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Automatic Railway Gate Control System

Monika N[1], Harshitha D[2], Kavya N R[2], Mounika B[2]

[1]AssistantProfessor, Department of Information Science and Engineering, Nagarjuna College of Engineering and Technology, Bangalore, India.

[2]B.E. Student, Department of Information Science and Engineering, Nagarjuna College of Engineering and Technology, Bangalore, India

Corresponding Author: reddyharshitha199@gmail.com

Abstract: - Automatic railway gate controlling system provides an automatic railway gate at the level crossing replacing the gates operated by the gate keeper by detecting train and stuck on the level crossing, generating corresponding alert signal and controlling the gate. The solution is provided by developing a train detection module, stuck detection module, signal light module, alarm module, railway gate controller and a controller module. There are only four ultrasonic sensors in the train detection module and one ultrasonic sensor in stuck detection module. Both, train detection and stuck detection module generate high frequency signal through the ultrasonic sensors and detect the presence of object if the echo is received back by the sensors. Then the controller unit determines whether the obstacle is train or stuck and takes necessary steps by controlling the gate, alarm generator and signal lights. Experimental studies show that the proposed methodology provides a more cost effective, reliable and simpler railway gate controller than existing dominant work.

Key Words:— ***Train Detection, Stuck Detection Alarm, generator, Level Crossing, Ultrasonic Sensor.***

I. INTRODUCTION

Railways being one of the safest and cheapest modes of transportation are preferred over all the other means of transport. So, it is essential to maintain and improve the current level of safety. A safe railway is more efficient and also a more attractive transport choice, enabling society to address the environmental and economic challenges of the 21st century. Railway safety is a crucial aspect of rail operation over the world. When we go through newspapers, we come across many railway accidents occurring at different railway level crossings and many people are dying. The place where rail track and highway/road intersects each other at the same level is known as “level crossing”. Bangladesh Railway said at least 201 people were killed and 349 others injured in 264 accidents at different level crossings in last seven years till 2013. This is mainly due to the carelessness in manual operations or lack of workers at level crossing. There is an inherent unreliability in the present manual system.

Automatic railway gate control system 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 sensors placed at a certain distance from the gate detect the approaching train and accordingly controls the operation of the gate. To avoid the accidents, sensors placed at some distance from the gate detect the departure of the train. The signal about the departure is sent to the microcontroller, which in turn operates the motor and opens the gate. Thus, the time for which the gate is closed is less compared to the manually operated gates since the gate is closed depending upon the telephone call from the previous station. Also reliability is high, as it is not subjected to manual errors. For the railway, research on automatic gate controller systems has traditionally focused on two main areas: information transmission and gate controlling. Problems related to information transmission concern train detection and fast transmission of this information to the control unit. Problems those are related to the gate controlling very sophisticated and challenging. They comprise presence of train, immediate closing and opening of gates. The existing solutions have many complexities and require research for supporting railway.

This paper proposes the design and implementation issues of an automated railway gate controlling system. The system detects the train and stuck by analyzing the reflected waves, produces alarm, controls light signal and gate. When the whole train passes the level crossing then the gate is opened, alarm generator stopped and indicator light switched on green signal. If there is a stuck on the level crossing the stuck signal is switched on The lesser equipment, reduced cost, simpler design and high efficiency of the proposed system prove the effectiveness over existing work.

The organization of this paper is as follows: Section 2 describes the related work of the proposed system. Section

3explains the construction and operation of the proposed system. The experimental analysis and comparison of specification and accuracy are shown in Section 4. Finally, concluding remarks are drawn in Section 5.

II. PROJECT DEVELOPMENT

Recently, many automatic railway gate controllers with advanced technology are introduced to make the level crossing risk free. Al-Zuhairi et.al concentrated on unmanned level crossing which caused frequent accident [2]. For this, they proposed a Microcontroller based Railway Gate and Crossing Control system. In their system they used IR sensor and Microcontroller. In their system IR sensor sense, the presence of train and send the signal to Microcontroller. Based on the signal Microcontroller controls the gate of the crossing. The main limitation of this system is low accuracy. The performance of IR sensor is not adequate at open place and light. SubrataBiswas et.al proposed pressure sensor based swift response anti-collision system for an automatic railway gate control system [3]. The pressure switches which have been integrated in this system detect the condition whether any vehicle gets stuck at the level crossing or not. IR sensors have been used to detect the arrival and departure of the train. The system is little bit complex and due to use of IR sensors performance is not satisfactory. Sandya Goutam et.al concentrated on predicting the major cause of railway accidents that is collision on the same track [4]. For this purpose, a technology used to identify train positions, collision detection as well as the points at where collisions may occur has been used. The primary goal of this paper is anti-collision system to identify such collision points and to report the error cases to main control room, nearby station as well as grid control stations. To build this system, advanced sensing technology, long distance communication system (RS 485protocol), microcontroller (8051) and wireless Communication protocol has been used. But this system is not concerned with the collision between the train and vehicles on the road. J. Banuchandaret.al proposed and an automated unmanned railway level crossing system [5]. In this system when the train arrives in a particular direction the transmitter IR senses and generates appropriate signal, then at the same time the receiver IR receives the signal and generates an interrupt. The main problem of this model is low accuracy because the interrupt signal can be generated even if a small object crosses the IR Sensor. Krishna et.al proposed a model to control the railway tracks by using anti-collision techniques [6]. The model of railway track controller is designed by using 8952 microcontroller to avoid railway accidents. When we go through the daily newspapers we come across many railway accidents occurring at unmanned railway crossings. This model is implemented using sensor technique. They placed the sensors at a certain distance from the gate detects the approaching train and accordingly controls the operation of the gate. Also an indicator light has been provided to alert the motorists about the approaching train. In their system they have used anti-collision device which uses GPS for preventing collision between two train and IR sensor for gate controlling at level crossing. Sheikh Shanawaz Mostafa et.al proposed "A Radio Based Intelligent Railway Grade Crossing System to Avoid Collision" [7]. Their system offers an intelligent railway crossing control system for multiple tracks that features a controller which receives messages from incoming and outgoing trains by sensors. These messages contain detail information including the direction and identity of a train. Depending on those messages the controller device decides whenever the railroad crossing gate will close or open. This system is also complex and costly. Upon realizing the importance of automatic railway gate controller in India Army M. Kottalil el.al proposed Automatic Railway Gate Control System gate [8]. The objective of their system is to provide an automatic railway gate at a level crossing replacing the gates operated by the gatekeeper. The system reduces the time for which the gate remains closed. The system works on a microcontroller based control. Their proposed system uses ATmega 16A microcontroller. With the help of IR sensors, the arrival and leaving of the system is monitored and the gate is operated accordingly. AntiCollision and Secured Level Crossing System was proposed by K. Vidyasagar et.al [9]. Their proposed model presents an automatic rail gate control system at level crossing positions and accident prevention mechanism. Two vibration sensors are used to control the open and close state of the gate at level crossing position. An ultrasonic sensor is positioned to detect an unauthorized object on the track. Open and Close status of the gate and unauthorized object on the track will be communicated with the central control room using wireless communication protocol. This system is complex, costly and requires a lot of equipment's to implement. The complex design, low performance and cost has raised a question on the effectiveness of the approaches.

III. RELATED WORK

The proposed system uses ultrasonic sensors which have very high efficiency. These ultrasonic sensors are placed near the rail line at the both side of the level crossing. These sensors which are placed at certain distance from the level crossing detect the train coming from either direction to the level crossing. Then the information of the train is transferred

to the control unit and the control unit switches on the red light, generates alarm and pull down the gate immediately.

The sensors of the either side determines whether the train passes a certain distance or not from the level crossing. If passes the controller switches on the green light, stops generation of alarm and pull the gate up. If any vehicle gets stuck at the level crossing of the rail-line is detected by the sensor placed at the level crossing. Our proposed system is very simple and inexpensive with respect to other system but its performance is very laudable and excellent.

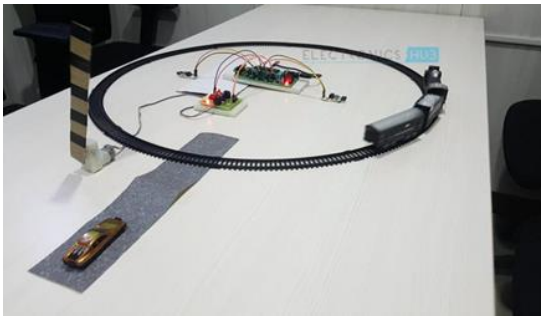

Fig.1. Design of Automatic Railway Gate Controller

The ultrasonic sensors which are placed at both sides of the level crossing detect the train and another ultrasonic sensor which is placed at the level crossing detects the stuck of vehicle at level crossing. Once the ultrasonic sensors are triggered, the sensors will generate and transmit ultrasound in the forward direction. This ultrasound will be reflected back to the sensor if any object is present within 3-meter range. The ultrasonic sensors are triggered at a regular time interval. If the both ultrasonic sensors of the any side of level crossing receive the reflected sound, then the controller unit decides that a train is coming. If the ultrasonic sensor place at the middle of the level crossing receives the reflected sound continuously for a certain period, then stuck is detected. If the train is detected, the controller measures the direction of the train, switches on the red lights, and generates alarm through alarm generator and pull down the gate immediately. This situation remains unchanged until the train passes the both sensors of the other either side. After that the controller pulls up the gate, stops sound generation and switches on the green light immediately. When the stuck is detected, the controller switches on the stuck signal light of the both side of line crossing so that the train operator can take necessary steps to avoid devastating accident.

IV. CONCLUSION

To save the human life and vehicles from miserable train accidents is a challenge of the era of modern science and technology. The working model was fabricated within the laboratory premises. The results exhibit that it is one of the expedient approach for secure railway system. The ultrasonic sensors detect the train and stuck on the level crossing very quickly and communicate with the control unit. The control unit takes proper steps which lead the train and vehicles movements either to move forward or to stop to avoid collision. Consequently, this is able to play a great contribution to the railway gate automation with reliability and lower cost. In future this developed working model will be equipped with GPS to navigate the position of the train and the track to avoid collision between two trains.

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