# Railway Management System using IR sensors and Internet of Things Technology

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## *Abstract*

*In Indian railways, accidents are still major concern in terms of safety of people which are caused due to unmanned rail road crossing and unidentified cracks in railway tracks. By looking at such conditions, we need to implement new technology in order to reduce accidents map. The main purpose of this paper is to provide safety at unmanned railway crossing and detection of faulty tracks. Unmanned level crossing is IR sensors base system and crack detection is a dynamics approach which combines the use of GPS (global positioning system) module to collect geographical coordinate of faulty tracks and GSM (global system for mobile communication) modem to send geographical coordinate of location. Here, we have introduced IOT (Internet of Things) which controlled the crack detection system dynamically.*

***Index Term-*** *unmanned gate crossing, GSM modem, GPS module, IR transmitter and Receiver, Internet of Things technology*

## I. INTRODUCTION

Indian Railways is an Indian state-owned enterprise, owned and operated by the Government of India through the Ministry of Railways. India possesses fourth largest network in the world exceeded only by those of the United States, Russia and China. The Indian railway network stretches across the globe with a length of 115,000 kilometers (71,000 mi) over a route of 65,000 kilometers (40,000 mi) covering 7,500 stations. The network traverses every nook and cranny of the nation carries over 25 million passengers and 2.8 million tons of freight daily. Despite boasting of such impressive statistics, the Indian rail network is still on the growth trajectory trying to fuel the economic needs of our nation. In terms of the reliability and safety parameters, we have not yet reached truly global standards. Though rail transport in India growing at a rapid pace, the associated safety infrastructure facilities have not kept up with the aforementioned proliferation. Our facilities are inadequate compared to the international standards and as a result, there have been frequent derailments that have resulted in severe loss of valuable human lives and property as well. The principal problem has been the lack of cheap and efficient technology to detect problems in the rail tracks and of course, the lack of proper maintenance of rails which have resulted in the formation of cracks in the rail sand other similar problems caused by anti-social elements which jeopardize the security of operation of rail transport. Indian railway is one of those modes of transport that faces a lot of challenges due

to human errors such as level cross accidents, collisions due to broken track etc. A level cross, an intersection of a road and a railway line, requires human coordination, the lack of which leads to accidents; also, the main problem about railway analysis is detection of the crack in the location. If these problems are not controlled at early stages they might lead to a number of derailments resulting in heavy loss of life and property. In traditional system level crossings are managed by the gatekeeper and the gatekeeper is instructed by the means of telephone at most of the level cross from the control room. But the rate of manual error that could occur at these level crosses is high because they are unsafe to perform without actual knowledge about the train time table. Delay in the opening and closing of the gate could lead to railway accidents. In order to avoid the human errors that could occur during the operation of gates and derailment due to crack, the proposed paper introduces the concept of railway gate automation and crack detection system has been modified by using IR sensors and IOT (Internet of Things) technology which performs automatic gate operation and helps in detecting of the faulty track. The IOT represents the coordination of multiple vendors' machines, devices and appliances connected to the Internet through multiple networks. To find the location of the faulty track, we have designed IOT website using Xampp server. We have also used GPS and GSM modem. GPS is used to read the current latitude and longitude data. GSM modem is used to send the current latitude and longitude data on hosted server. The rest of paper is organized as follows. Section II gives a review of the previous papers that relate to our work. Section III describes a working of proposed system. The experimental results are discussed in Section IV and the conclusion of the work is discussed in Section V.

## II. LITERATURE SURVEY

Security in the unmanned railway crossings has always been a matter of uncertainty. Many various systems have been proposed and some implemented but they have some shortcomings. Some system has poor stability and performance while others utilize active sensors which defects like instability and short reliable life cycle, hence requiring replacement every few years and thereby making the system expensive. FM communication system has been used to automatically close gates. There are two IR transmitters and receivers. Also, sensors are present on either side of the level crossing at a distance of 1km. Hence depending on the activation of the corresponding sensors, the closing and opening of the gate are performed [1] . A GPS receiver was designed and operated to monitor the L- band amplitude scintillations. Thus, the ionospheric irregularities are monitored [2]. Zig- Bee based train anti- collision and level crossing protection system consists of 4 modules: train module, control center module, signaling part module, and level crossing gate module[3]. Microcontrollers and IR sensors have been employed to automatically close the gates at the level crossings. Hence, the errors due to manual error can be avoided and a fast response system is obtained [4] . A programmable logic controller can be used to automatically close gates at the level crossings. These controllers can be programmed for respective mechanisms of operations, technical diagnostic aiding in fault detection and remote monitoring [5]. A programmable logic controller-based arrangement using the ladder diagram is designed and programmed which can be employed at all the unmanned level crossings. This has proved to be an economical system [6]. A track monitoring

system using a probe-vehicle system was designed. Here the rail irregularities are estimated. GPS and map matching techniques have been used to locate the faults on the tracks. In-service vehicle were used to carry out the experiments [7]. The usual railway interlocking devices comprising of large wiring and cables is replaced by utilizing optical LAN which significantly reduces the signal cables and wiring works. A data-driven method was employed to replace the interlocking device and making operations easy [8]. GPS and GSM were used for a crossing warning system. This increases passing efficiency in railway crossing [9].A swift response system using a pressure sensor is used for an automatic railway gate control. The sensor senses the arrival and departure is train to control the opening and closing operations of the gate. Operation of the system is controlled by a microcontroller. Hence it consists of motor, IR sensor and microcontroller [10]. Selvamraju somalraju et.al proposed a system that utilizes LED-LDR configuration for railway crack detection. RRCDS utilizes simple component inclusive of GPS module, GSM modem and LED based crack detector assembly [11]. Qiao jian-hau proposed a system that takes the linear charged couple device (CCD) as a image sensor, processes the image signal collected, judges out the crack signal, Display the curve through LCD and gives off alarm.[12].K.Vijayakumar et.al has investigated crack detection using microwave sensors. It describes how a Microwave horn antenna can be used to detect the crack in a rail track [13].Richard J. Greene et. al have presented a new crack detection method for rail which utilizes the change in infrared emission of the rail surface during the passage of the train wheel[14]. We have proposed new method which utilizes components inclusive of a GPS module, GSM modem, IR sensors for the prevention of accidents which are caused due to level crossing and derailment due to crack in the railway track.

## III. PROPOSED SYSTEM WORKING

In this paper we have proposed two systems i.e. unmanned gate crossing controller and Crack detection system. Unmanned gate crossing controller system used FM communication system. It has one arrival point at 3 km distance on one side and one departure point at 3km distance for train from the level crossing. At the level crossing, proposed system have microcontroller for receiving the signal from sensors and as per receiving signal opening and closing of gate are performed. When train comes at arrival point i.e. Arrival IR sensor, sensor sense the arrival of the train and send signal at the level crossing and at the same time closing of the gate are performed. Similarly, when train goes at departure point i.e. Departure IR sensor, IR sensor sense the departure of the train and send signal at the level crossing and opening of the gate performed. In the Crack detection system, before the start ofthe rail-way line scan the robot has been programmed to self-calibrate the IR transmitter and receiver. After calibration, the robot waits for the predetermined period of time so that the GPS module starts reading the correct geographic coordinate. The principle involved in this crack detection is that light reaching the IR receiver is proportional to the intensity of the crack. Both IR transmitter and receiver will be placed straight line to each other on rail. During operation, when the light from the transmitter does not fall on receiver so that it gives result NO Crack found. And when light from the transmitter fall on receiver i.e light deviates from the path due to crack in the railway track then it gives result as a crack found. In order to detect current location of the train in case of detection of crack, we have used GPS receiver whose function is to receive the current

latitude and longitude data. And this latitude and longitude date will be sent by GSM modem to IOT website. We have managed this crack detection system using internet of things technology. On IOT website we will get information about train in terms of train no. lat, long, crack YES or NO and date.

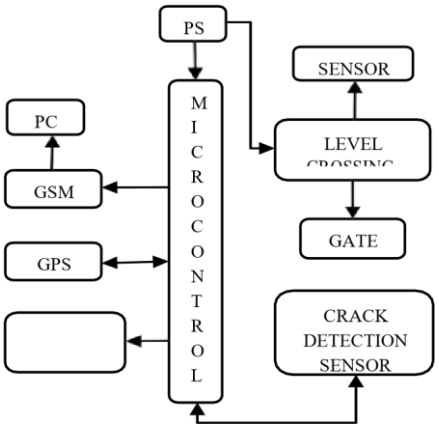
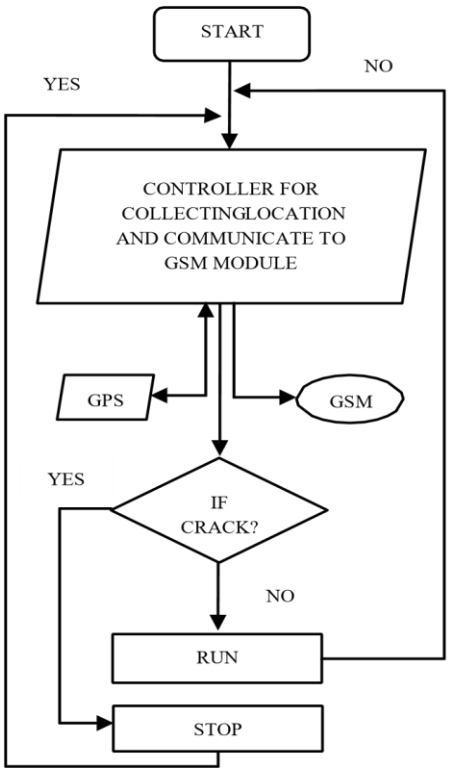



Fig 2: Flowchart of Crack Detection



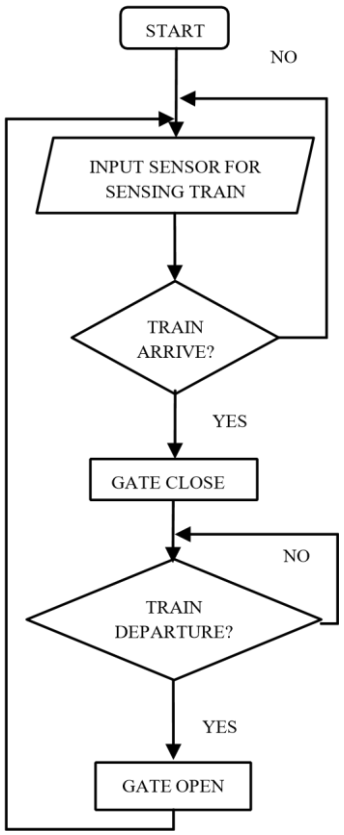



Fig. 3: Flowchart of Unmanned Level Crossing

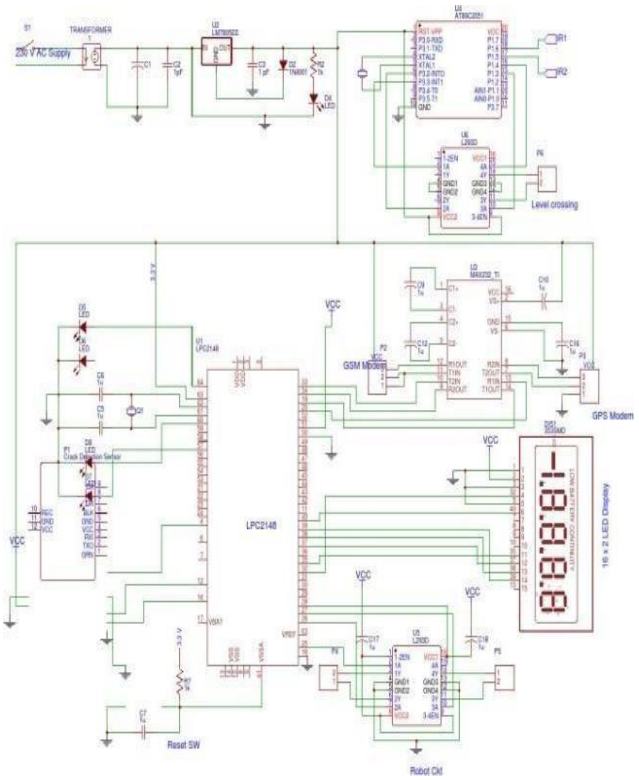



Fig.4: Combine Circuit Diagram of proposed systems

## IV. RESULTS AND DISCUSSION

The component is assembled and program was burned in LPC2148 microcontroller. For testing purpose, we used stepper motor to get pulley up down at the level crossing in the unmanned gate crossing controller system and crack detection was managed and monitored by IOT. For that We introduced xammp server. Xammp server is integrated with Mysql and PHP. The program is done using PHP language.PHP is scripting language and Mysql is open source database. we have used Mysql to store and manage the data and we have accessed the database using hosted website (IOT). In crack detection system we used aluminium frame for testing purpose kept in the form of track and model was made to travel through it. We included break manually and found that device successfully detected that user created crack and current latitude and longitude values were received by the GPS module. However, as the railway track did not contain crack, we were unable to test GSM and GPS.


Fig.5 : Overview of IOT website

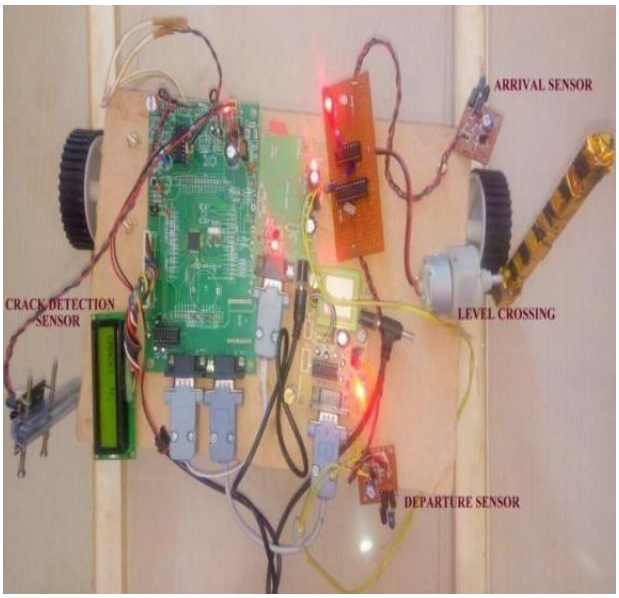



Fig. 6: Assembly of Proposed System

## V. CONCLUSION

This system proposed has been a very reliable one. We can prevent heavy loss of life using internet of things technology and IR sensor-based system. The proposed unmanned railway gate crossing system perform automatic opening and closing gate function without help of human participation and also railway track broken system automatically detects faulty railway track without human intervention. There are many advantages with the proposed system when compared with the traditional system. The advantage includes less cost, low power, high accuracy, low power consumption, less analysis time and main advantages in crack detection is that we can centrally manage this system using internet of things technology and we can find the exact location of the faulty track using hosted website (IOT) so that many lives can be saved.

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