**American International University- Bangladesh (AIUB) Faculty of Engineering (EEE)**

# MICROPROCESSOR AND EMBEDDED SYSTEMS

## Final Project Submission

# Automatic Railway Gate Control system using Arduino

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# Automatic Railway Gate Control system using Arduino

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***Abstract*— The majority of train accidents in Bangladesh happen at level crossings because of carelessness in the manual manipulation of railroad gates or human negligence. crashes caused by impediments like animals or cars on the rails, as well as head-on collisions caused by poor manual railroad switching. These railway accidents result in considerable property damage to both people and organizations as well as major financial losses. In order to prevent accidents at level crossings and head-on collisions caused by human errors when switching manually, this paper offers automatic railroad switching mechanisms. It also gives an automatic railway gate regulating system.**

**Keywords- Radio Frequency Identification [RFID],Global Positioning System [GPS], Infrared sensor [IR], Liquid Crystal Display [LCD], Ultrasonic sensor [UV]. Servo Motors, Arduino Nano, Crossing Gates, real Time Tracking, Rail Gate Automation**

## I. INTRODUCTION

One of the most well-liked and practical modes of transportation is the railway system. The railroad transports tons of cargo and millions of passengers each day as the main component of the public energy-efficient option to other types of transportation. As a result, both the number of people using the railroads and their use had increased over time. It has a significant impact on our economy. According to surveys carried out by Bangladesh Railway, level crossings account for roughly 17% of all railroad accidents in Bangladesh [6]. Accidents of which majority occurs at passive railway crossings. The old signaling and operating systems sometimes make wrong operation which causes severe train accident with a huge number of casualties as well as colossal financial losses. The soul idea was to design a system to avoid the accidents at level crossing by employing anautomatic railway gate controlling system at unmanned level crossing replacing the gates operated by the gate keepers. It deals with two things. Firstly, the reduction of time for which the gate is being kept closed. Secondly to provide safety to the road users by reducing the accidents that usually occur due to carelessness of road users and errors made by the gate keepers [1,2]. The automatic railroad switching system using RFID reader and cards to avoid errors made by human which causes head-on collisions [3] (It occurs only when two trains travel on the same track towards each other) of trains. An anti-collision system which is used to detect the obstacles on the track and inform the loco-pilot about the obstacle on the track [5]. The existing system uses traditional telecommunication systems like Walkie-Talkies or other communicational devices. Due to human carelessness if fails sometimes [3]. So, the proposing system will work automatically and send the information to the central control authorities for further processing.

## II. LITERATURE REVIEW

[1] M.Duraishanmugapriyan, developed the concept of "Automatic Railway Gate Controlling System", using ATmega328P microcontroller with the help of two types of sensors. It has three IR sensors which are used to detect arrival and departure of the train. Even they have used RF transmitter and receiver for the transmission of sensor output to controller which is in remote location. The microcontroller forms the main unit of the system.it receives input

signal from the sensors and sends the information to the gate motor driver for opening and closing the gate. The output signal Arduino will active LCD display and alarm.

[2] Dhanashree Anant Umbarkar, Khushabu Talele, Samrudhi Salunke, Geeta Salunke developed the concept of "PLC Based Fully Automated Railway System". This system consists of self-acting PLC system which works round the clock to alert train collision and accidents at the level crosses. Thus, enhances safety in train operations by providing a non-signal additional safety overlay over the existing signaling system. The system operates without replacing any of the existing signaling and nowhere effects the vital functioning of the present safety system developed for the train operation, the proposed system gets data from the vibration sensors. The efficiency of the system is expected to the considerably increased as the proposed system takes input from sensor and also from the level crossing gates.

[3] Naga Hema Kumari.V, China Appala Naidu.R, developed a concept called "Train Collision Avoidance by Using Sensors" to provide safety to human lives and to reduce the accidents they developed a new product using UV sensor, IR sensor and LPC2184 processor. By this proposed system it can identify the both head-on and rear end collision and can be controlled. In this proposed system they are using sensor-based identification to prevent these accidents. The existing system uses traditional telecommunication systems like walkie-talkies or other communication devices. The anticollision device uses radio modems for communication and received inputs from GPS through satellites.

[4] Dogan Ibrahim developed a new concept called as "Smart Train Collision Detection System using a Microcontroller" they introduced this system by using novel microcontroller-based system using RFID, GPS and an RF transmitter/receiver module to detect possible collisions and to inform the drivers, when the train travel on the same track. The design of novel microcontrollerbased system is described that which helps to detect possible train collision. Here the system uses RFID to detect the unique track ID that a train is travelling on, a

GPS to know the exact positions and speeds of other nearby trains, a powerful RF transmitter/receiver module for communication between the trains and buzzer to warn the drivers of any risk of collision. [5] Ranu Dewangan, Pratibhadevi Umesh, developed the concept of “Automatic Accident Control System on Railway Tracks”, This system is used to develop the presence and absence of vehicle or any object on the track within a certain range by setting the appropriate duration. Their function is when train is coming in any track and same track is damaged or any fault are present or any object are present or from other side other train is coming in speed at that time RED light which is present in engine boogie automatically GLOW or ON, they inform that the driver who is driving the same train by using this system it is difficult in winter seasons to detect the light due to snow fall we cannot detect the light in the snow fall.

## III. OBJECTIVES

- This project is designed to control the railway gate at the level crossing automatically through sensors such as IR sensors or ultrasonic sensor and controlling through actuators such as buzzers, LED display, servo motors.

- Manual track switching errors are to be minimized by an automatic railroad switching mechanism using RFID readers and servo motors.

- Train accidents because of obstacles like animals on the railway track in an accidental zone can be detected by ‘Anti-collision system’ which has ultrasonic sensor and servo motor, which alerts the loco-pilot in the train on that track.

## IV. METHODOLOGY

Figure 1 depicts a level crossing with an automatic railway gate control system. By using the automatic railway gate control at the level crossing, the sensors positioned on either side of the gate at a distance of about 5 km from the level crossing are used to detect the approach of the train. Once the arrival has been detected, the perceived signal is transferred to the

microcontroller, which next uses sensors to check if any vehicles may be present between the gates.

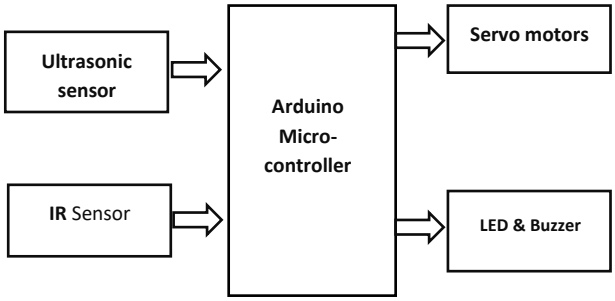


Fig.1Railway gate controlling system

Following that, buzzer signals and light signals on either side of the road alert drivers to the approaching train. The motor is turned on and the gates close if there are no vehicles detected between the gate and the wall. However, in the worst-case scenario, the loco pilot in the train will be alerted if any obstacles are detected using a nRF24L01 transmitter before the train has traveled two kilometers from the gate.

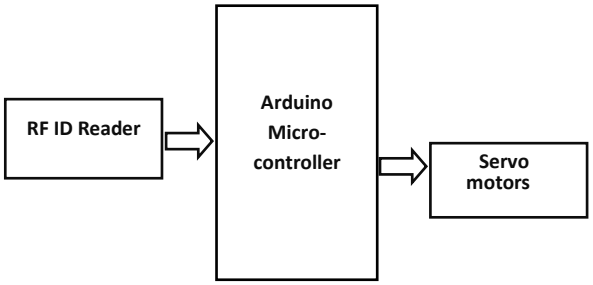


Fig.2 Railroad Switching system

Figure 2 depicts an automatic train switching system that uses an Arduino microcontroller as a control unit and an RFID reader that is situated a specified distance from the switching system to sense radio frequency identification numbers. The track is switched using a servo motor in accordance with the distinct ID of the train, and it sends the loco pilot an acknowledgement.

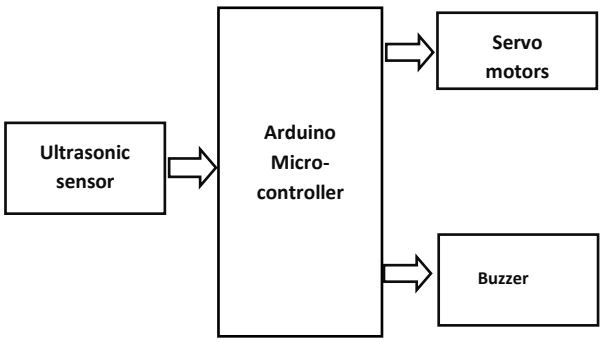


Fig.3 Anti-collision System

The anti-collision system in Fig. 3 uses an ultrasonic sensor and a servo motor to rotate the ultrasonic sensor from 0 to 180 degrees in order to detect impediments on the railway track, such as animals or automobiles, from a distance. If the barrier is there, it will use the nRF24L01 transceiver module to communicate its location to the train that is currently on the track.

## V. SOFTWARE IMPLEMENTATION

Control Circuit is the image of the prototype we have designed. We tried to make it as small as possible by using smaller tracks but as the train is supposed to move at a constant speed and acquiring data that fast would create further problems. The main problem occurring was the overlapping of signals from the sensors to the gate and was, thus, not functioning to its optimum level. We had to check and design the size of the total prototype several times to come to a suitable form. The way it is designed now produces the most accurate reading in a minimum size. As for the lighting system, we have used USB input lights to set on the track and there are actual lights along the rail tracks. As this is an automatic system, the lighting system has been automatized as well. We have connected the light base to the on board Arduino and have used an LDR sensor on the PCB connected to the Arduino as well. The connection has been programmed in such a way that the lights are powered automatically when there is no light around. So, it works at night and remains off during day time. This is directly operated from the control station for now but in the next development stage, we are thinking to use something more self-powered system to the lights and other electrical systems so that we can enhance the Sustainable Development Goals.

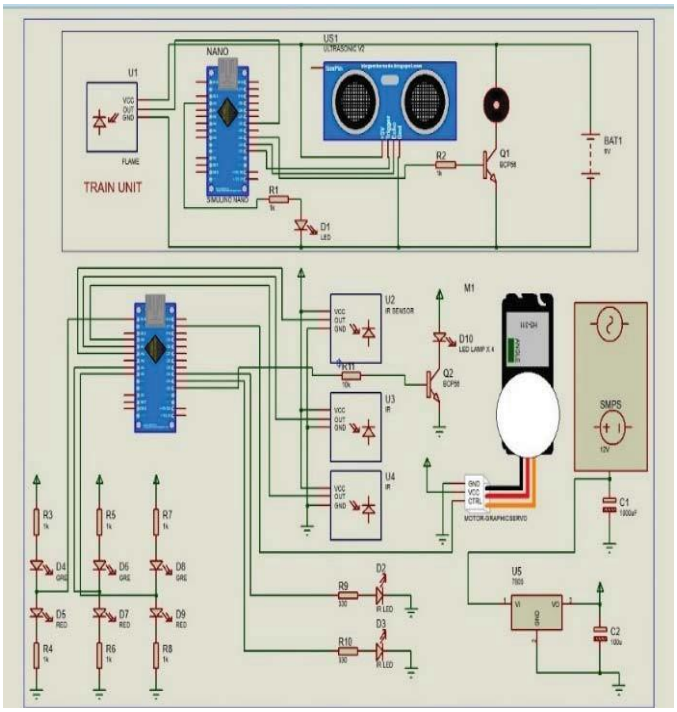


Fig:Design of the prototype on PROTEOUS Software

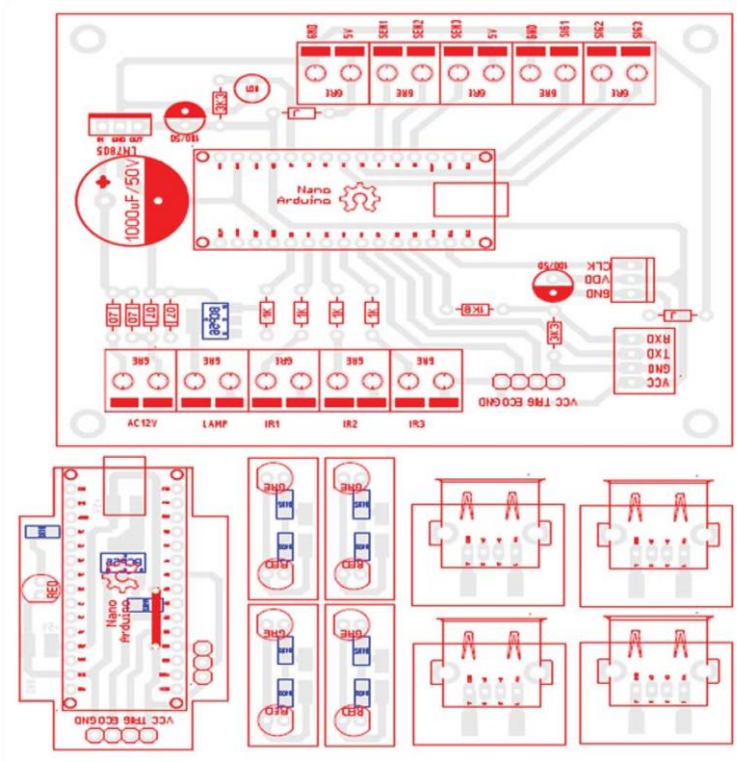


Fig: Design of the PCB connection

## Vi. HARDWARE AND SOFTWARE REQUIREMENTS AND SPECIFICATION

- *Hardware Requirements*

1.Node-MCU :-

Open source prototyping board designs are available for Node MCU, an open source device firmware. The words "node" and "MCU" are combined to form the moniker "Node MCU" (micro-controller unit).

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*2. Ultrasonic Sensor*


- Ultrasonic Sensors measure distance by using ultrasonic waves.
- Range of ultrasonic detection is 100 KHz – 50MHz.
- Ranging distance 2cm – 350 cm.
- Effectual angle <*15*.
- Resolution of 0.3 cm.
- Power supply 5 volts DC.
- Pulse in/outcommunication.

*3. Servo motors*

- A servomotor is a rotary actuator or linear actuator that allows for precise control of angular or linear position, velocity and acceleration.
- The servo motor is controlled by a signal (data) better known as a pulse-width modulator (PWM).

- Forward voltage of 6 V. • Rotating speed is 0.12sec/60degree.

*4. Buzzer*

- A Buzzer is an Audio signaling device, which may be mechanical, electromechanical, or piezoelectric.
- Operating voltage DC 3.0 – 30.0 V.
- Sound pressure level 85 dB minimum (continuous tone).
- Current consumption of 9 mA (maximum).

- *Software*

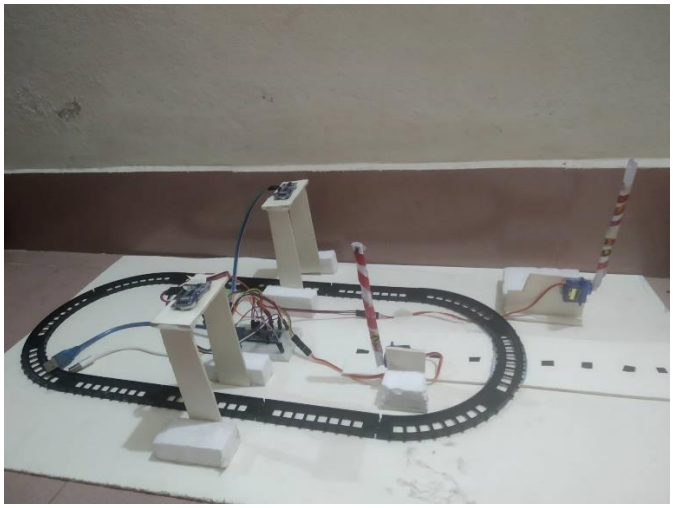
*1. Arduino IDE (Embedded c)*

Arduino is a tool for making computers that can sense and control more of the physical world than your desktop computer. It's an open-source physical computing platform based on a simple microcontroller board and a development environment for writing software for the board.

Arduino can be used to develop interactive objectives, taking inputs from a variety of switches or sensors, and controlling a variety of lights, motors, and other physical outputs. Arduino projects can be stand-alone or they can be communicated with software running on your computer (e.g. Flash, Processors, MaxMSP.) The boards can be assembled by hand or purchased preassembled and it is open-source IDE can be downloaded for free. The Arduino programming language is an implementation of writing, a similar physical computing platform, which is based on the Processing multimedia programming environment.

## VIII. RESULTS AND DISCUSSION

This project uses both hardware and software components. Two infrared sensors next to the gate track the movement of trains. a tiny servo motor that helps automate gates. Node MCU, GPS module, Blynk software, and a fire sensor are used to detect the occurrence of a fire in the train. While the railway crossing gate will be automatically closed with the aid of our hardware employed in this project and the Buzzer will be used to signal the coming of a train. With the aid of Google Firebase, we also integrated this project into a mobile application, allowing us to carry out or carry out this project with the aid of an application. For those cities or nations where train travel is the most affordable and frequently used mode of transportation, this project is particularly helpful. The outcome will be shown on the IOT website together with all pertinent details like a map of the area, the longitude and latitude of the crack, and train information. Additionally, the LCD display that is connected to the LPC 2148 microcontroller will display NO if there is no crack and YES if there is one.



## *VII. Advantages*

- The system provides safety for the road users by reducing the accidents inside the gate as there is no manual operations.
- The reduction of time for which the gate is being kept closed.
- Error due to manual operations in track switching is prevented.
- It senses the obstacle in accidental zone and transmit the information to current train on that track.
- Due to automatic sensing and controlling no need of man power.
- It is reliable, economical and cost-effective system compared to existing system.

## IX. CONCLUSION

This method can stop severe life losses. Technologies using IR sensors and internet of things Without the requirement for human involvement, the system automatically opens and closes gates, and a railway track crack detection system finds damaged rail lines without human intervention. The suggested alternative has a number of benefits over the current method. The benefits of this technology include inexpensive costs, minimal power requirements, high accuracy, quick analysis times, and the capacity to help with fracture detection. to use hosted websites (IOT) to locate the precise location of the damaged track and to help with centrally controlling everything so that many lives can be spared.

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## X. REFERENCES


[1] M.Duraishanmugapriyan, "Automatic railway gate controlling system", 2nd International Conference on Emerging Trends in Engineering, 20th may 2017.

[2] Dhanashree Anant Umbarkar, Khushabu Talele, Samrudhi Salunke, Geeta Salunke, "PLC Based Fully Automated Railway System", International Journal of Advance Engineering and Research Development, June - 2017

[3] Naga Hema Kumari .V, China Appala Naidu, "Train Collision Avoidance by Using Sensors", International Journal of Advanced Research in Computer Scienceand Software Engineering, Volume 6, Issue 6, June 2016.

[4] Dogan Ibrahim, "Smart Train Collision Detection System using a Microcontroller", International Journal of Computer Applications (0975 – 8887), October 2016.

[5] Ranu Dewangan, Pratibhadevi Umesh, "Automatic Accident Control System on Railway Tracks", International Journal of Advanced Research in Electronics and Communication Engineering, (IJARECE), Volume 5, Issue 7, July 2016.

[6] Acy M Kottalil, Abhijith S, Ajmal M M, Abhilash L J, Ajith Babu, "Automatic Railway Gate Control System", International Journal of Advanced Research in Electrical, Electronics and Instrumentational Engineering, Vol. 3, Issue 2, February 2014.

[7] www.indianrail.gov.in / https://indianrailinfo.com.

[8] Wikipedia, Eletronicsforu, NORDIC Semiconductor etc.