

AUTOMATIC SAFETY AND PROTECTION SYSTEM FOR RAILWAY TRANSPORTATION

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ABSTRACT

The main idea of our project is to develop an automatic system for protection and safety of passengers and to bring down the number of accidents and death rate. The protection system includes automatic signal detection, crack detection, obstacle detection, footboard passenger safety, automatic and manual railway gate operation. Our project also includes mobile application interfacing for performing manual railway gate operation. These are implemented using microcontrollers like Arduino Mega, Uno, ultrasonic sensor, radio frequency (RF) 433 MHz transmitter and receiver module, and Bluetooth module for interfacing with mobile application.

KEYWORDS: Microcontroller, signal detection, radio frequency module.

I. INTRODUCTION

In Today's world, railway transportation is used by huge amount of passengers and it is a network. Due to many errors and lack of preventive measures, the safety of passengers and property is questionable. The existing system involves more number of human errors and also there is manual operation in almost every sections. The main purpose of this idea is to provide safety and protection for passengers and railway property. The project proposed consists of system for obstacle detection, speed detection, footboard passenger safety, and automatic operation of railway gates. The accidents caused due to human errors are reduced by deploying fully automated system. The system consists of Arduino mega, RF transmitter and receiver, ultrasonic sensors, stepper motor for automatic operations.

II. METHODOLOGY

A) Introduction

This section explains about the detailed hardware implementation, communication between various sections such as Signal light system, train system, railway gate system. This section also explains about methodology used and interfacing of mobile application with the controller. Three main sections of our project is as follows

- Train side circuit
- Gate side circuit
- Signal side circuit

Hardware Installed In Train

The train side circuit consist of Arduino mega, RF transmitter, RF receiver, three Ultrasonic sensors, Bluetooth module, DC motor, LCD display, Motor driver.

The below picture shows the working of train side system. When the RF receiver receives the character from signal light the motor operates according to the character received from the signal light. The train also has RF transmitter which transmit the character to the railway gate. There are 3 ultrasonic sensors for obstacle detection, footboard passenger safety, and crack detection. The ultrasonic sensors are set for a fixed measurement and when these distance changes, the operations are done accordingly.

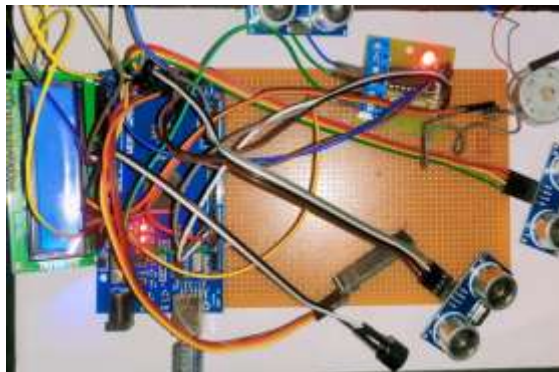


Figure: 1 Train side circuit

Hardware Installed In Signal

The signal side circuit consists of Arduino uno, Bluetooth module, signal light, RF transmitter. The signal light is selected via mobile application through Bluetooth. The RF transmitter installed on the signal is used to transmit the particular light signal as a character to the RF receiver of the train. The RF module used here may work up to 100 meters and in practical situation we can use RF-UART-433 Transceiver module for communication up to 1 KM.

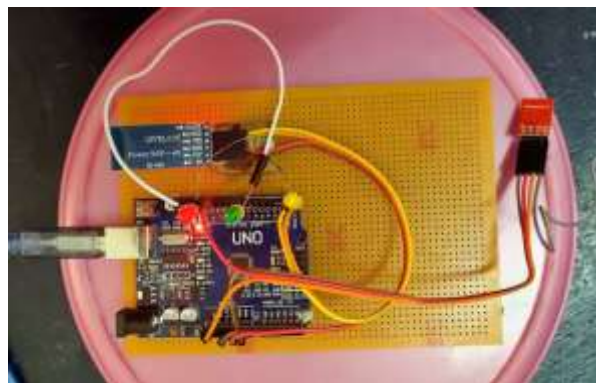


Figure: 2 Signal side circuit

The above shows the signal side circuit in which a Bluetooth module is used to change the signal by using mobile app. An RF transmitter is used to send character to the train.

Hardware Installed In Railway Gate

The gate side circuit consist of Arduino uno, RF receiver, servo motor, Bluetooth module. RF receiver installed on the gate is used to detect the signal that is sent from the RF transmitter on the train. When the train comes into the particular range of distance the gate closes automatically and if it goes out of ranges the opens automatically by using servo motor.

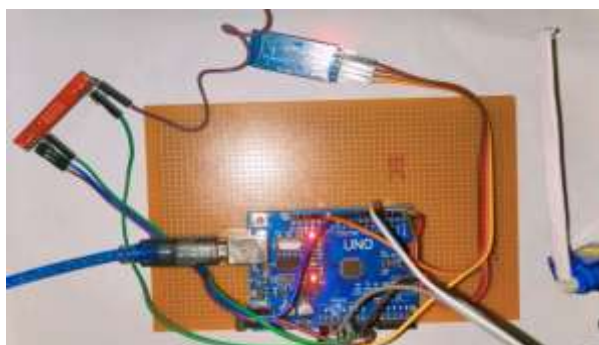


Figure: 3 Gate side circuit

The above shows the control of railway gate through mobile app and the gate side has RF receiver to catch signal from train.

B) Mobile Application

The bluetooth application helps in particular operation of controllers. The mobile app images is as shown below,

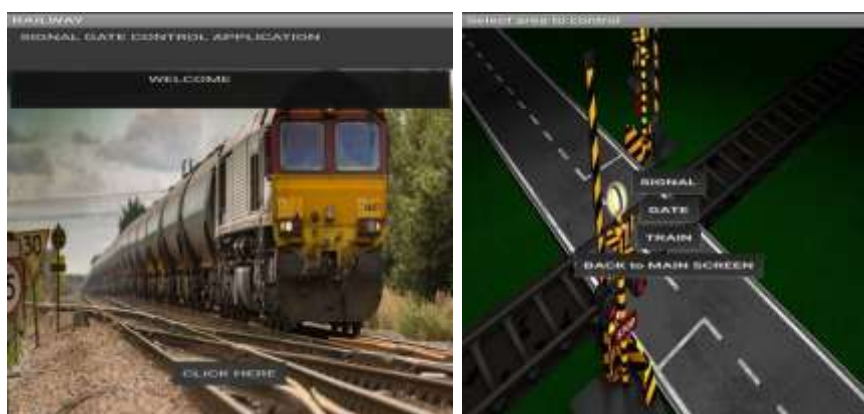


Figure: 4 Mobile app – first screen and selection of area to control

The above image shows the first screen of the image and when we press 'click here' button the next screen will appear in which we can select the area to control and operate on that area.



Figure: 5 Mobile application – selection of Bluetooth and signal



Figure: 6 Mobile application – manual and automatic gate operation screen

As shown above we can select the area of control according to the selected area, the screen for that area will open and we need to connect to the Bluetooth device of that area.

C) Data Flow

The dataflow diagram shows the communication between all the three modules involved in the project. The data flow is as shown below

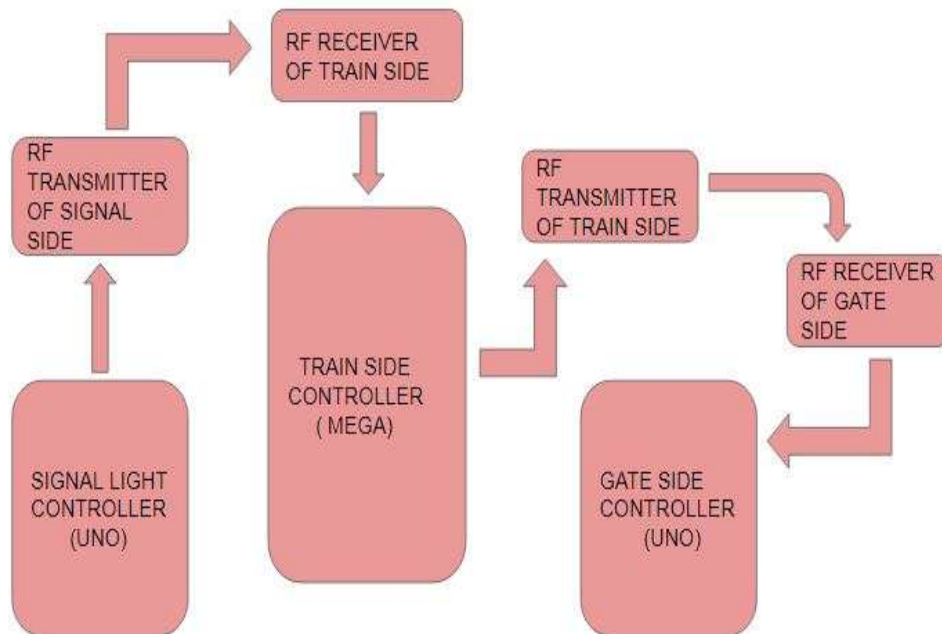


Figure: 7 DATA FLOW DIAGRAM

The data flow shows the RF communication that is happening between train and gate, signal and train. The train side communicates with both gate and signal that is it receives character or data from signal light and sends character or data to gate side.

III. BLOCK DIAGRAM AND HARDWARE DESCRIPTION

A) Block Diagram

The below block diagram explains about the system installed in train, signal light, and railway gate. The hardware components used are arduino Mega, arduino Uno, RF transmitter- receiver module, Bluetooth module, ultrasonic sensors, DC motor, servo motor, L293D motor driver.

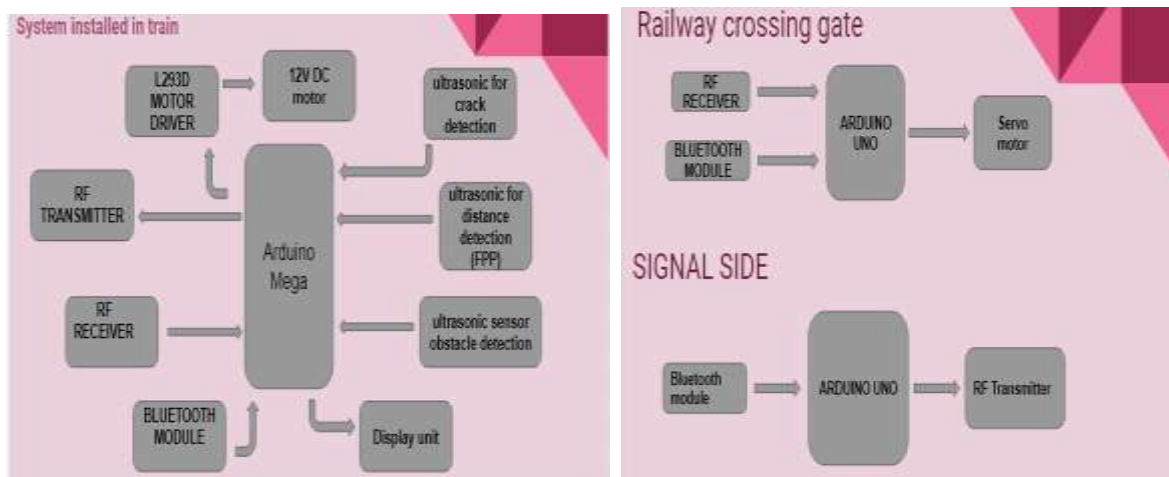


Figure: 8 Block Diagram

B) Hardware Description

Arduino Atmega328 (Uno)

The Arduino ATmega328 (Uno) is an 8-bit microcontroller that works on the AVR enhanced RISC architecture. It has less power requirement and the hardware is an open source and is used for developing individual projects based on embedded systems. The controller consists of 14 digital input/output pins in which there are six pulse width modulation (PWM) pins and there are six analog pins. The controller can be programmed by using an open source arduino IDE software. The input voltage ranges from 5V to 12V. Here the controller is used in the railway gate side and also in the signal side.



Figure: 9 Arduino uno

Arduino Mega 2560

This microcontroller is similar to atmega 328 but the number of pins are more than the arduino uno. It consists of 54 digital input/output pins of which 14 are PWM pin and also it has 16 analog pins. The input voltage ranges from 5V to 12V. It includes everything that essential for supporting the microcontroller. The mega controller is used in train side circuit which has more number of connections.

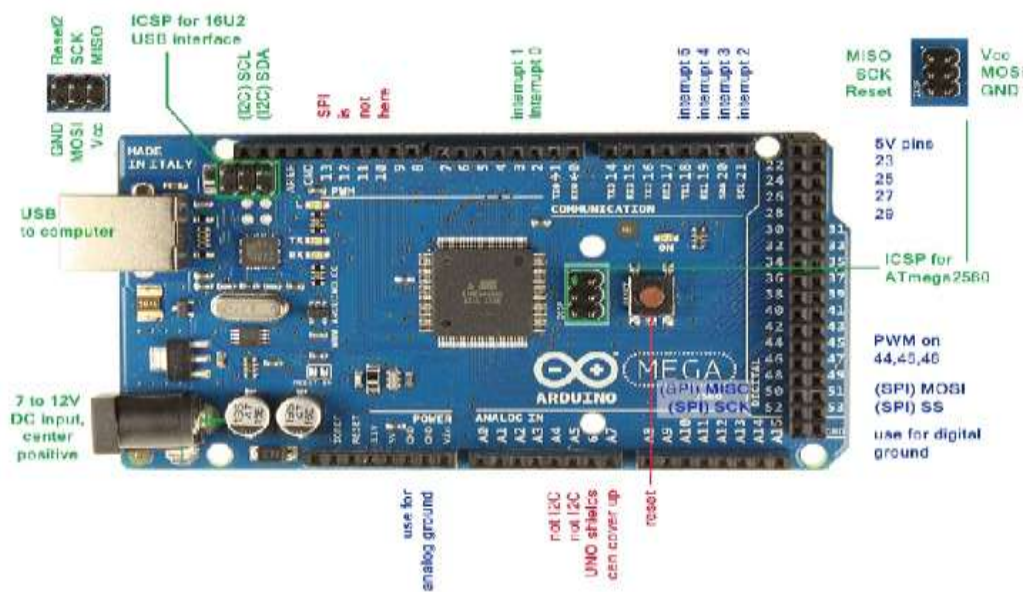


Figure: 10 Arduino Mega

Bluetooth Module

The Bluetooth module is used for establishing a wireless serial communication to communicate with other devices. The device operates in master or a slave configuration. The Bluetooth device acts as a connector between smart phone and the microcontroller. A mobile application is created and is connected to the controller via Bluetooth module for controlling different operations.

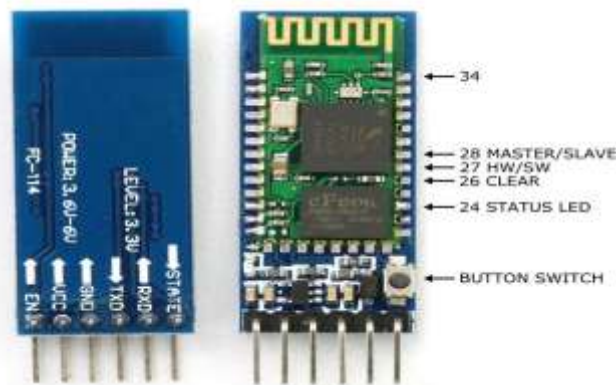


Figure: 11 Bluetooth Module

L293d Motor Driver

The Motor Driver is an integrated chip module that is used for speed control and direction control of DC motor. A single driver can be used for two motors simultaneously. According to the signal received from the controller, it sets the output voltage and thus controls the motor. The output voltage ranges from 5V to 36V.

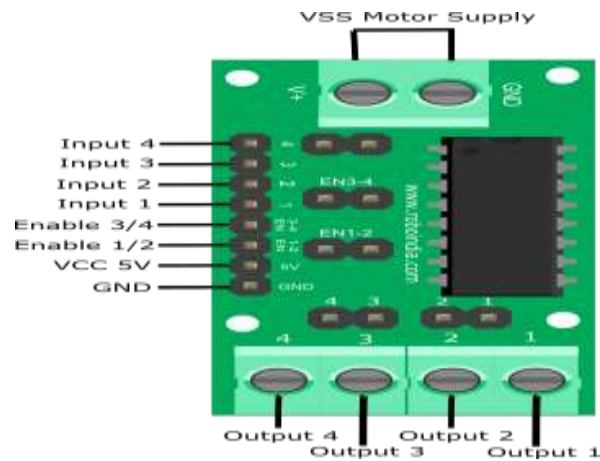


Figure: 12 Motor Driver

Ultrasonic Sensor

An ultrasonic sensor is an electronic device that is used to calculate distance of objects placed in front of it using ultrasonic sound waves. It consists of a transmitter that sends sound waves towards the object and the receiver collects the waves that is bounced from the object and thus calculates the distance. In this project , the sensor is used for crack detection, obstacle detection and for footboard passenger safety distance measurement.

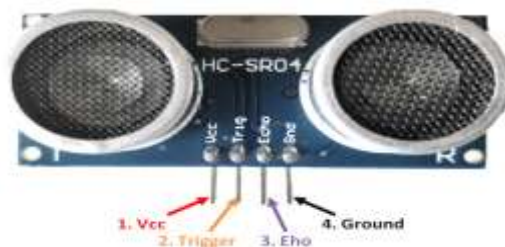


Figure: 13 Ultrasonic Sensor

Servo Motor

A servomotor is a one that works according to the pulse received from the microcontroller. The servo motor can operate very accurately and thus it is used for railway gate operation . According to the program described in the microcontroller, the servo rotates to the angle described by the controller



Figure: 14 Servo Motor

433mhz RF Transmitter Receiver Wireless Module

The Purpose of using RF module is to establish a wireless communication for the gate operation. This module contains both transmitter and receiver for sending and catching the signal. The transmitter is a simple and cheap module and operates with very low value of current (11mA). Here the data to be transmitted is directed given by the microcontroller.

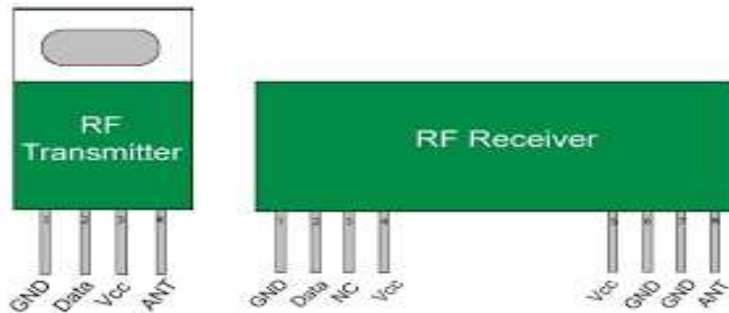


Figure: 15 RF Module

Liquid Crystal Display (Lcd)

The Liquid crystal display commonly known as LCD is used for displaying any kind of messages in the form of alphabets or numbers. In this project a 16 pin LCD is used and to which an I2C adapter is attached to reduce the number of pin connection to 4. The LCD is used for displaying messages in two lines of 16 characters each and the start of the message and the type off displaying the message can be changed in the program.

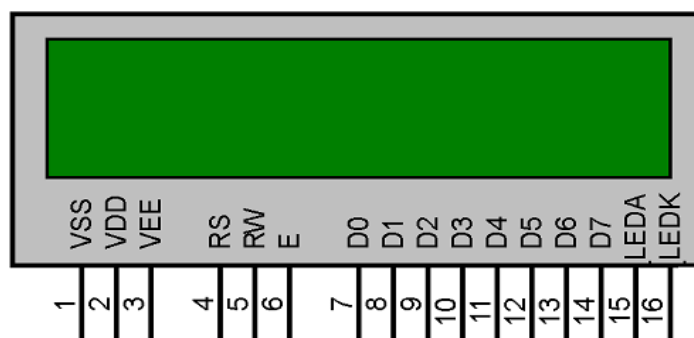


Figure: 16 Liquid Crystal Display

DC Motor

Here the DC is used to drive the train as it is easy to control the speed of the train. A 12 V dc motor is used here as driving system and is controlled by the main microcontroller. The DC motor is cheap and easy to operate on. The speed of a motor is controlled changing the input DC voltage or by changing the value of current within its field windings.



Figure: 17 DC Motor

IV. CONCLUSION

The implementation of automatic safety and protection system for railways helps in reducing and preventing major accidents. The footboard passenger safety gives an alert to the passengers when there is a chance of accident due to side walls and poles and reduces the speed of train for a certain time. The gate operation involves partial or no involvement of worker. Moreover the automatic signal and obstacle detection helps in foggy weather conditions. The crack detection reduces the time and man power. Thus by implementing these system helps railways in reducing the damage to people, property and also helps in maintaining quality of service.

V. REFERENCES

- [1] N.Ramasamy, "Automatic Obstacle detection in railway network using embedded system" 2014,vol. 13.
- [2] Ahmed Salih Mahdi, Al-Zuhairi,"Automatic Railway Gate and Crossing Control based Sensors & Microcontroller",International Journal of Computer Trends and Technology(IJCTT), Volume 4,Issue 7, July 2013.
- [3] Krishna, Shashi Yadav and Nidhi,"Automatic Railway Gate Control Using Microcontroller", Oriental Journal Of Computer Science & Technology, Vol.6, No.4, December 2013.
- [4] Assembly," IEEE Int. Conf. on Networking, Sensing and Control, vol. 6, iss.3, pg. 453-460 ,May2012.
- [5] Akhil N,Dinu Mohan,Fayis P,Sija Gopinath "Railway Crack Detection System",International Research Journal of Engineering and Technology(IRJET) Vol.3,Issue 5,pp: 277-279, May 2016.