International Journal of Science and Research (IJSR)
ISSN (Online): 2319-7064

Intelligent System for Train Engine with Automatic Gate Controlling using Wireless Technology in Bangladesh

Kawshik Shikder

Department of EEE, American International University-Bangladesh (AIUB),
Banani, Dhaka, Bangladesh

Abstract: ***In the developing country like Bangladesh, accidents in the level crossing are increasing day by day. Negligence of train drivers and gatekeeper is the main reason of this accident. No fruitful steps have been taken so far in these areas. So this system is designed to help out the railway department. This paper deals with intelligence of train engine with automatic gate controlling to avoid accidents at level crossings. The main concept of the system is that, depending on arrival or departure of the train near level crossing, the crossing gate will close or open automatically with displaying proper signal like Red or Green signal. That means when the train approaching near level crossing, the crossing gate will close and showing Green signal for train. So train can move without any interruption of its speed. After leaving the train from level crossing, the crossing gate will open. But there may be a chance that when a vehicle is trying to cross the level crossing then the crossing gate may close as the train is approaching nearby. At this situation, the crossing gate has to be closed but cannot be closed and showing Red signal for train. Thus, the person may be injured severely due to this. So the gate will be opened till the vehicle moves away from the crossing gate and also the train will be stopped as it detects the vehicle as obstacle just under crossing gate. Another common scenario due to huge traffic jam in our country, it may happen that the crossing gate is closed but there is a vehicle on the track that cannot be moved forward because of traffic jam or returned as the crossing gate is closed. In this situation Red signal will be displayed for train and train will be stopped as it detects the vehicle as obstacle on the track. Thus, the rail accidents of Bangladesh can be avoided and also controlling of the gate is done perfectly without injuring the people who crossing the level crossing. The system is designed using RF Transceiver, IR Sensor, Microcontroller, DC Motor, Relay and some external devices.***

Keywords: RF Transceiver, IR Sensor, Microcontroller, DC Motor

1. Introduction

An intersection where a railway line crosses a road/highway at the same level is known as “Level Crossing”. Level crossings present a significant risk of collisions between trains and road vehicles. In Bangladesh, the crossing gate is still operated manually by a gatekeeper after receiving the information about the train's arrival that is more risky. So the train accidents at the level crossing are becoming more and more usual. That’s why the topic has been chosen. Now-a-days, every system is automated in order to face new challenges. Automated systems that have less manual operation are flexible, reliable and accurate. Due to these demands every field prefer automated control systems specially in the field of electronics where automated systems are giving good result. Microcontroller is one of the major devices in the field of electronics. While using microcontroller has become very much popular for its wide application field and user adaptability, microcontroller is used in many major areas. Due to this I have tried to design this intelligent system for train engine with automatic gate controlling to avoid accidents at level crossings based on microcontroller. Actually the main objective of designing this intelligent system is to avoid accidents at level crossing and save human lives as well as valuable property of a country. In this system there are mainly two units: Signal Pole Unit and Train Unit. Signal Pole Unit includes some major equipment like IR Sensor, Buzzer, LEDs, RF Transmitter, Encoder, DC Motor, Motor Driver, Relays.
Train Unit also includes some major equipment like RF Receiver, Decoder, DC Motor, Motor Driver, Relays. Some common equipments have used in both sections like Microcontroller, Voltage Regulator ICs (78XX), Power Supply and so on. For demonstration, we have used these equipments to observe the result of this system effectively.

2. System Model

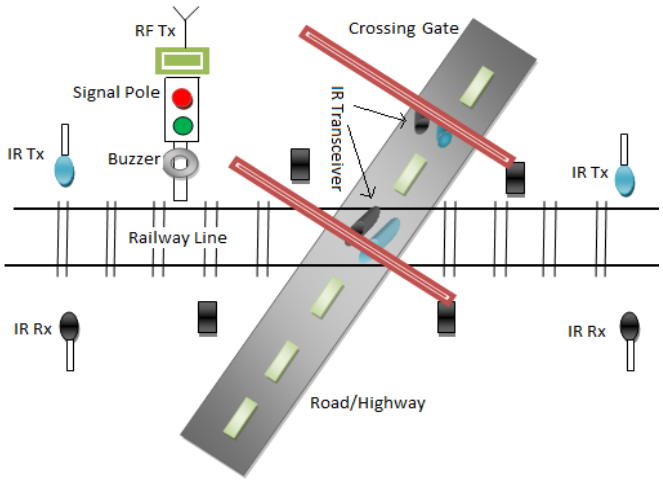

Figure 1: Overall System Model

This project utilizes six IR Tx/Rx pairs. Two Pairs are placed at either side of the level crossing with some distance to sense the train arrival and departure. Rest four pairs are placed at crossing gate of either side. In a crossing gate, one pair is placed vertically downward to sense any vehicle as obstacle just under the crossing gate and other pair is placed

horizontally to sense any vehicle on the track as obstacle. Other two pairs are placed in the same way on the remaining gate. Three DC motors are used in this system. One is used to drive the engine and remaining two are used to open or close the gate at both side of the track. Green and Red LEDs are used as signal light, and Buzzer is used as an alarm. RF Tx/Rx is used to control the engine depending on the position of the crossing gate where Tx is placed on the signal pole and Rx is placed on engine.

3. Block Diagram and Description

3.1 Signal Pole Unit

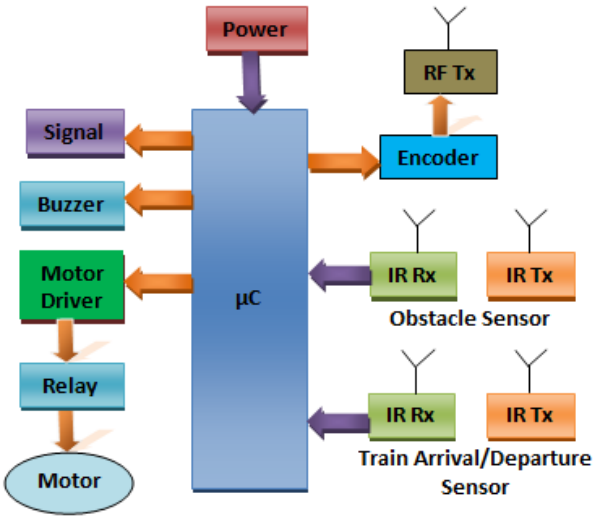

Figure 2: Block Diagram of Signal Pole Unit

Detection of train approaching to the level crossing can be sensed by means of two pairs of IR sensors (named Train Arrival/Departure Sensor, shown in figure 2) that placed on either side of the level crossing with some distance. Another four pairs of IR sensors (named Obstacle sensor, shown in figure 2) are placed on the crossing gate on either side of track. On each side one pair is placed horizontally that senses any vehicle as obstacle on the track and other pair is placed vertically downward that senses any vehicle as obstacle under the crossing gate. Buzzer and signal light are placed on the signal pole. RF Transmitter is placed on the top of the signal pole to transmit signal to the train (shown in figure 1). Two DC Motors are placed on each side of track to control the gate. Total mechanism is done by software embedded into Microcontroller. Microcontroller is used for both units.

When the train cuts first sensor, it generates an interruption for IR sensor (Train Arrival/Departure Sensor) and sends the interrupted signal to microcontroller. After getting the signal, Microcontroller actives a buzzer until the train cuts second sensor and trying to runs both the motor using relay on either side in clockwise direction through motor driver to close the gate. By this time, Microcontroller also checks any obstacle on track or under gate through obstacle sensors. If there is no obstacle, it runs both the motor in clockwise direction through motor driver to close the gate and shows Green signal for train. Due to Green signal there is no transmission of RF Transmitter means no interruption of train's speed. But there is an obstacle, it doesn't run the motors that means gate is open and shows Red signal for train. Due to Red signal, RF Transmitter transmits the signal through encoder. This is done within few seconds. After removing obstacle, Microcontroller runs both the motor in clockwise direction through motor driver to close the gate and toggled signal from Red to Green for train.

When train cuts second sensor, it generates an interruption for IR sensor (Train Arrival/Departure Sensor) and interrupted signal again goes to Microcontroller. Microcontroller turns off buzzer as well as signal and drives both the motor anti clock wise direction through motor driver to open the gate. The system is made bidirectional so direction of train doesn't matter.

3.2 Train Unit

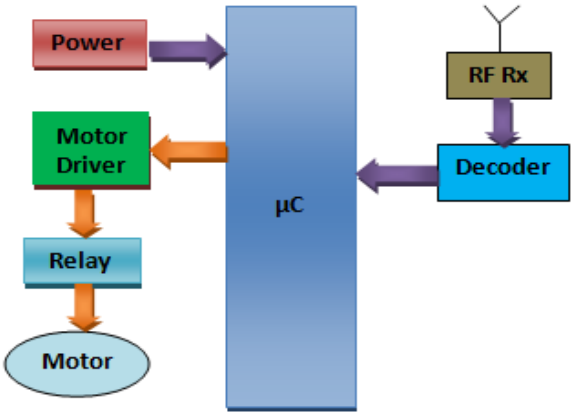

Figure 3: Block Diagram of Train Unit

RF Receiver is placed on train to receive RF signal. DC Motor is used to run the train engine and relays are used to control the speed of train. When the train approaches to the level crossing, if RF Receiver detects any RF signal then it sends the signal to Microcontroller through decoder. After getting signal, Microcontroller gradually decreases the speed of DC motor through motor driver and stops automatically. After that, while RF Receiver doesn't receive any signal, it runs automatically and increasing its speed. Speed of the DC motor is controlled with the help of relays.

4. Circuit Diagram

4.1 Signal Pole Unit

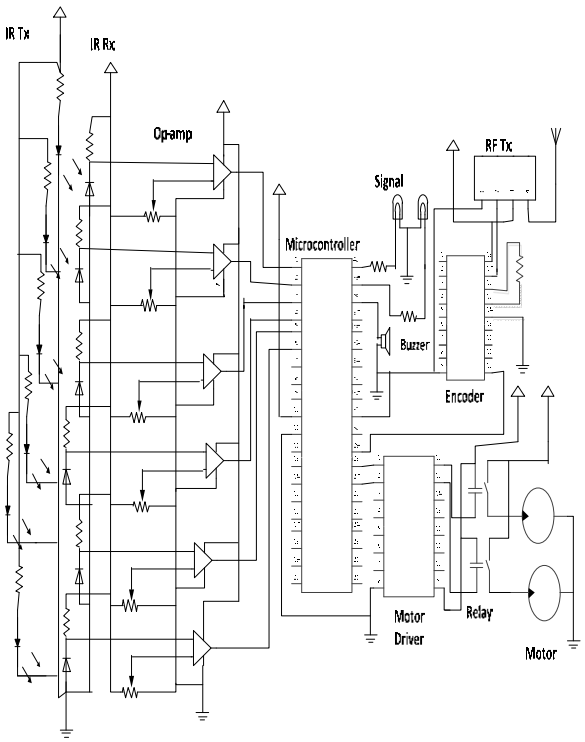

Figure 4: Circuit Diagram of Signal Pole Unit

4.2 Train Unit

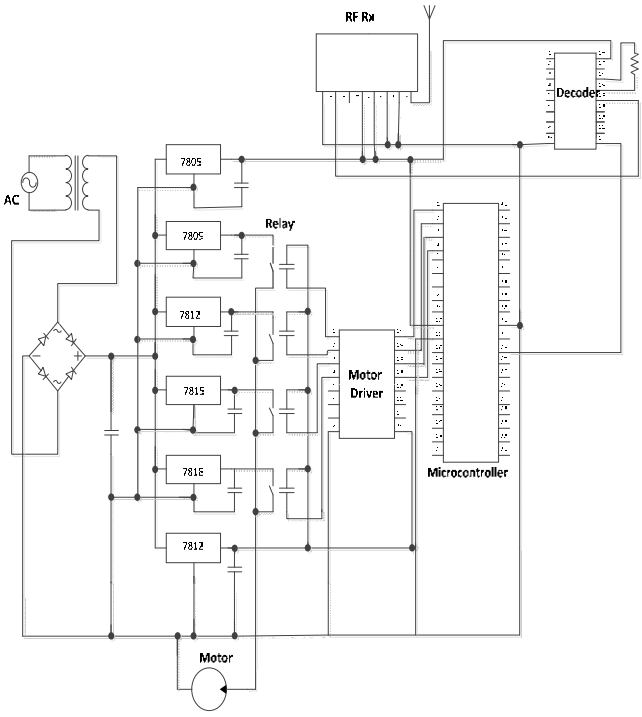

Figure 5: Circuit Diagram of Train Unit

5. Hardware and Software Tools

5.1 Software Used

- Code-Vision AVR (CVAVR)

5.2 List of Hardware Equipments

- Microcontroller ATMega16
- RF Transceiver
- Encoder HT12E
- Decoder HT12D
- IR Sensor
- Motor Driver ULN 2003
- SPDT Relay 12V
- DC Motor 24V & 12V
- Buzzer
- Resistor
- Capacitor
- LED
- Op-amp LM324
- Voltage Regulator IC (7805, 7809, 7812, 7815, 7818, 7824)

6. Advantages and Disadvantages

6.1 Advantages

- Automatic operation
- Prevent accidents
- Safety to the peoples
- Fault analyze is easy
- Cost effective
- Greater accuracy
- Low power consumption
- Easy installation
- No wastage of man-power

6.2 Disadvantages

- Every train should be provided with RF technology
- Need to be installed in large numbers

7. Applications

This design can be implemented together in the train engine as well as at level crossing to avoid the accidents up to the maximum extent.

8. Future Advancement

This paper has satisfactorily fulfilled the basic things such as prevention of accidents inside the level crossing and the wastage of a man-power. Since this arrangement can be used in remote areas where the power supply can't be expected for the motor operation, sensors, buzzer and signal lights, solar power can be the solution there. It can be used directly during the daytime and by charging the battery during night.

Using the same principle as that for gate control, I have developed a concept of automatic track switching. Considering a situation where an express train and a local train are travelling in opposite direction on the same track,

the express train is allowed to travel on the same track and the local train has to switch on to the other track, indicator lights have been provided to avoid collision. Here the operation is performed using a motor. Electromagnets can be used in practical purpose.

9. Conclusion

From the above discussion and information of this system, it is clear that the system is highly reliable, effective and economical at dense traffic area, suburban area and the route where frequency of trains is more. As the system is completely automated, it avoids manual errors and thus provides ultimate safety to road users. By this mechanism, presence of a gatekeeper is not necessary and automatic operation of the gate through the motor action is achieved. If there is any difficulty then train will stop at few distances from the level crossing.

I believe that, designed Intelligent Train Engine can make a positive contribution in our country. So Bangladesh Railway (BR) should take immediate step to implement intelligent system in the railway sector to minimize the chance of accident and to ensure safety to the peoples.

References

[1] Anil Kumar Verma, Dharmendra Kumar, Gopal Krishna gole, Jitendra kumar, "Intelligent Train Engine for the Fastest New Age Technology", International Journal of Innovative Research in Computer and Communication Engineering, vol. 1, Issue 1, March 2013.
[2] Nisha S.Punekar, Archana A. Raut, "Improving Railway Safety with Obstacle Detection and Tracking Sysstem using GPS-GSM Model", International Journal of Science & Engineering Research, Vol. 4, Issue 8, August 2013.
[3] Sanjeev Kumar, Shweta Gupta, Dibyayan Das Sharma, "An Intelligent Train Engine Based on Auto-Signal Following Scheme Using IR Technology", The IUP Journal of Electrical and Electronics Engineering, Vol. IV, No. 4, pp. 36-47, October 2011.
[4] J. M Khan and J. R Barry, "Wireless Infrared Communications", Proceedings of the IEEE, Vol. 85, pp. 265, February 1997.
[5] Zehang Sun, George bebis, and Ronald Miller, "On-Road Train Detection: A Review", IEEE Transactions On Pattern Analysis and Machine Intelligence, Vol. 28, No. 5, May 2006.
[6] Steven F. Barrett and Daniel J. Pack, Atmel AVR Microcontroller Primer: Programming and Interfacing, second edition (Synthesis Lectures on Digital Circuits and Systems), paperback - june 27, 2012.
[7] Bruce Fette, Roberto Aiello, Praphul Chandra, Daniel Dobkin, Dan Bensky, Douglas Miron, David Lide, and Ron Olexa, RF and Wireless Technologies: Know It All, Published - September 2007.
[8] K. Feher, Wireless Digital Communications, Englewood Cliffs, NJ: IEEE Press, 1992.
[9] Davis, Peter T. and McGuffin, Wireless Local Area Networks: Technology, Issues, and Strategies. New York: McGraw-Hill, 1995
[10] IndianEngineer "Intelligent Train Engines", Available: http://indianengineer.wordpress.com/2009/08/03/intelligent-train-engines/
[11] Maureen Kaine-Krolak, and Mark E. Novak, An Introduction to Infrared Technology: Applications in the Home, Classroom, Workplace, and Beyond, Trace R&D Center, University of Wisconsin, Madison, WI, Presentation Manuscript, 1995, Available: http://trace.wisc.edu/docs/ir_intro/ir_intro.html
[12] http://www.engineersgarage.com

Author Profile

Kawshik Shikder was born in Rajbari, Bangladesh on August 18, 1991. He obtained his B.Sc degree in Electrical and Electronic Engineering (EEE) from American International University-Bangladesh (AIUB) in May, 2013. Currently, he is studying in M.Sc in Electrical and Electronic Engineering (EEE) at American International University-Bangladesh (AIUB). His areas of interest include mobile communication systems, wireless communication network, data communication, power electronics, and power system.