

Design and Construction of An Automatic Railway Gate System

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Abstract:

In modern technology is largely depends on automation and control system. Automation and control system refers the use of various control systems for operating equipment such as machinery, processes in factories, heat treating ovens, switching on telephone networks, steering and stabilization of ships, aircraft, automobile and other applications with minimal or reduced human intervention. The greatest advantage of automation and control system is that it saves labor as well as save energy and materials and to improve quality, accuracy and precision. In the present project is to design an automatic railway gate control system to replace the railway level crossings which are operated by the gatekeeper with an automatic system by using microcontroller. This project deals with the development of a prototype of a railway gate that functions automatically during the train arrival and departure to minimize accident of level crossing between the railroads & highway. This types of accidents are happens due to the miss communication of pedestrian . The operation using microcontroller that integrated with other circuits are power supply, light dependent IR sensors, force resistive sensor, and gate servo motor. All the circuits are combined to demonstrate the operation of microcontroller. Two IR sensors have been used to detect the arrival and departure of the train. IR sensor will give the signal to the Microcontroller and the Microcontroller will pass this signal to the servo motor and it will rotate as its requirement. The novelty of this project is the use of Force Resistive sensor which has been integrated in this anti-collision system for the railway. By chance if a vehicle gets stuck at the level crossing of the rail-line, the pressure sensor will detect the object and will take necessary action by following the developed algorithm. It is a very economical process to reduce the human effort as well as very reliable.

Keywords

Automation; control; Rail gate; Microcontroller; Sensor

1.Introduction

A level crossing (a primarily British term; usually known as a railroad crossing in the United States) 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 rail line with separate right-of-way or reserved track crosses a road in the same fashion. Other names include railway crossing, grade crossing, road through railroad, and train crossing .Early level crossings had a 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. Manual or electrical closable gates that barricaded the roadway were later introduced. The gates were intended to be a complete barrier against intrusion of any road traffic onto the railway. In present days in Bangladesh a deal of railways are running on track daily without any stress. A railway truck is straight , hazardous and dangerous as per as public and traffic concern. But every year a lots of pedestrian roll round during the level crossing of the rail-line due to the carelessness and miscommunication of the gate keeper. Also some major collisions occur when any vehicle gets stuck at the level crossing. Now a days the rate of the accidents at the level crossing is increasing enormously. For this case, the project concept is to construct an automatic system to avoid the unwanted accident at the level crossing of the rail-line[7]. Road/rail grade suspensions are common scenario all over the world of transportation as well as they represent the only fact of two several infrastructures region under various liabilities and got around by the vehicles with the dramatically various perfections which meet during their general activities. The result of these suspensions mount high-hazardous zones for all the railways over the world. The possibility for accidents is increased rapidly as the railways can control half of the labyrinth. The another half cannot be monitored by one being as, even though traffic rules and regulations which are supposedly exist, the movements of the pedestrians are not conscious and monitored by one specific being while rail movements.to success. In Bangladesh it is the common scenario ,every year, mishap during level crossings both cause the misfortunate death or major part of the body be injured to a lot of road users, and put down a heavy economic pressure in

terms of obstructions of services and make mischief of property. According to Bangladesh Railway



Figure 1. Conventional Rail Road system in Bangladesh

(BR), statistics there are 2,541 level crossings all over the country but there is almost 2,170 gatemen of them i.e a lion shear of them are in secured all the time. 15 people were lost the life in 14 accidents in the insecure level crossings from Rajshahi to Khulna from the year 2011 to 2014[11]. Another media report represents 53 accidents took place at railway level crossings in 2010 alone, killing 22 people[11].

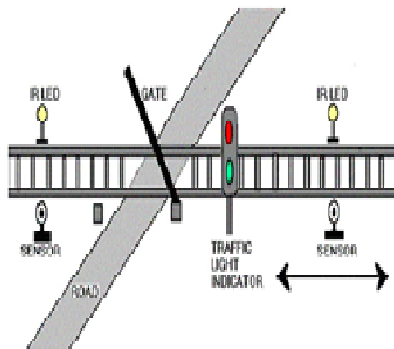


Figure 2. Railway crossing on middle of road.



Figure 3. Unexpected accident scene

The present paper make reduce the unwanted death by installing an automatic railway gate control

system which is an arrangement of physical components which sense the arrival of the train and make the gate pull up and pull down automatically. As a train approaches at the railway crossing from either side, the IR sensors placed at a certain distance from the gate detect the approaching train and accordingly controls the operation of the gate. Also an indicator light has been provided to alert the driver of the train if any vehicle or living object gets stuck at the level crossing of the rail -line [8].

2. Bangladesh Signal Railway Technology

The ministry of railways has taken various steps to abate the accompanying rail unwanted accidents during level crossing. Ministry of railways has endowed a deal of money for modernization and up taking nets of the technologies incorporated to the Bangladesh railway. In resnet Bangladesh Railways bargain some sign and signal to prevent the accident. Sign shows the road users to slow down for looking and listening for the upcoming train and be raided to stop at the crossing. Cross bucks are placed at all grade crossings on both close to the crossing A cross buck sign bargains the last evidence to the driver at the crossing region. A stop line colored across the road users fistula of the road exhibits the road users where to stop and lock for a train. Manually Signals are operated by level crossing staff on instructions transmitted by telephone or telegraph signal from the nearest station. But automatic gate control need to arrange circuit which detect trains without any human effort or any gatekeeper. This reduce the accident and system is more economical.



Figure 4. Advance Warning Sign



Figure 5. Cross buck Sign



Figure 6. Stop Sign and Line

3. Historical Background

The first U.S. patent for such crossing gates was awarded on 27 August 1867, to J. Nason and J. F. Wilson, both of Boston[1]. With the appearance of motor vehicles, this barrier became less effective and the need for a barrier to livestock diminished dramatically. Many countries therefore replaced the gated crossings with weaker but more highly visible barriers and relied upon road users following the associated warning signals to stop. At railway stations, a pedestrian level crossing is sometimes provided to allow passengers to reach other platforms in the absence of an underpass or bridge. Where third rail systems have level crossings, there is a gap in the third rail over the level crossing, but the power supply is not interrupted since trains have current collectors on multiple cars. Level crossings constitute a significant safety concern internationally. On average, each year 400 people are killed in the European Union [2] and over 300 in the United States [3] in level crossing accidents. Collisions can occur with vehicles as well as pedestrians; pedestrian collisions are more likely to result in a fatality [4]. Among pedestrians, young people (5–19 years), older people (60 years and over) and males are considered to be high risk users [5]. In terms of warning systems, level crossings are either passive crossings which have warnings such as signs, or

active crossings which have automatic warning devices such as boom gates, flashing lights and warning tones[2]. Fewer collisions take place at level crossings with active warning systems [6]. Today radar sensor systems for automatic level crossing free detection are a cheap way to improve safety of level crossings [7].

4. Components

The components of the system are as follows:

- At mega 8 Microcontroller
- SERVO MOTOR
- LED
- IR SENSOR
- FORCE RESISTIVE SENSOR
- RESISTOR
- Power Supply

5. Working Procedure

One of the major advantages of this system is its simple circuit and working principle. The circuit is parted into three parts. First one is the microcontroller portion second is the IR sensor portion incorporated on rail line region and third is the servo mechanism which is employed to operate the gate. By employing the automatic railway gate control at the level crossing the arrival of train is detected by the sensor placed on either side of the gate from the level crossing. Once the arrival is sensed, the sensed signal is sent to the microcontroller and it checks for possible presence of vehicle between the gates, again using sensors. Subsequently, buzzer indication and light signals on either side are provided to the road users indicating the closure of gates.

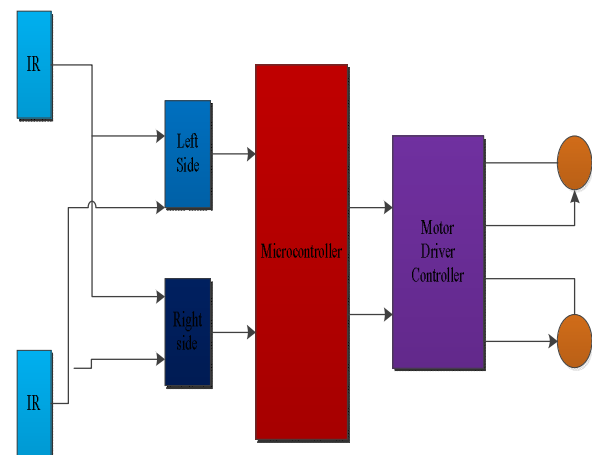


Figure 7. Technical block diagram

Once, no vehicle is sensed in between the gate the motor is activated and the gates are closed. But, for

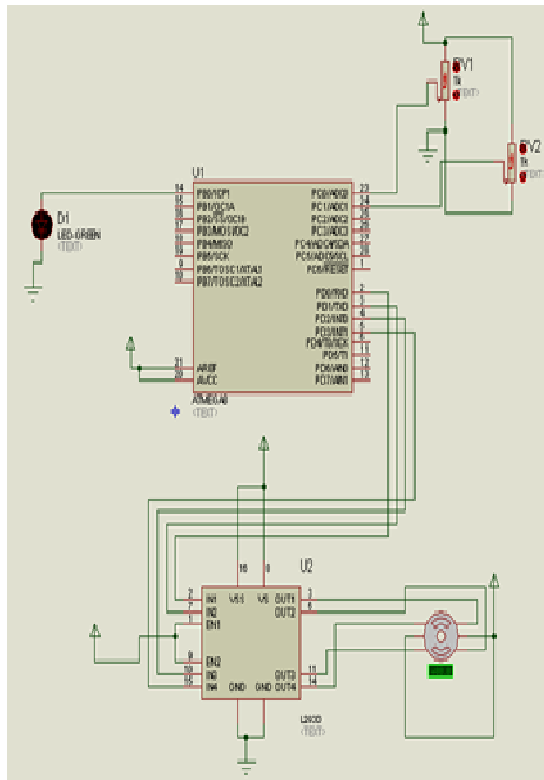


Figure 8. Circuit design using Proteus

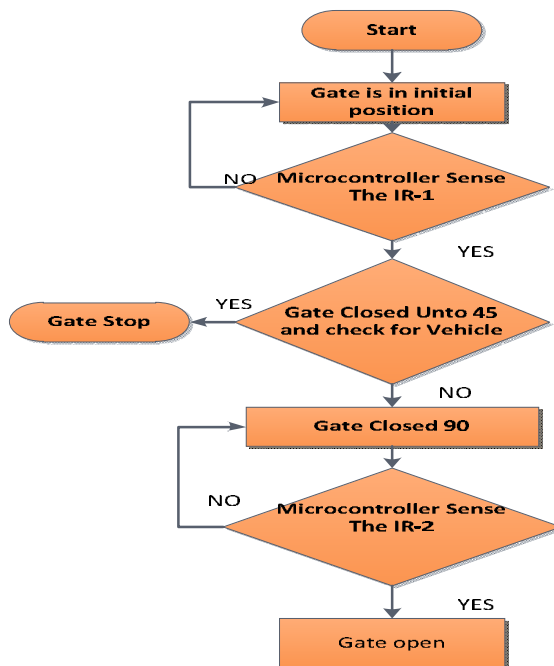


Figure 9. Flow Chart

the worst case if any obstacle is sensed it is indicated to the train driver by signals (RED) , so as to bring it

to halt well before the level crossing. The red signal changes to a green one once the obstacle is moved away from the rail. The sensor placed at 2km away from the rail cross detects the departure of the train. Once the train is left, the sensed signal is sent to the microcontroller and the motor is activated and the gate is reopened. The above mentioned steps repeat for the arrival of the train from either direction.

6. Performance Test

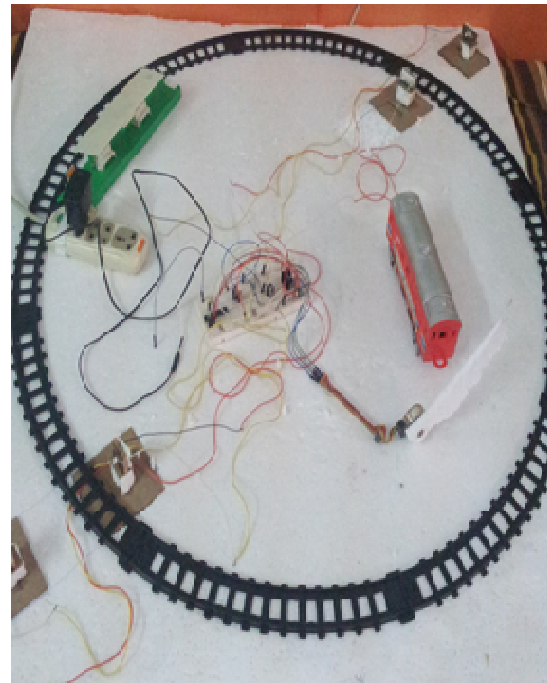


Figure 10. Arrangement of automatic rail gate system

Result part presents three important cases here. Those are:

- When the train arrives
- When the train leaves
- When any vehicle gets stuck

As the gate will always check at 45° it would always be closed as we can see from the figure. When the train is coming. So the gate will be closing down and at 45° it will check for the presence of any vehicle that gets stuck. If any object is not found then the gate it is closed properly. That's why it is rotating in anti-clock wise direction .when the train cross the gate the IR sensor sense the location , it will send signal to the Microcontroller and motor will rotate in clock wise position so that the gate can open and allow the vehicle to pass through the level crossing. the gate is closing down it will check at 45° and it will get a signal of any living object that gets stuck at the level crossing of the rail-line. So our

Microcontroller will give signal to the motor to Stop and send this emergency signal to the train driver making the emergency light ON and train driver will take necessary actions to reduce the accident.

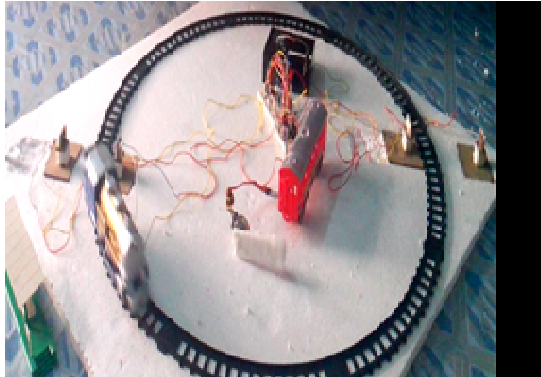


Figure.11 Gate is closed when the arrival of the train

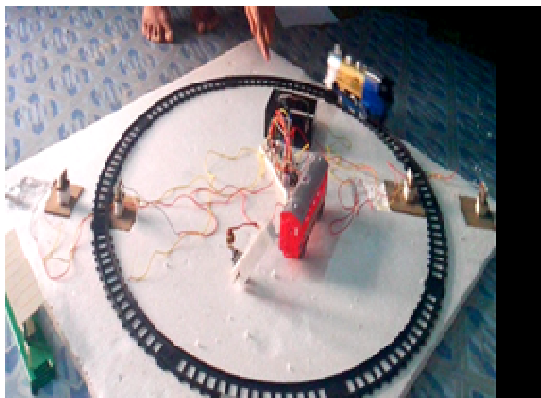


Figure. 12 Gate is opened when the departure of the train

7. Conclusion

Now a days, automated railway gate system has already been implemented in several countries successfully. Even though frequent number of maintenance cycle is needed to achieve its proper advantages, it is still much safer than manually operated railway gate control system in rather less populated rural areas. As fatigue and negligence of duties doesn't interrupt the operations, it is possible that the percentage of accident due to collision at level crossing will decrease greatly. Though coverage of the entire railway network is quite costly but the overall advantage and cost due to damage will benefit the overall cost expenditure. As the method is quite simple to achieve, the maintenance will be easier too. An automated railway gate control system will provide the road

user reduced waiting time at level crossing and a safer path across the railway.

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