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Smart Railway Track Monitoring System

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Abstract: ***The project aims in designing railway track crack detection system with Microcontroller, IR obstacle Sensors, which detects the cracks along its path, it is also capable of monitoring the location of the crack by using the GPS module and alerts through SMS using GSM module. PIC Microcontroller is a central component of the system. When any crack or deformation is detected on the track by the IR SENSOR then with the help of GSM AND GPS MODLUE it will inform to the, to railway authorities and to loco pilot of train running in that particular range, and the train will be stopped automatically. The railway authorities will be provided with a SMS about the detection of problem in track with the longitude and altitude of the location. Also to detect fire, Fire Sensors are being used with help of which authorities can be informed in case of fire.***
Keywords: Microcontroller (PIC16F877A), IR Sensor, Railway Cracks, GSM/GPRS MODULE, LED, LDR

I. INTRODUCTION

In India railway network is the most of used transport it is also used to carry out commercial tasks and therefore if there is any problem in railway transportation, economy faces major damage. The Indian railway network is the fourth largest railway network in the world. It is still on the growth trajectory trying to fuel the economic needs of our nation. Though railway transport network in India is growing in a swiftly, but provided facilities are insufficient as compared to the international standards and as a result, we have to face frequent derailments that have resulted in loss of valuable human lives and property as well. On further analysis recent statistics reveal that approximately 60% of all the rail accidents have derailments as their cause, of which about 90% are due to cracks on the rails either due to natural causes or due to antisocial elements. Therefore these cracks in railway lines have proven to be a serious problem which has to be solved as early as possible. These railway lines cracks problems are generally not to improper maintenance and lack of alertness in manual checking work. Because of the high frequency of trains and the unreliability of manual labor it is need to have an automated system to monitor the presence of crack on the railway lines. To solve this problem, an implementation of an efficient and cost effective solution suitable for large scale application is presented in this paper. In this paper we are using IR sensor to detect crack in railway tracks. GPS service to trace the position of the train and GSM service to send the alert message to the authorities. Objective of this project is that to present the hardware which is implemented for detecting the cracks are robot based vehicle which will travel across the railway lines and detect the crack in the track but as we know there are 'N' numbers of railway lines in India, travelling a robot vehicle is not possible every time and it contains more cost as compared other system. Therefore we are implementing this system which is cost effective as well as useful. At the end of the project, a system is designed which can avoid the accidents as well can detect the problem in the railway tracks and once after the problem is detected it will inform to the authorities via GSM and sends the location via GPS.

II. RELATED WORK

1) Recent research has invented way to use the RF TRANSMITTER for crack detection .This technique has given very accurate results in lab based testing. But, it requires ROBOT which are both costly and also can't be placed onboard a moving robot because of their delicate nature. RF based methods are used to overcome the limitations associated with RANGE. But they have the problem of very slow overall speed which reduces the usability of the same.[4]

2) The work done in the field of crack detection mostly uses the infrared sensing technique. This technique was initially thought to be the best solution for the crack detection, but later it was found it can give error in the output due to external disturbances and hence came to be considered inaccurate.[2]

3) Automatic train control (ATC) is a train protection systems for railways that involves a speed control mechanism in response to external inputs. ATC usually tend to integrate various signaling technologies and use more granular deceleration patterns in lieu of the rigid stops encountered with the older automatic train stop technology. Automatic train operation (ATO) are used by ATC and it is usually considered to be the safety-critical part of the system.[6]

4) Fixed mechanical signals began to replace hand signals From the 1830s fixed mechanical signals began to replace hand signals. Originally they worked locally, but later it became normal practice to operate all the signals on a particular block with levers grouped together in a signal box. [5]When a train passed into a block, a signalman would protect that block by setting its signal to 'danger'. When the signalman received an 'all clear' message, he would move the signal. Gradually during the 1850s and 1860s the absolute block system came into use and became mandatory in the United Kingdom after Parliament passed legislation in 1889 following a number of accidents, most notably the Armagh rail disaster. This required block signaling for all passenger railways, together with interlocking, both of which form the basic of modern signaling practice today. Similar legislation was passed by the United States around the same time.[7]

5) At first rail inspections were done visually. after a derailment at Manchester, New York, in 1911 came many sources cite that the need for better rail inspections . That accident resulted in the death of 29 people and injuries to 60 others. The investigation of the accident revealed that the cause was a transverse fissure (a critical crack which lies perpendicular to the length of the rail) in the rail.[8]

III.DESIGN AND IMPLEMENTATION

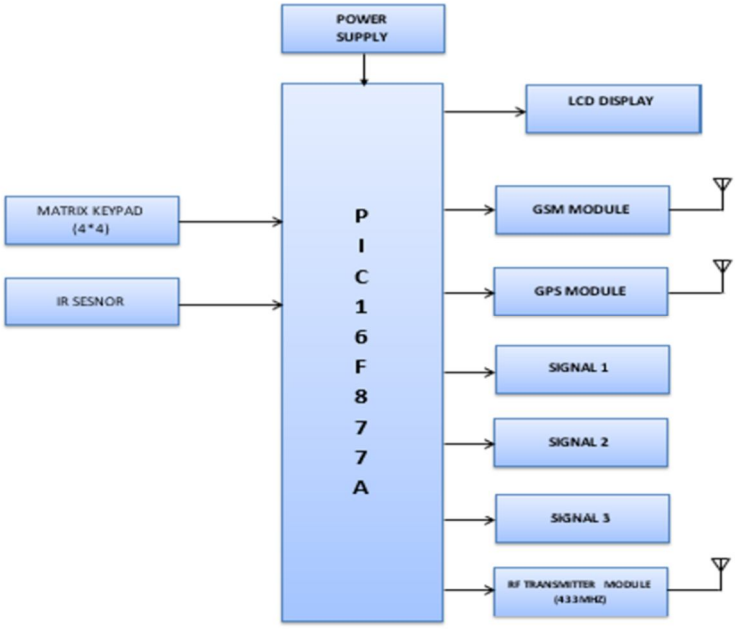

Fig 1. Transmitter Block Diagram

1) *Microcontroller:* The name PIC means "Peripheral Interface Controller". It has various features like general purpose i/o pins , synchronous/Asynchronous Serial Interface USART, Analogto-digital converters (up to ~1.0 MHz),Integrated analog RF front ends (PIC16F639, and rf PIC),KEELOQ Rolling code encryption peripheral (encode/decode) Internal EEPROM Memory and many more. Here we are using pic for interfacing various blocks such as power supply, signals (g,y,r), crack detection, LCD display ,decoder, level convertor, driver circuit, etc.

2) *IR Sensor:* Infrared radiation covers the region of the electromagnetic spectrum between microwaves and visible light. In infrared communication an LED transmits the infrared signal as bursts of nonvisible light. Photodiode or photoreceptor detects and captures the light pulses At the receiving end, which are then processed to retrieve the information they contain.

3) *LCD Display:* LCD display utilizes sheets of polarizing material which has liquid crystal solution between them. An electric current is passed through the liquid crystals, it causes the crystals to align so that light cannot pass through them. LCD technology has advanced rapidly since its initial inception over a decade ago for use in laptop computers.

4) *GSM Module:* Subscribers using GSM module can use their phones throughout the world, enabled by international roaming arrangements between mobile network operators. GSM differs from its predecessor technologies. In GSM both signaling and speech channels are digital, and thus GSM is considered a second generation (2G) mobile phone system.

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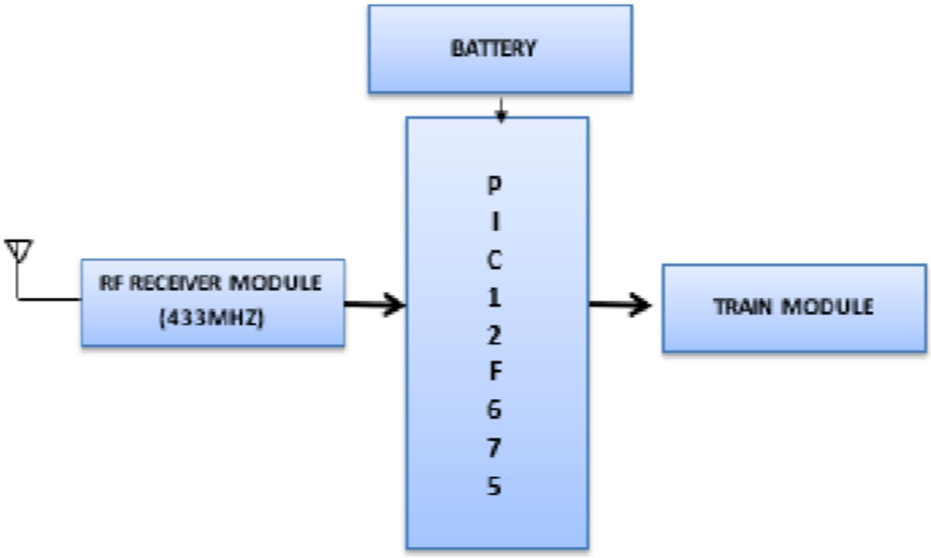

Fig 2. Receiver Block Diagram

5) *RF Transmitter and Receiver Module:* The RF module, operates at Radio Frequency. It's frequency range varies between 30 kHz & 300 GHz. The digital data is represented as variations in the amplitude of carrier wave in RF system. This is known as Amplitude Shift Keying (ASK) Modulation. Transmission through RF is better than IR (infrared) due to many reasons. Signals through RF can travel through larger distances therefore it is suitable for long range applications. IR mostly operates in line-of-sight mode but RF signals can travel even when there is an obstruction between transmitter & receiver. IR transmission is less strong and reliable than RF transmission. RF communicates at specific frequency unlike IR signals which are affected by other IR emitting sources. This RF module has two units an RF Transmitter and an RF Receiver. The pair of transmitter/receiver (Tx/Rx) operates at a frequency of 434MHz. RF transmitter receives serial data and transmits it wirelessly through RF using its antenna connected at pin4. The transmission occurs at the rate of 1Kbps - 10Kbps.The transmitted data is received by an RF receiver which is operating at the same frequency as that of the transmitter.

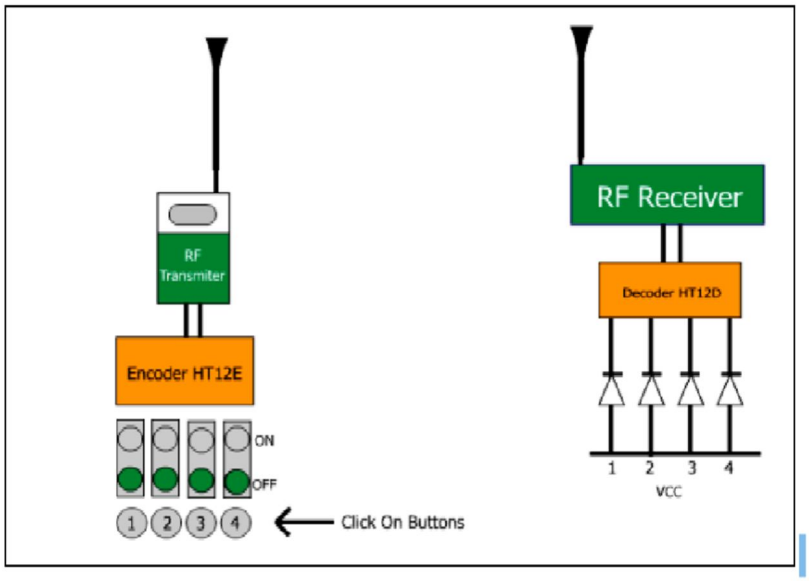

Fig 3. RF TX AND RX

IV. PROPOSED SYSTEM

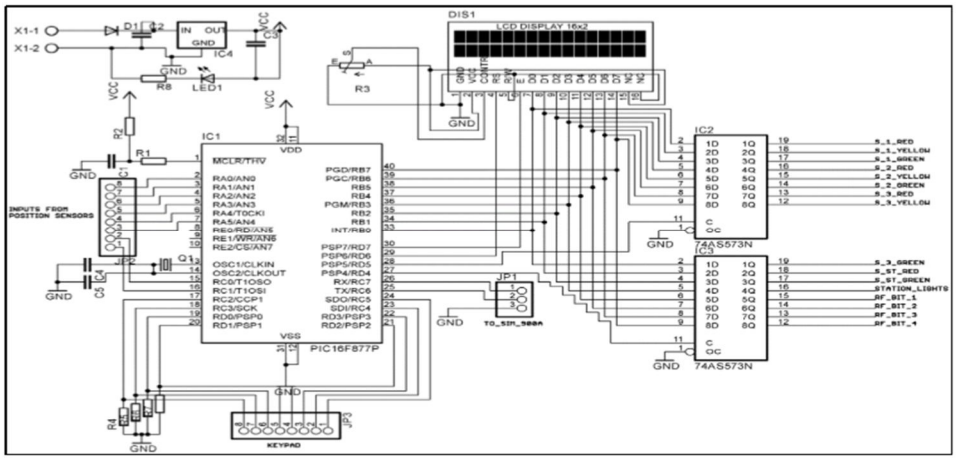

Fig 3. Circuit Diagram Of The System

This project focuses on three important features of train which will be helpful further and overcome the existing system used for it. The proposed system for the features focused in this paper is given below.

1) *Automatic Signal Control:* The RF transmitter fitted on the pole will send the corresponding signal, when a particular signal is observed on signal pole; which will be received by the RF receiver fitted on the train and will reduce or increase or stop depending on the signal.
2) *Message Alert System:* For message alert System we are making use of GPS system instead of using timer system, to locate the position of the train which will trace the location of the upcoming station. It will send an alert message to the passengers who will be shortly reaching their destination by using GSM service.
3) *Crack Detection:* One of the most important reasons for rail accidents is crack in railway track due to climatic changes. The existing technique used to monitor the rail track consists of manual checking done individual person which leads more man power and also is less efficient. To make it more efficient we are using IR sensor to detect the crack in rail track which will give an alert and suitable action will be taken.

V. CONCLUSION

Using this system when there is some obstacle present in front of the track or there is a presence of gap between two joining tracks, the IR sensor will detect the gap between the two tracks and indicate on LCD display. With the help of GSM and GPS system the authorized person of railway will be informed via SMS function about any inconvenience in track.When the LDR and LED pairs are cut in the sequence, the alert message is sent via GSM about the NEXT STATION and it is displayed on LCD display.The exact location of obstacle or crack in the track can be determine and it is shown on google map.

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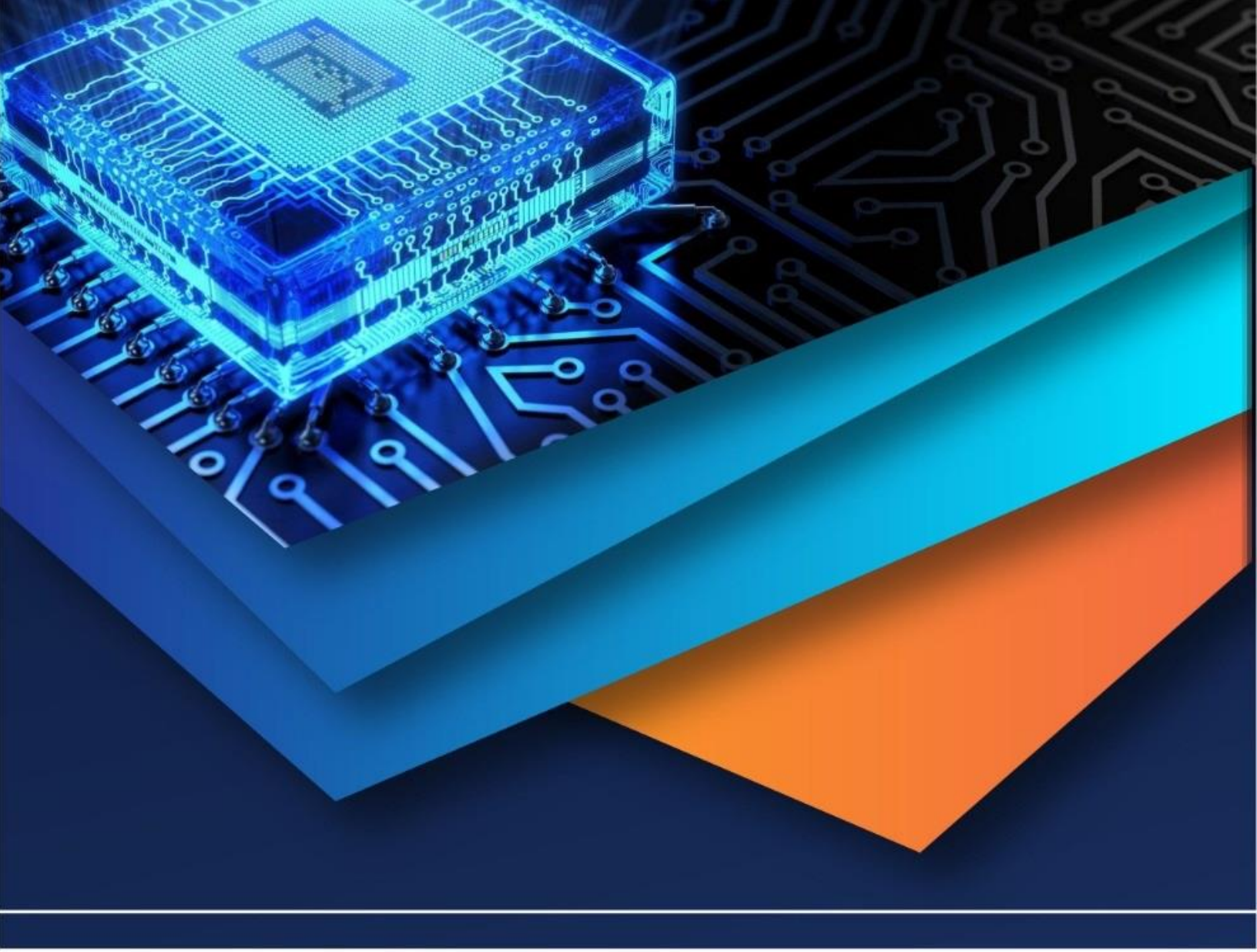

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