Grenze International Journal of Engineering and Technology, June Issue

Design and Fabrication of Optimized Rail Gate Control and Obstacle Detection using Wireless Protocol

Leo Raju[1], Arthika N[2] and Lokapriya V[3]
[1-3]Sri Sivasubramaniya Nadar College of Engineering, College of Engineering, Chennai
Email: leor@ssn.edu.in, arthika2110848@ssn.edu.in, lokapriya2110811@ssn.edu.in

***Abstract*—It has been noted that lot of fatalities of lives occur every day due to manually operated rail gates. This is due to unmanned gates of crossing zones. This paper presents the design and implementation of automatic rail gate control and obstacle detection for developing countries. This project was carried out using parallel monitoring architecture along with IR sensor, PIR sensor, DC motor and LCD. This project is a combination of old technology with recent wireless technology and analytics to provide the best possible service to the nation.**

***Index Terms*—Automatic Rail Gate System, Real Time Monitoring, Automatic Train Stop and Rail Gate Automation.**

I. INTRODUCTION

Railways are the largest mode of connectivity and transport inside a country. Poor maintenance of level crossings and railway bridges by the authorities, among other issues, contributed to the rise in rail accidents. To reduce the accidents in the level crossings by using parallel monitoring architecture. This project is a combination of old technology with recent wireless technology and analytics to provide the best possible service to the Nation. Railways are the largest inland mode of connectivity and transport inside a country. Poor maintenance of level crossings and railway bridges by the authorities, among other issues, contributed to the rise in rail accidents. Negligence of officials lead to the increase of the death toll in the past 10 years. Poor management with a manual system that dates back to the British era made it quite vulnerable. Vision for a digitalized railway system is imminent. There were 129 railway-related accidents last year, in which 39 people were killed and 155 injured, and most of the accidents were caused by signal violations and derailments. (Daily Star, 28 June, 2020). At least 198 people were killed and 347 were injured in 162 railway-related accidents, while Shipping and Communication Reporters Forum (SCRF) stated that at least 421 people were killed and 366 injured in 393 railway-related accidents in 2019. (Source:Nirapad Sharak Chai, 2019). Demonstrates how reluctant people are maintaining safety rules and regulations while using a manually operated rail gate. Automation of Rail Gate Control is explained in [1]. Basic IOT operations using Raspberry Pi and Arduino are given in [2]. A Secure Railway Crossing System using IOT is given in [3]. Here the basic IoT operations are explained in detail for Train applications in various forms. Unmanned Automated Railway Level Crossing is explained in [5]. Here the basic functions of train crossing using an auto functioning gate using Zigbee is explained in detail. Automation in Unmanned Rail Crossing‖ is given in [6]. Here they have used IOT for auto crossing. Feasibility and application of Internet of things in smart railways are analyzed in detail in [7]. Automated Train Control and Supervision System is well explained in [8].

Grenze ID: 01.GIJET.11.2.501_2

Here, a detailed information of automated train control is explained. Methodology for Railway Automation Study and Automatic Generation of PLC Program is explained in [9]. In this study all the theoretical details are well explained.
Automatic Train Control System Development and Simulation for High-Speed Railway is explained in [10]. Diagnostics and monitoring of railway automation and remote-control power supply devices are explained in [11]. Unmanned Automated Railway Level Crossing System Using Zigbee is explained in [12]. The Case of Turkish National Railway Signalization Project on Application of Automation Theory to Railway Signalization Systems is explained in [13]. Here the practical implementation details are clearly explained. Automation in Unmanned Railway Level Crossing is further explained in [14]. Unmanned Level Crossing Controller and Rail Track Broken Detection System Using IR Sensors and Internet of Things Technology are discussed in [15]. Automatic Railway Gate Control System is explained in [16]. In all the above references the papers the automatic railway gate control is not comprehensively explained. Also, the real time implementation is not considered in order to go for production of such a system for a wider application. Hence our paper discusses in detail about this in order to go for implementing it across the country in a massive scale using advanced technologies like IOT.

II. PROPOSED SYSTEM

In this system, it has architecture similar to most modern train control systems, with the addition of parallel monitoring hardware. The new system is designed to meet requirements such as data acquisition, data transmission, data processing and alarm control. Here we use two sections. We are using PIR sensor and ultrasonic sensor to monitor human crossing and obstacle detection in the train section. The gate section has an IR sensor and gate motor to detect if any person crosses the gate. Our system is designed in such a way that minimal human contact is required, avoiding all kinds of human error. High Efficiency makes it extremely reliable, gaining the trust and reliability of such service users in our country. The Next Generation of Train Control System has an architecture similar to most modern train control systems, but with the addition of parallel monitoring hardware. However, the majority of the new key functionality is achieved through modifications to existing software. Based on the framework of current control systems, the new system is designed to meet requirements such as data acquisition, data transmission, data processing, and alarm control. Here, we used two sections namely the train and gate section. In the train section, the microcontroller is connected with PIR sensor, Vibration sensor and Ultrasonic sensor to monitor the humans crossing, crack in track and obstacle detection. This information is monitored by the control unit and it also has the automation facility to control fans and light. The gate section has an IR sensor and gate motor connected with a microcontroller, if any person crosses the gate the buzzer will turn on. The information of arrival time is transmitted and received using MIWI.

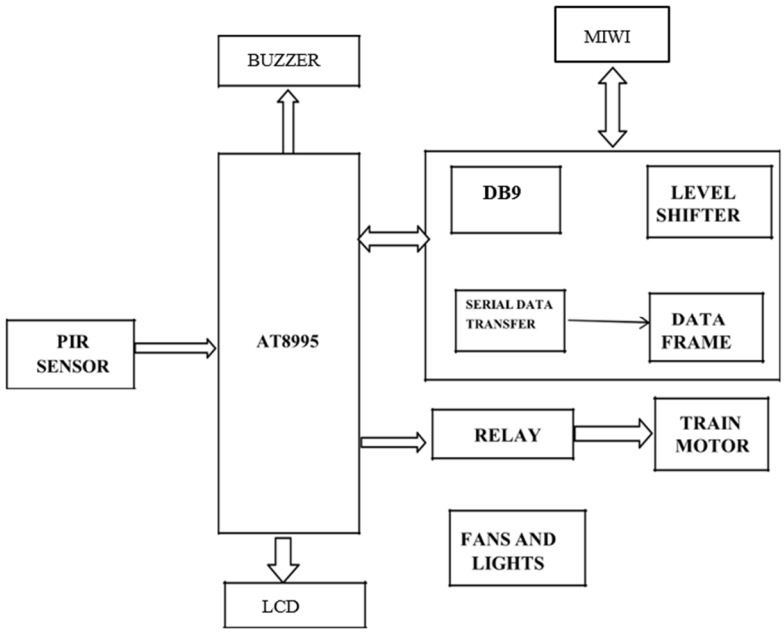

Fig.1 Block Diagram for Train Section

III. Design Process

This process includes two sections namely the Train section and the Gate Section

A. Train Section

The train section is shown in Fig 1. In the train section, we use a PIR sensor to monitor whether any human crosses the track within a specified range. The microcontroller is connected with a PIR sensor. The information is monitored by the control unit and it also has the automation facility for fans and lights. It receives signals from the gate section and runs by the command of the gate section to open or close the gate based on the PIR Sensor inputs.

B. Gate Section

The Gate section is shown in Fig. 2. The gate section has an IR sensor and gate motor connected with a microcontroller. If any person crosses the gate, the buzzer will be turned on. The information of arrival time is transmitted and received using MIWI.

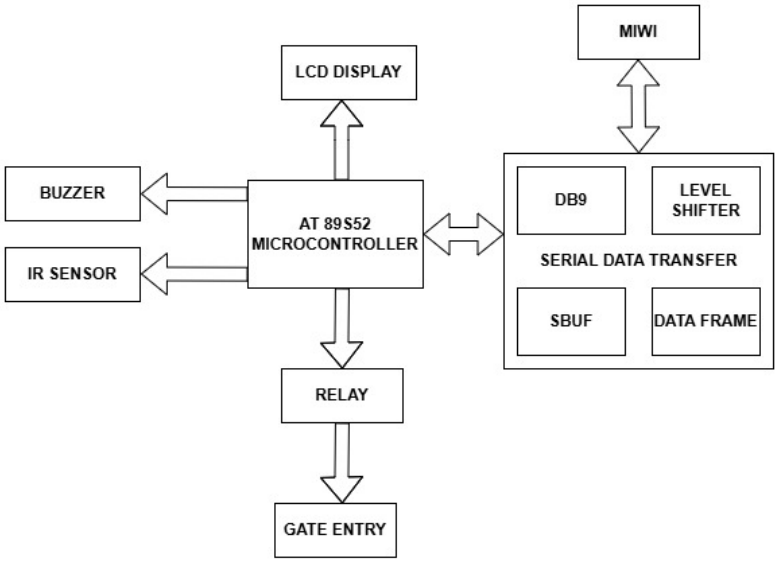

Fig 2. Block Diagram for Gate Section

The below figure 3 shows the prototype model of train section in which the working of train in process.

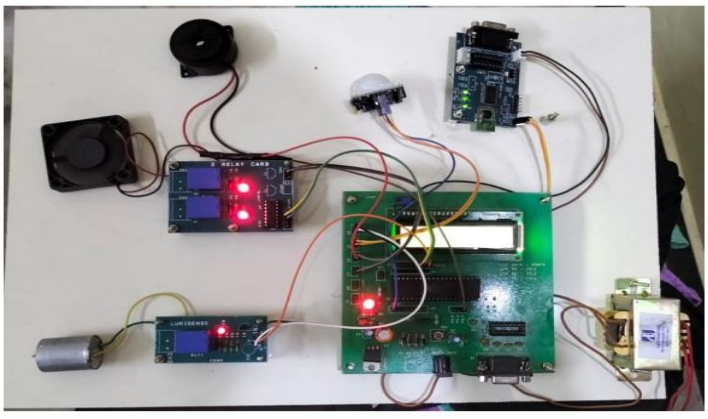

Fig.3 Prototype Model of Train Section

The prototype contains microcontroller, PIR sensor, step down transformer, buzzer and relay circuits for lights and fans. The below figure 4 shows the prototype model of gate section. It contains a microcontroller, IR sensor, buzzer and the gate motor. The train section will be at the train and the Gate section will be outside to sense humans throw PIR sensor and actuate using a actuator.

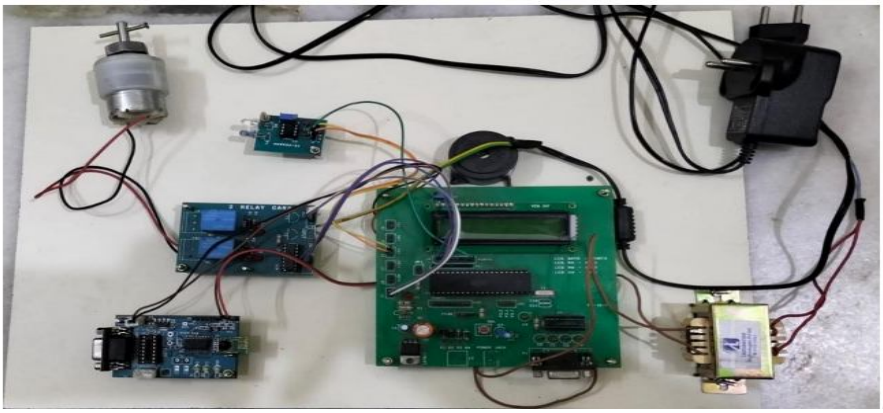

Fig.4 Prototype Model of Gate Section

Thus, the train section and Gate section will coordinate to effectively sense the human trying to cross the gate and take auto closing of the gate using Arduino based IOT control.

IV. CONCLUSION

An automatic rail gate control system and the real time monitoring is done using parallel monitoring architecture. Microcontroller is used to sense the human movement using PIR sensor and the motor of the gate is actuated based on the conditions. This project will save many human lives in the rail crossing gates across cities and towns. This will help to reduce such accidents across the gates and will alert the humans by the alarm. Also, in future several PIR sensors will be used from different part of the gate for accurate sensing. The gate is monitored from a remote place using a camera through the cloud to provide further the layers of protection to save human lives.

REFERENCES

[1] Kuraish Bin Quader Chowdry, Md.Abdur Razzak, and Moshiur Rahman Khan, “Automation of Rail Gate Control with Obstacle Detection and Real Time Tracking in the Development of Bangladesh Railway”, 2020

[2] Jeff Cicolani, “Beginning Robotics with Raspberry Pi and Arduino”, 2018

[3] E. Amarnatha Reddy and K.Srinivas Rao,“A Secure Railway Crossing System using IOT”, 2017

[4] M. Siva Ramkumar, “Unmanned Automated Railway Level Crossing System using Zigbee”, 2017

[5] Alexandra Simic and Milena Milosevic, “Driver Monitoring Algorithm for Advanced Driver Assistance System”, 2016

[6] B. Brailson Mansingh and S.R.Vignesh Kumar, “Automation in Unmanned Rail Crossing”, 2015

[7] Ohyun Jo, Yong-Kyu Kim, and Juyeop Kim, “Internet of Things for Smart Railway: Feasibility and Applications”, IEEE Internet of Things Journal PP(99):1-1, September 2017

[8] Ashfak Niyasdeen, “Automated Train Control and Supervision System”, April 2017

[9] Raphael Coupat, Alexandre Philippot, Mohamed Niang, Christian Courtois, David Annebicque, Bernard Riera, “Methodology for Railway Automation Study and Automatic Generation of PLC Programs”, IEEE Intelligent Transportation Systems Magazine, June 2018

[10] Hairong Dong, Bin Ning, Baigen Cai, Zhong-Sheng Hou, “Automatic Train Control System Development and Simulation for High-Speed Railways”, IEEE Circuits and Systems Magazine, February 2010

[11] Alexey Poroshin, Alexander Nikitin, Vitaly Shatokhin and Alexey Kotenko, "Diagnostics and monitoring of railway automation and remote control power supply devices", 2017 IEEE East-West Design & Test Symposium (EWDTS), September 2017

[12] M. Siva Ramkumar, "Unmanned Automated Railway Level Crossing System Using Zigbee", Article, January 2017

[13] Mehmet Turan Söylemez, Mustafa Seçkin Durmuş, Uğur Yıldırım, Serhat Türk and Arcan Sonat, "Application of Automation Theory to Railway Signalization Systems: The Case of Turkish National Railway Signalization Project", 18th IFAC World Congress, August 2011

[14] B.Brailson Mansingh, K.S.SelvaKumar, S.R.Vignesh Kumar, “Automation in Unmanned Railway Level Crossing”, IEEE, 9th ISCO, 2015

[15] Bharti.S.Dhande, Utkarsha.S.Pacharaney, “Unmanned Level Crossing Controller and Rail Track Broken Detection System Using IR Sensors and Internet of Things Technology”, IEEE, 2017

[16] Acy M. Kottalil, Abhijith S, Ajmal M, Abhilash L J, AjithBabu, “Automatic Railway Gate Control System’’, IJAREEIE, Vol.3, February 2014.