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Track Vibration Based Signal System for Unattended Rail Crossing and on Track Signalling

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***Abstract*—** Number of unattended level crossing accidents and people involved in train track accidents are increasing after each year as per the rail accidents statistics in previous year . Most cases involve accidents due to the carelessness, sound of train not heard and accidents on curved tracks as train suddenly appear .Possibility of providing manned level crossing at regular intervals of distance is merely possible as lot of infrastructure , human resource and track modification are to be performed . The fatalities can be minimized to a great extend if a vision based signal system can be implemented , which could provide a signal when the train is about to pass and signal stays on until all the compartment pass. As the sense of vision provides much more attention than any other sense. The system can be implemented easily and left unattended with minimal maintenance also the system can be positioned at regular intervals of track with less track modification.

***Keywords*—**Unmanned Level Crossing, Piezo Vibration sensor, Train, Railway Tracks, Jaywalkers

I. INTRODUCTION

Rail crossing is considered one of the dangerous activities which lead to a bizarre accident. The outcomes are heavy fatalities due to carelessness, less time for humans to react to the situation and unattended level crossing. Creating many attended railway crossing are expensive and require huge maintenance.

Rail crossing on curved tracks, crossing while on other activities like talking, texting, on a phone call, hearing music using headphones , hurry to cross the track, walking on the tracks are some of the most common reasons which lead to loss of life. At times even though when the pedestrians take necessary precautions before crossing the railway track accidents occur as the approaching locomotives will be not in line of sight. Some other accidents which happen even with caution are when two locomotives cross at the same time. The nature of sound characteristics are at times confusing for the pedestrians which too become another reason. Due to the impact mostly the victims body gets scattered due to large momentum of locomotives.

Mishaps at level crossings are the biggest killer, accounting for 40 percent of train accidents and 66 percent of fatalities, reflecting the railways' failure to man these crossings or build road-over bridges and road-under-bridges. There are 30,348 level crossings, of which around 40 percent are unmanned.

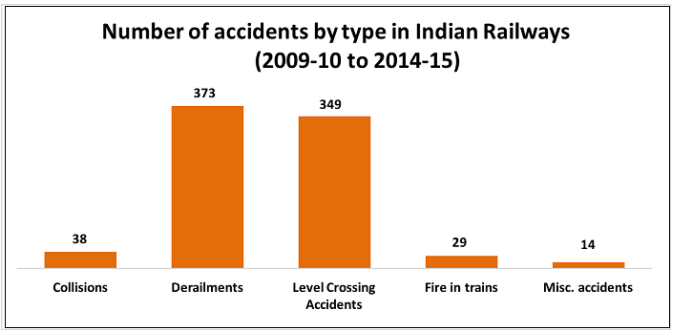

Figure 1. Statistics of railway accidents in India from 2009 to 2015 according to the nature of accident

Therefore setting up a simple signal system for the pedestrians at certain intervals of railway tracks in order to show whether a train is about to pass or is the track free and also in which direction the train is about to pass , can minimise the death toll. This can be implemented using simple device which has very less infrastructure cost and maintenance cost. These devices can be left attended up to a great extend.
Sense of vision is much more powerful than sense of hearing, thus vision based signal system will yield better result than any other mechanism.

Rest of the paper is organized as follows, Section I contains the introduction to the area of rail accidents , its types and various statistics , Section II contain the related work in

making rail crossing and securing the railway tracks by complete autonomous rail crossing , Section III contain the hardware parts used with a short description of each part with a circuit , Section IV contain the working of proposed system, section V concludes with the need of such a device in current scenario, Section VI contain scope and future work.

II. RELATED WORK

Previous works on level crossing safety include autonomous level crossing technology which need no use of manned level crossing and can be controlled by nearby railway stations and completely autonomous . The proposed system infrastructure is expensive and therefore is avoided as many number of such autonomous systems are required .[1][3]

III. METHODOLOGY

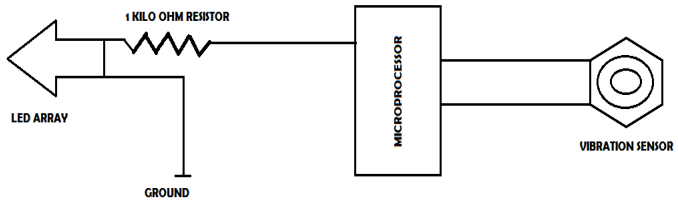

Fig 2. Proposed system Diagram

The Hardware consist of very less infrastructure and is autonomous, hence can be left unattended providing very low maintenance schedule .Less infrastructure contributes to low expense and can be easily set up. The device with sensor can be positioned on the tracks with regular distance intervals.

A. Hardware

The device consist of large mass vibration sensor, microprocessor board, conduit, LED array and 1 Kilo Ohm resistor.

B. Software

The device settings were programmed using C and C++. The system was prototyped on an Arduino mega 2560 board with atmega 2560

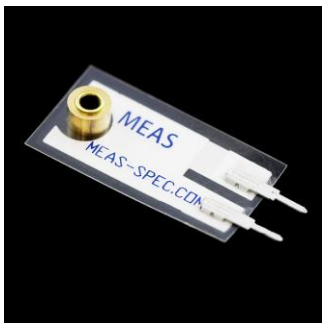

Fig 3. Piezo Vibration sensor with large mass

- Large Mass Vibration Sensor : This basic piezo sensor from Measurement Specialties is often used for flex, touch, vibration and shock measurements. A small AC and large voltage (up to +/-90V) is created when the film moves back and forth. A simple resistor should get the voltage down to ADC levels. Can also be used for impact sensing or a flexible switch. Comes with crimp pins which can be soldered and a mass attached to the tip. This mass increases the sensitivity to motion.

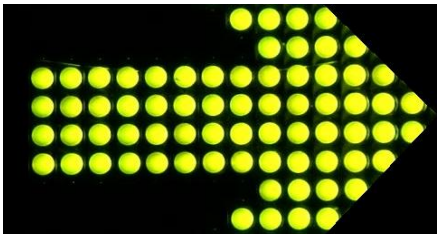

Fig 4. Direction indicating LED array

- LED Array : An array of led which form a specific shape.

Fig 5. 1 kilo ohm resistor

- 1 Kilo Ohm resistor is used to connect in series with the Led Array and microcontroller board.
- Copper conduits in order to conduct the signals from sensor to board and from board to led array.

IV. WORKING

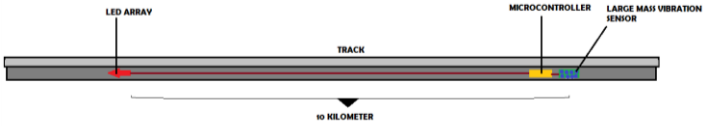

Fig 6. Proposed system

The piezo vibration sensor is placed at regular distance intervals on the railway tracks. The directional led array is placed a distance not greater than 10 kilometres from the sensor as these distance provide enough reaction time to humans preparing to cross the track or jaywalkers and trespassers.

When a train or locomotive passes over the track at any speed the vibration sensor trigger and send a signal to the microcontroller board. This action is performed as the sensor

is set with a threshold of 5 Hertz and the vibration caused will be more than the threshold . The value of 5 Hertz is selected as per findings from vibration caused on track by a train varies from 4 to 50 Hertz.

The trigger caused will thereby communicate with the board to send signal to directional led array which illuminates the led array. This conveys the information with the nearby humans regarding the arrival of train and its direction.

V. CONCLUSION

The system is proposed as the current system is expensive , much bigger in infrastructure and need rigorous maintenance schedules.

When railway authorities look for inexpensive yet good result yielding device , the dive can be considered as it is inexpensive , smaller infrastructure and less maintenance.

VI. FUTURE WORK

Providing a solar powered power supply unit to the whole network of system which can considerably reduce periodic maintenance schedule .

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Authors Profile

Mohamed Ameen pursed Bachelor of Technology from Calicut University 2016 , in computer science engineering . He is currently working as Network Engineer . His main research interested topics include Embedded systems, Wireless AdHoc Networks, Robotics, Networking, Remote Sensing, Unmanned Aerial Vehicle.

