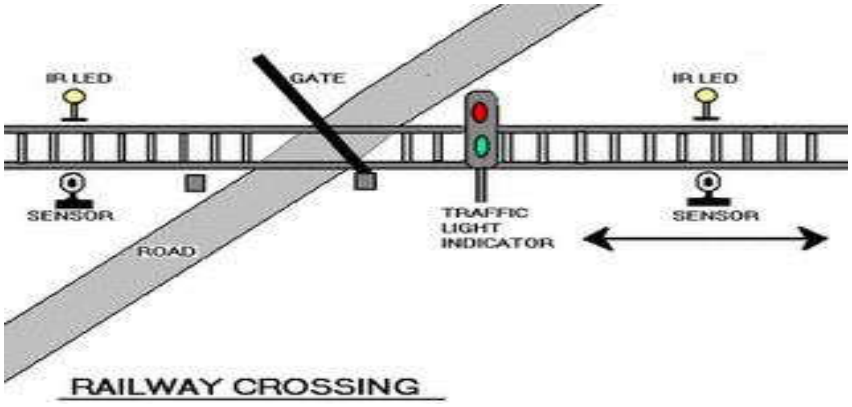

Figure.2 Schematic Diagram of Automatic Railway Gate control usingArduino and IR sensors

When the Arduino gets this signal from two sensors, then the Arduino sends the PWM signal to the servo motors. As a result, servo motors start working and close the gate. Currently, the Arduino sends commands to turn on Red LED and the buzzer starts to generate beep-beep sound, which means that the train is Arriving.When the train crosses the level crossing, and the train comes in front of the IR sensor 2. Then IR sensor-2 detects the arrival of the train. So, the sensor 2 output goes LOW (0). But, on the other side, the IR Sensor-1 output is HIGH (1) becausethis time sensor 1 does not detect the train. When the Arduino gets this signal from two sensors, then again, the Arduino sends the PWM signal to the servo motors. As a result, the servo motors back to the first position, and automatically open the gate. This time Yellow LED will turn on and the buzzer will stop, it means that the train isgone. When IR sensor 1 and IR sensor 2 does not detect the train, then the output of the sensor is High (1). In this condition, the gate is open, and the Yellow LED will turn on and the buzzer will stop, it means that the train does not come.

CONCLUSION

Automatic railway gate control system is centred on the idea of reducing human involvement for closing and opening the railway gate which allows and prevents cars and humans from crossing railway tracks. Therailway gate is a cause of many deaths and accidents. Hence, automating the gate can bring about a ring of surety to controlling the gates. Human may make errors or mistakes so automating this process will reduce the chances ofgate failures. Automation of the closing and opening of the railway gate using the switch circuit reduces the accidents to a greater extend. The obstacle detection system implemented reduces the accidents which are usually caused when the railway line passes through the forest. Most of the times greater loss has been caused when animalscross the tracks.

FUTURE SCOPE

Like we left the GSM module for future scope. After adding this module, upon arrival anddeparture oftrain, the GSM module will send an SMS to registered phone number for acknowledgement and safety.

Also adding a pair of pressure sensor increases the chance of fault triggering of gate as well as alarm the loco pilot . After adding the pressure sensor, the arduino closes the gate after receiving both signal from IR sensor as well as pressure sensor.

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