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A Review on Accident Prevention Methods at Railway Line Crossings

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Abstract - *Various systems have been developed for tracking trains at unmanned railway crossings as well as for detection of objects along with automated opening and closing of gates. The Systems which have been proposed till now; may efficiently close and opens the gates at the arrival and departure of trains to avoid any accident at the crossing. But, there are so many accidents occurred while crossing the railway tracks, due to the sudden arrival of train. One of the major reasons of accidents at railway track is people indulging with their head phones. After the survey of various papers, there is no any system which has been proposed to avoid these incidents. The objective of this paper is to review all existing systems based on real time accident prevention using various techniques. To overcome the existing problems, a system is required to sense the 'train' either by recognizing its horn at real time even in a noisy environment and able to stop all audio players if a person is listening music or in a voice or video call or in non active position, it is able to generate an alarm for accident prevention especially at railway crossings. System can work even in noisy environment.*

Key Words: Railway Crossing, Unmanned, Speech Recognitions, Hidden Markov Model, Accident Prevention, Sensors.

1. INTRODUCTION

India has the biggest rail network and becomes major mode of public transportation. According to the survey of public relation office of Indian railways, there are more than 30,300 railway crossings in India. More than 11000 railway crossings are unmanned where there is no man to manage barriers while arrival and departure of trains. Many techniques have been developed to enhance the security system of railway crossings. Many of the systems use ultrasonic sensors and infrared sensors to detect the arrival of train and access it at control room that can manage railway barriers. Some systems used GPS and GSM for tracking train to avoid accidents at railway crossings. Image processing has also been used to develop a system for secured railway crossings. Overall, a reliable system is required to operate in robust condition and able to prevent accident at the railway tracks. Review of various systems which has been proposed is discussed in the section of literature survey.

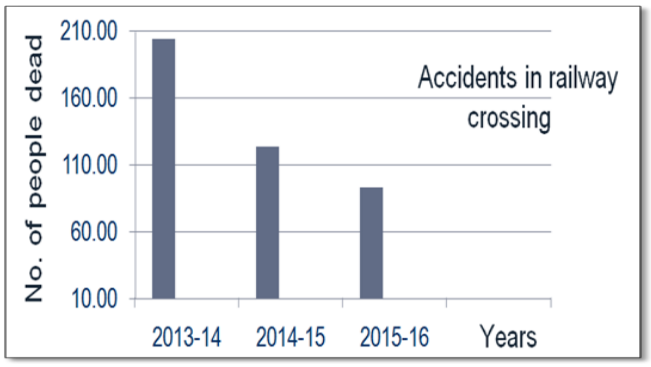

Figure 1.1: Data on Railway Crossing Incidents

Figure 1.2: Railway Crossing without Gates

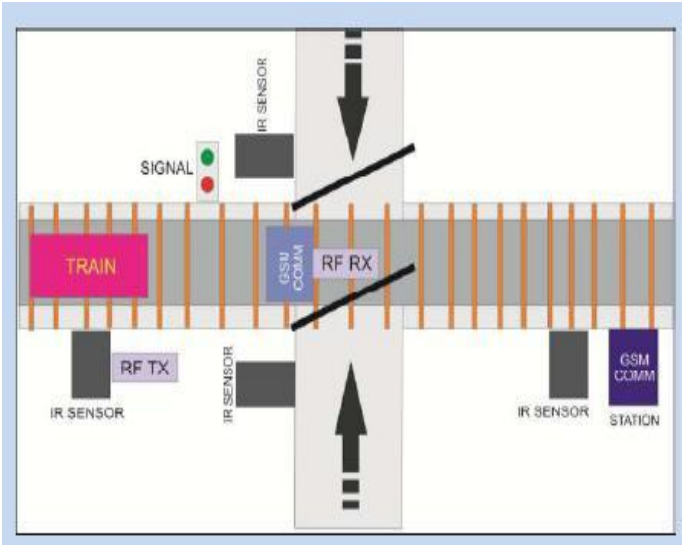

Figure 1.3: Automated Railway Crossing System [10]

2. LITERATURE SURVEY

Nisha S.Punekar et al. proposed a system for the safety of railways by detecting obstacles and tracking trains. GSM and GPS technologies have been exploited to develop a tracking system of trains. For this, sensor is mounted on the train to sample the acquired signals from GPS satellite systems. Extracted information is processed in data processing workstation where position and sensor's velocity has computed to find the location of train. Infra red i.e. IR sensor has been deployed to detect any obstacle and alarmed the system before any casualty. The system which has been proposed has many flaws for its practical usage. As for large area coverage, the system needs repeaters to get installed which increases the complexity of system. Bandwidth provided by the GSM is shareable which may interrupt the resultant data. GPS signals may get fluctuated in dense areas which leads failure of the system or may provide inaccurate information. Furthermore, use of infrared sensors for obstacle detection is not a reliable option for the system as it has the capability to control one device at a time and uses for short range. Transmission rate of data, provided by IR sensors is very low. So the proposed system is not an effective and reliable option to get implemented.

Figure 2.1: Control system using Microcontroller [1]

Figure 2.2: Connection of GPS receiver to Server [1]

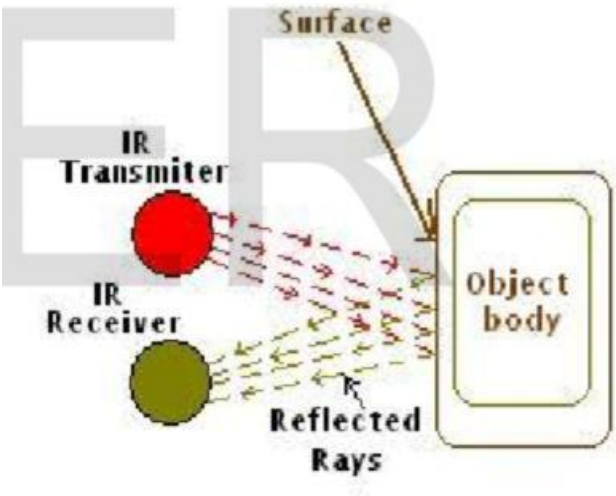

Figure 2.3: IR Sensor Detection [1]

Sina Aminmansour et al. proposed an application to robotically spot near miss events by using forward facing videos from trains. Method which has been approached examines the visual data to recognize near miss events at railway crossings. Location of a train and distance of the spotted vehicle from the railway lines has also been calculated in the system. The accuracy of system is based on the quality of image processing which may get reduced in rainy environment. Method proposed in this paper relies on the detection of vehicle but prevention technique is not introduced in the system which has been developed as it needs to get implemented due to security reasons.

Figure 2.4: Subplot shows a cabin view where a detected vehicle is marked with a red circle [2]

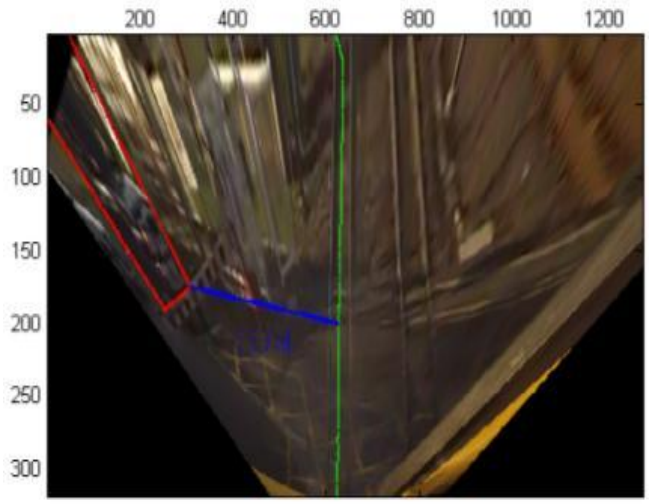

Figure 2.5: Subplot shows the bird's eye view of detected vehicle, marked in red box [2]

K. Vidyasagar et al. proposed an automated system to control barriers at railway crossings and also presented a technique to prevent accidents. Approached method exploited piezoelectric transducer as a vibrator sensor to operate the barriers. Use of Ultrasonic sensor ensured the presence of any illicit object on the track. Conditions, on which proposed system relies, i.e. Detection of object and positional state of the gate, are managed and observed at the control room via wireless communication protocol. Although the use of piezoelectric transducer and ultrasonic sensors are not the reliable option as both are sensitive to change in nature. Vibrator sensors used in this system is highly sensitive to hike in temperature whereas ultrasonic sensor may get harmed due to dust, water and in high temperature. This sensitivity of installed sensors may oscillate the overall accuracy of system.

Figure 2.6: Departure of Train from the Gate [3]

Figure 2.7: Passing of Train from the Gate [3]

Figure 2.8: Controlling Module [3]

Marco Govoni et al. presented review on various techniques which has been developed for the safety at railway level crossing areas and also addressed the pros and cons of those systems. Perspective of the system is to consider two key points which are detection ability and discrimination of vehicles and objects. This paper concluded that the technology exploited ultra-wide bandwidth with suitable signal processing can be considered as the best solution. Although, the implementation cost of UWB technology is much higher than other systems. In this technique, time taken to gain a signal is long and acceptance rate is low. Considered technology of ultra-wide bandwidth may get distracted due to the existence of other radio based systems.

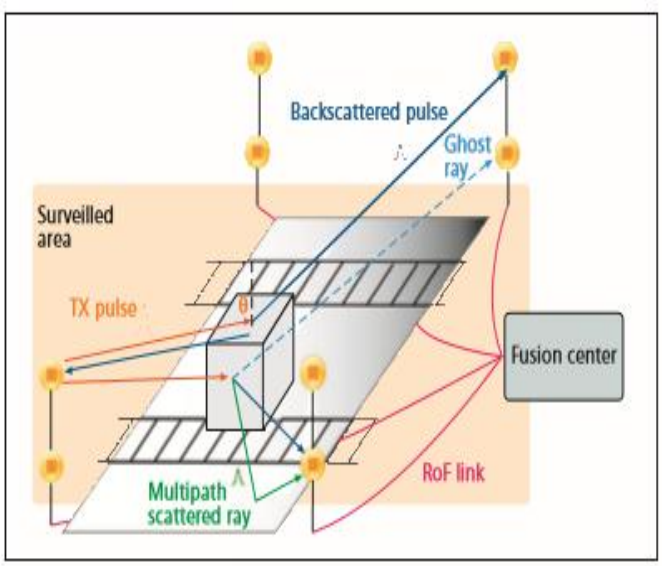

Figure 2.9: Architecture of the level crossing surveillance system with the FOS UWB radar. [4]

Bhuvaneswari P.T.V. et al. proposed a system which is based on data acquisition technique by using ultrasonic target sensing. Method which has been developed is aimed to precisely spot the occupancy status of rail tracks. Proposed system stated that their performance relies on the features of used sensor and XBEE module. Obtained result shown in the paper examine the distance covered is 11.75m for the measurement and best possible orientation is 800 to 1000 with respect to the sensor. Communication range measured is up to 280m in 10 db scale of power. Receiver of the system obtains the detected events and generates an alert alarm. Ultrasonic sensors are exploited in the system to detect the target. These sensors are efficient enough to detect the target but are sensitive to change in nature whether it can be air, dust, change in temperature, rain etc due to which the effectiveness and reliability of the proposed system may get reduced.

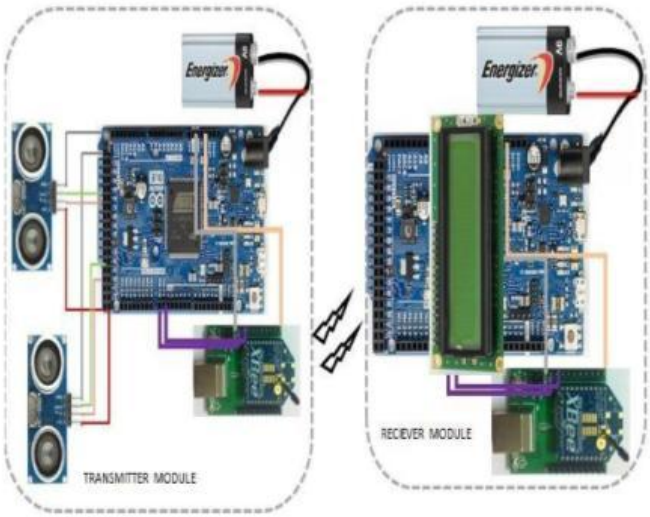

Figure 2.10: Wheel based Level Crossing Safety System [5]

B. Brailson Mansingh et al. developed a system to automate the manned and unmanned railway crossing operations. Technique which has been proposed has mechanical and electrical mechanism to operate the gates at level crossings of railway. Infrared detectors are deployed at some distance to detect the arrival of a train and if any detection found, the extracted data processed to the receiver placed at the control room. There is an LED display is used to display the remaining time for opening and closing of gate. Setup of L-shaped cylinder is used as a mechanism to close and open the barriers. Although, infrared sensors are not able to distinguish objects with similar temperature range which leads an inaccurate result.

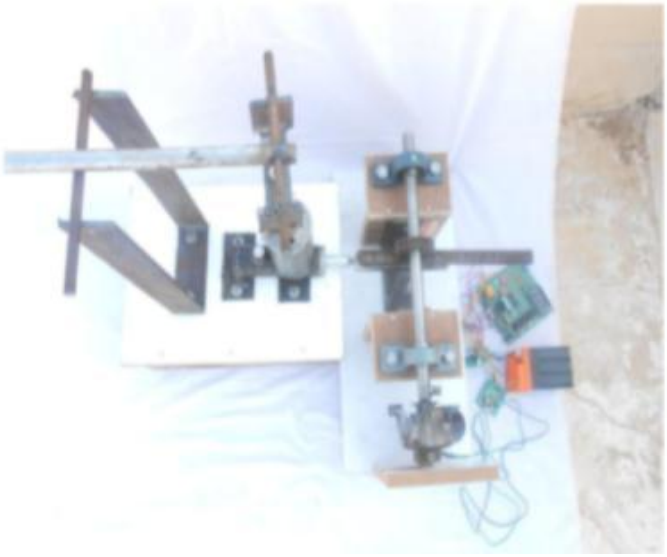

Figure 2.11: Overview of Circuit based on IR detection [6]

Eric Trudel et al. proposed a method relies on acquired data to scrutinize the effect of various aspects which can influenced the protection at railway crossings and concluded the key reasons for increasing safety at rail crossings. Proposed study took the database of accidents held at Canadian rail-crossings. Analyzed result is able to spot the main factors which can highly contribute to increase the safety and prediction of collision at rail crossings. Evaluation of the efficacy of geometric characteristics and factors involving in the collision of trains and vehicles at Canadian grade crossings taken place in the paper. Investigational outcomes shown three factors i.e. DSTOPPED, area of sight and clearance distance are highly influenced constraints for accidents. Various techniques like model fusion; which merges the result of separate systems to generate a comparative result with better accuracy, has been suggested to develop an effective system. Considering a model, based on weather and time will also be helpful to develop a reliable system.

Dr. Velayutham. R et al. developed a system which can spot and track the arrival of a train. Train tracking used GPS system for execution of its system and rooted it with an application of mobile which has been proposed in the paper

to control the barriers at the crossings. Proposed application is accessible by engine drivers to manage the gates at the crossing of railway lines. According to the conditions which have been proposed, when the train is 5 km away from the crossing, a green signal will generate in the mobile phone. Engine driver has the accessibility to control the opening and closing of gate by pressing the shown button on the mobile screen. When the driver pressed the button to close the gate, meanwhile an alarm will be generated at the crossing to notify the vehicle about the closing of gate and arrival of train. But if more than one train, passing through the railway crossing which may have slight difference in arrival period, so the operation may clashed and inaccurate result will be obtained which may led to an accident. Mobile application needs network and internet accessibility to operate that application which may fluctuates. So the practical implementation of the proposed system is not achievable.

Figure 2.12: System using GPS and GSM [8]

Pranjali Gajbhiye et al. proposed a system based on visual surveillance to detect, track and separates the objects moving around the region of rail crossings by using technique relies on variation. Used method subtracts the current background with the previous one, calculates the dissimilarity and tracks it. The position of moving object is obtained by the difference calculated in pixels of image. Vision based detection has an effective accuracy at day time but their result may fluctuates in dark.

Figure 2.12: Moving Object Tracking and Detection [9]

3. CONCLUSIONS AND FUTURE WORK

Various techniques which have been proposed had an objective to improve the systems based on tracking trains and nearby objects at the railway crossings. Many techniques have developed to automate the operations of barriers at railway crossings. This paper reviewed several systems and their working that has been proposed so far and concluded that these systems are not effective for meeting all the scenarios of security, if it is practically implemented. The acuity of some systems which have been developed diminishes in the dark. Some installed sensors get affected due to bad weather and so on. It has been observed that, there is no any system developed which can alert a human about the arrival of train while crossing railway tracks. Here the proposed system is able to recognize the train at real time by their horn along with its distance to prevent accidents. Proposed system maintains the high level of accuracy by detecting trains, even in noisy environment. Detection of train will generate alarm to alert the person even if he is using headphones or indulge in any application.

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