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Crack Detector & Fire Safety Monitoring System for Railway Inspection

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Abstract:
In recent technologies several sensors are used to detect the crack in railway track. This paper is to design a robotic module to detect cracks in the railway track and indicate it to the corresponding track inspector. In railway track, there may be cracks due to natural calamities or due to the displacement of track. Today's system has some limitations. If the bridge or track is damaged, that information goes to railway authority people, they inform to the corresponding train operator so that it will take more delays for such process. So to avoid delays, our proposed system will immediately notify and informs the current train comes on the track through ZigBee Network in this prototype. Track status is monitored by ultra-sonic sonar sensor modules. Another major thing is Fire Alarms. The paper proposed here can detect fire accident and alert the distant Driver immediately in the same train. Also the system can capable of informing about the fire accident to fire service station. And we propose a cost effective solution to the problem of railway track crack detection utilizing ultrasonic sensor assembly which tracks the exact location of faulty track which then mended immediately so that many lives will be saved. So the rescue team can easily and quickly reach the place and also guide the passengers regarding the emergency exit immediately.

Keywords: *Railway cracks, Ultrasonic sensors, MEMs sensor, Fire sensor.*

1. Introduction

Railway is lifeline of India and it is being the cheapest modes of transportation. when we go through the daily newspapers we come across many accidents in railroad railings. Railroad related accidents are more dangerous than other transportation accidents in terms of severity and death rate. Therefore, efforts are necessary for improving safety. Train collisions form a major catastrophe, as they cause severe damage to life and property. Train collisions occur frequently eluding all latest technology. This paper is aimed at helping the railway administration in detection of faults. Railroad intersections are very unique, special, potentially dangerous and yet unavoidable in the world. The railway carriage carrying the control equipments is provided with ultrasonic sensor to detect the crack, fire sensor is used to detect the fire and MEMs sensor is used to detect the obstacle in track i.e., used as obstacle avoider. This project pertains to a process for monitoring the condition of rail on train tracks and more specifically identifies the faulty location of track and intimates to the train operator through LCD. The communication is done by ZigBee network in the prototype kit. Another added technique is detection of obstacle through MEMS sensor and fire through fire sensor. They are widely used and have become a standard safety device.

Different types of fire alarms and each of them has their own pros and cons. In order for the fire alarms to work efficiently, their placement becomes very important. While this is good, it still left with a potential problem. In big train compartments, when one of the alarms is ringing, it may not be able to give sufficient sound to warn distant Driver immediately. Consequently, passengers might not be notified early enough and thus exposing them to danger. The simple way of solving this problem is to realize a device that not only solve the problem, but also enhances the functionality of the fire alarms. More specifically, the device is aided with the capability to alert smoke alarms in other areas of fire, and at the same time is notified when a fire breaks out in another zone. Traditional fire monitoring system needs arrangement of wires in the region. Our project proposed here can detect fire accident and alert the distant Driver immediately in the same train. Also the system can capable of informing about the fire accident to fire service station through ZigBee network. Our paper is designed in consideration with cost efficiency and also the exact location of defect identification.

2. Literature Survey

There are so many methods have been used for prompt detection of the condition of rails. LED- LDR is widely used sensors for the detection of crack but it's disadvantage is that it can detect crack only above the surface area. The interior or the under surface cracks cannot be detected by this technique. Then digital image processing techniques have been used to give solution for the railway crack

problem. But it takes a lot of power and a large amount of time. Therefore, it becomes unsuitable.IR sensors are then used to detect cracks but its efficiency is also so low in case of external disturbance. These are the existing techniques in determination of cracks. The widely used technique with accuracy in detecting cracks is ultrasonic sensors. And also all the existing system designed the robot to be placed in the track for detection. So it requires more robotic module for inspection. Therefore, it becomes costly. In use of fire alarms the existing system uses ringing bell to be notified in case of fire in the compartment to both the driver as well as people in train. The drawback in this case is, if the sound is not heavier then it will not be reached to the train operator. so it results in heavier damages of life and property. In existing method, in order to detect the current location of the device in case of detection of a crack, a GPS receiver is used whose function is to receive the current latitude and longitude data. To communicate the received information, a GSM modem has been utilized. The GSM modem transfers the received information to the GPRS which then shows the exact location of the faulty rail track in the mobile. In such case there will be delay.

3. Proposed Work

Our proposed system overcomes both the traditional and current system limitations. In this System robotic module is placed in the train section in which ultrasonic sensors is placed on the side portion of train so that in case of track bend the rays without deviation has the ability to detect the crack. The ultrasonic sensor placed in train sensing the track by spreading the ultrasonic rays over it. The ultrasonic range is about 2 to 3 km in real time applications. In case of crack in track the rays will deviate and the signal reaches the train section with delay. This delay conforms the presence of crack. Once the crack is detected immediately the LCD display in the train displays to the train operator as crack in the railway track. So that the train operator stops the train immediately. This communication to the train unit is done through ZigBee network in prototype.

3.1. System Description

In real time communication RF technology can be implemented. The fire safety technique and collision avoidance also incorporated in the same train. It is done by keeping 6 to 7 smoke sensors in each compartment. Fire sensor is placed in ac compartment. In case of fire the smoke sensor detects the fire in train and notifies in the same LCD display as fire to the operator and train operator informs through bell to the passengers. Collision avoidance is done by MEMS sensors. This sensor is also incorporated in train unit along with sonar sensor. The accelerometer type of MEMS sensor is used to detect the object in track if train is nearing on track.

The microcontroller used is PIC (PIC16F87X) provide high performance RISC CPU. It has only 35 single word instructions. The operating speed is DC - 20 MHz clock input DC - 200 ns instruction cycle. A power supply provides a constant output regardless of voltage variations. Accelerometers can be used to sense inclination, vibration, and shock. Modern accelerometers are often small micro electro-mechanical systems (MEMS), and are indeed the simplest MEMS devices possible, consisting of little more than a cantilever beam with a proof mass (also known as seismic mass). This is used to detect obstacle in railway track. This input is given to ADC because the controller process only the digital input.

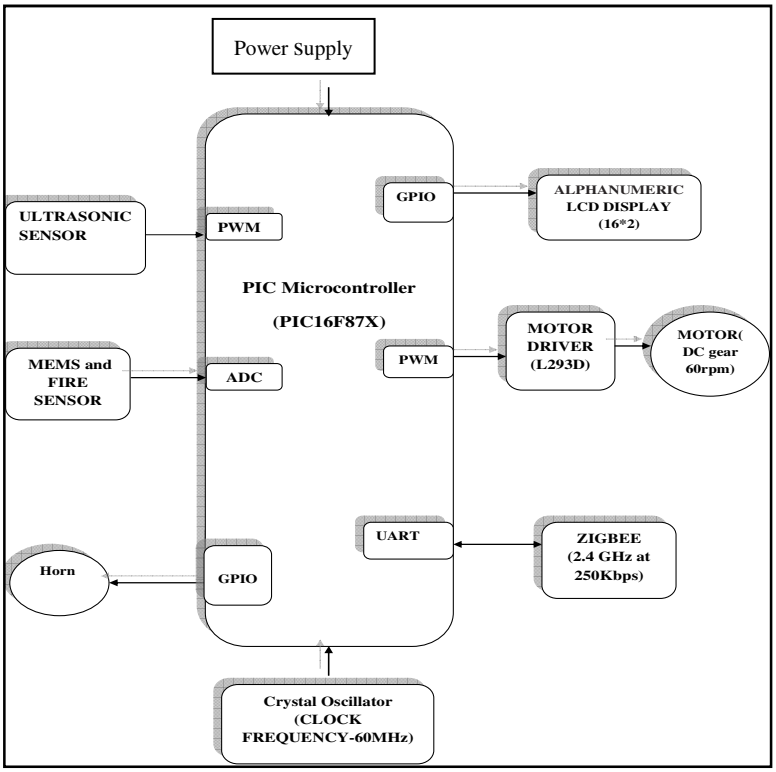

Figure 1: Robotic unit for railway crack detection

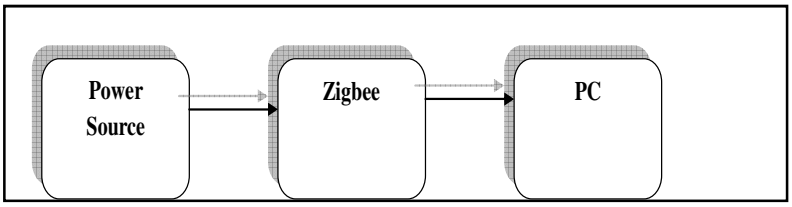

Figure 2: Control Unit for railway tract detection

The ZigBee is the communication protocol based on the IEEE 802.15.4standard for wireless personal area networks (WPANs).It operates with 2.4 GHz frequency at 250 kbps. ZigBee is targeted at radio-frequency (RF) applications which require a low data rate, long battery life, and secure networking. The motor driver used is L293D and the motor speed for the robot is 60 rpm. The crystal oscillator should be given separately to tune the controller to the clock frequency of 60 MHz. The output used is 16 *2 LCD display and horn to alert the driver and passengers in train.

4. Conclusion

The proposed broken rail detection system automatically detects the faulty rail track without any human intervention. There are many ad vantages with the proposed system when compared with the traditional detection techniques. The advantages include less cost, low power consumption and less analysis time. By this proposed system the exact location of the faulty rail track can easily be located which will men die immediately so that many lives can be saved.

5. Future Scope

There are a number of promising directions for further research in condition monitoring in the railways. One future direction is a move toward holistic integrated systems which provide near real-time information and alerts.CCD camera can be placed in integration with robotic circuit so that the defect shape, its position can be photographed and sent to the station nearby regarding the severity of danger.

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