

# A Study of Technologies for Supervising Unmanned Level Crossings

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**Abstract**--Unmanned railway crossing in railway stations means crossing the railway tracks without any signal or indication to the people whether the train is arriving at a particular location or not. Due to this a great number of accidents and mishaps happen. Reports show that more than five hundred people meet with accidents at different railway stations around the country due to the improper handling and no proper control at the railway stations. The different technological developments in the modern era can be used towards the prevention and control of the unmanned railway systems. Technologies like the Internet of Things, sensor-based networks, and microcontrollers are used in designing new software and systems to save human lives. This paper provides a glimpse of various technologies and methods which can be implemented to increase the safety of people crossing the railway gates by automating the level crossings.

**Keywords**-- Unmanned level crossing, accidents, Internet of things, sensors

## I. INTRODUCTION

The interconnection where track and highway/road joins each other at the same place is known as a level crossing. There are mainly two categories of level

crossings. They include manned level crossing system and unmanned level crossing system. The manned level crossing is further categorized into spl.class, A class, B Class and C Class. On the other hand unmanned level crossing is classified into, C class, D class. Railways, being the cheapest mode of transportation is widely preferred over all the other vehicles and is the fastest growing network in the country. Railway accidents are the most common thing which is seen in papers today. This is mainly due to the lack of laborers working for the cause or due to the irresponsible handling of the situation. Simple electronic components can be used to automate the control of railway gates around the country. When a train reaches the railway crossing the sensors or devices placed at a certain distance from the gate can detect the train and accordingly can control the operation of the gate.

## II. LITERATURE SURVEY

a) Smart Unmanned Level Crossing System in Indian Railways

The paper [1] proposes to use piezoelectric technology to solve the issues present in unmanned level crossing. It

proposes a system which places piezoelectric plates near the level crossing. It senses the electrical signals generated by piezoelectric plates when mechanical pressure is applied on the tracks. The pressure is applied on the tracks when the train is running over the piezoelectric plates placed near the level crossing. The electrical signals are given to hooters and speedometer. A LED is synced with speedometer which tells the time of arrival of the train at the level crossing.

b) Automated Unmanned Railway Level Crossing System.

The paper [2] proposes an unmanned level crossing system based on a 40 pin DIP microcontroller manufactured by CMOS technology. The IR sensors are placed on either side of the track at a level crossing. As the train approaches the level crossing the IR sensors will detect it and close the gate. Two IR sensor pairs are used for transmitting and receiving signals. The IR transmitter will have a resistor and IR LED and IR receiver will have resistor and IR LED. The IR transmitter operates at 100ohms voltage. The IR receiver operates at 470ohms voltage.

c) Unmanned Railway Crossing Gate Control Based On PLC.

The paper [3] proposes an unmanned level crossing system based on proximity sensors and PLC. PLC stands for Programmable Logic Control which is an electronic apparatus utilizing a memory which is programmable for implementing specific operations which can be controlled by analog or digital modules and various other types of industrial processes. The operations implemented in the PLC can be anything like arithmetic operations, timing, logics or sequencing operations. The PLC here contains a DC motor, proximity sensor and a relay. When the sensor detects a train, it sends a signal to PLC and based on ladder logic, it produces an output signal which will start closing the gate.

d) Design & Safety of Automatic Railway Gate Control Using Wireless Sensor Network.

The paper [4] proposes an unmanned level crossing system based on RF sensors. The system contains a RF transmitter

and receiver pair, microcontroller and pressure sensors. The RFID transmitter receiver pair will control the opening and closing of the gate. Whenever there is a train approaching the level crossing. The tracks near the level crossing are equipped with pressure sensors. The pressure sensors will sense the approaching train and will transmit the signal to the Arduino. The RF sensors will sense if there is any object present in between the transmitter and receiver, if any object is present then the information will be sent to microcontroller. If the presence of train is detected by RF sensors, the information will be sent to control room and the gates at the level crossing will be closed.

e) Sensor Based Alert System at Unmanned Level Crossing

The paper [5] proposes an unmanned level crossing system based on Microphone sensor. The system makes use of solar energy for uninterrupted supply of energy to the sensors. The sensors are fixed on either directions of the level crossing and the Microphone sensors are fixed at a particular distance from the

level crossing. The Microphone sensors are configured such that the vibrations from the train within 1km radius are sensed and people who are crossing the track are alerted by using a siren fixed along with the level crossing before the gate is closed.

f) Improvement of availability of Level Crossing system by autonomous decentralized technology

This paper [6] concentrates on the fact of reducing the time taken for the controllers that are used in a level crossing system. The time taken by trains varies from a train and thus to devise a way that would enable the controllers to work efficiently and save a lot of valuable time the following approach is used. The following approach also takes into consideration the system failures caused by external sources and warns the passersby by enabling an alarm thus saving a lot of precious life. It is an efficient way to monitor the level crossing system controllers.

g) Ultra-Wide Bandwidth Systems for the Surveillance of Railway Crossing Areas

This particular paper [7] focuses on the possibilities in which a vehicle or any hindrance that might show up on the railway tracks sometime and which might cause fatal consequences to human lives and thus to prevent this type of mishaps from occurring, a system is devised so as to sound an alarm and notify concerned parties to act upon. The slow communication makes it difficult for the control center and the train drivers to act on time. It uses backhauling technology as well as optical fibers laid across the tracks for faster communication. The slow communication makes it difficult for the control center and the train drivers to act on time.

h) Radar Sensors for Hump Yard and Rail Crossing Applications

The following paper [8] focuses on preventing mishaps caused due to track congestions. Trains occupy the tracks for a certain period of time and sometimes the other trains get on the same track to any untimely notification of these cases can lead to fatal consequences. It is difficult for other sensors to operate under climatic conditions such as monsoons and snowfalls. Thus radar sensors on the Hump Yards are an efficient way to detect these congestions and notify the control centers at time and thus it can prevent a lot of railway accidents.

i) Unmanned Level Crossing Controller and Rail Track Broken Detection System Using IR Sensors and Internet of Things Technology

This paper [9] focuses on the ways to prevent the mishaps caused due to cracks on the railway tracks. Sometimes the heavy load and excess effect of the climate might lead to cracks on the tracks and if the cracks are noticed on time it may lead to accidents. The IR Sensors are used to check the levels of the tracks and any disturbance in the level is reported and is checked for the crack. The following system is also monitored using IoT that keeps track of the damaged regions.

j) Unmanned Automated Railway Level Crossing System Using Zigbee

The following paper [10] is based on the distance from which a train is detected from a level crossing. The time required to pass the crossing is taken into consideration by taking the speed and length of the train too. The following detailed transmission of the train movement along the tracks is monitored and reported by sensors which trigger the action of closing and opening the gate. A good amount of time is conserved using this technology.

TABLE I. Advantages and Disadvantages

Sl. No	Paper	Advantages	Disadvantages
1	Smart Unmanned Level Crossing System In Indian Railways	Totally automatic and works regardless of human error	Not robust when scaled to many level crossings.
2	Automated Unmanned Railway Level Crossing System	Less hardware requirement and easy to implement.	The IR sensors can be affected by various other physical objects.
3	Unmanned Railway Crossing Gate Control Based On PLC	Accurate service by the system	System is subject to power fluctuations.
4	Design & Safety of Automatic Railway Gate Control Using Wireless Sensor Network	The system is scalable. The position of the train can also be monitored accurately	The implementation of the system will be costly when scaled to many level crossings and trains.
5	Sensor Based Alert System at Unmanned Level Crossing	The system can be implemented in low cost.	The Microphone sensors may also sense other kind of vibrations which could be perceived as an approaching

			train.
6	Improvement of availability of Level Crossing system by autonomous decentralized technology	Saves a lot of time by having an efficient controller setup.	The failures caused by external sources cannot be prevented to some extent.
7	Ultra-Wide Bandwidth Systems for the Surveillance of Railway Crossing Areas	The optical fibers used provides an improved communication time.	The objects that might be present on the tracks should be greater than one cubic meter to be detected.
8	Radar Sensors for Hump Yard And Rail Crossing Applications	Works perfectly under rough climatic conditions.	The area of coverage of the sensors is very limited.
9	Unmanned Level Crossing Controller and Rail Track Broken Detection System Using IR Sensors and Internet of Things Technology	The manual works is reduced by the use of IR sensors.	Constant uplink is required for smooth functioning of the IoT device.
10	Unmanned Automated Railway Level	The time taken for gates to operate is reduced.	Constant connection is required to make the device work.

	Crossing System Using Zigbee		
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### III. CONCLUSION

The unmanned level crossing can be made safe by various methodologies. These techniques can be implemented in an effective and controlled manner thereby reducing the number of accidents and deaths. Infra-red sensors are one of the most preferred options to be implemented. Infra-red sensors are highly valuable and effective, but it is prone to detect any kind of objects or animals that cross its path. Piezoelectric technology is another most opted

technology that is being used. The major disadvantage of this method is that it is not robust

and can also be erroneous. Another efficient technology is found to be the usage of the RFID sensors. The radio frequency identifier uses a tag and a reader which detects the train arrival and departure. This technology is found to be less prone to errors and also it is a very cheap. Optical fiber usage is also found to enhance the communication between the systems. The decentralized system is found to have a very powerful controller setup which is found to save a lot of time. The techniques which can be implemented are cost-efficient and mostly require less machinery and also can reduce human labor. With proper maintenance, usage and surveillance people can be protected from mishaps.

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