

MOBILE CRACK DETECTION SYSTEM FOR RAILWAY TRACKS USING IR AND PIR SENSORS

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ABSTRACT: This paper proposes a robot for detection of cracks on railway tracks, by which the possibility of accidents can be reduced with frequent assessment. Manual checking for cracks consumes much time and man power, thus to reduce these problems, a method of sensor based detection is proposed in this paper. It incorporates both IR and PIR sensors, GPS & GSM module etc. to identify cracks and obstacles, to position, and to send the message to the concern respectively. It is a cost effective method to detect cracks.

KEY WORDS: IR sensor, PIR sensor, GPS & GSM module;

INTRODUCTION

In India, most of the commercial transport is being carried out by the railway network. Economical development also relay on transportation. The train safety has been a difficulty with the increasing range of incidents being reported that has caused death and injury. Average train accident would price several Indian rupees and these may be avoided if there's a mechanism to trace the crack location and warn the concern.

Due to periodical running of trains over railway tracks, the tracks may get damage or crack after some extent. Thus this necessitates cracks detection manner though there is a change or no change in weather conditions.

The existing methods of Crack Detection are using Rayleigh wave-like wideband guided Ultrasonic waves, Electromagnetic acoustic transducer (EMAT), Composite Detection System [1],[2],[3]. Consumption of time, man power, wages of labour are the major factors which should be considered while checking in a frequent manner. These are the limitations in manual detection method which can be overcome by sensor based detection.

PROPOSED METHODOLOGY

The proposed methodology uses a robot to run over tracks using aurdino AT Mega 328 as a controller, through which all the sensors and motors and GSM & GPS are connected. The block diagram representation of proposed method is shown in figure.(1).

The major components required are aurdino atmega328, infrared transmitter and receiver, global positioning system (GPS), Global System for Mobile communications (GSM) Module, serial communicators, Passive Infrared Sensors (PIR), DC motors, relays, power supply etc.

The importance of each component is described below and its block diagram is shown in fig.1..

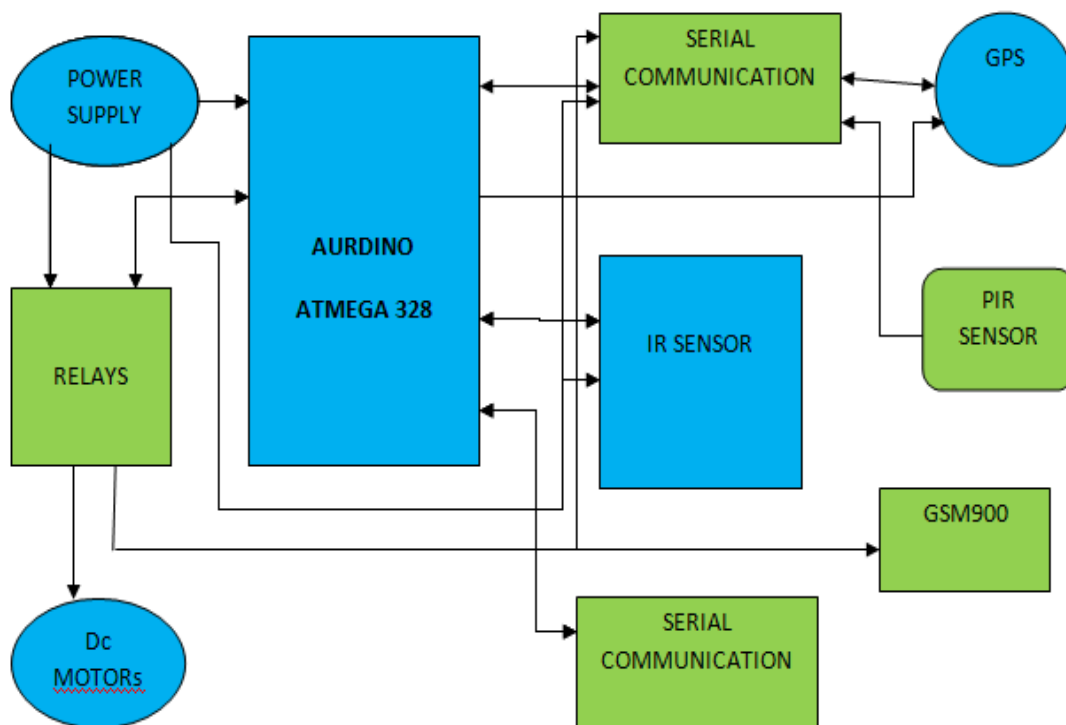


fig. 1. Block diagram representation for proposed method

POWER SUPPLY:

The supply to the circuitry of detection system is depicted in figure.2 consists of three major units, such as a step down transformer, bridge rectifier and filtering unit. The system requires 12V & 5V dc supply, which can be obtained by power supply circuit.

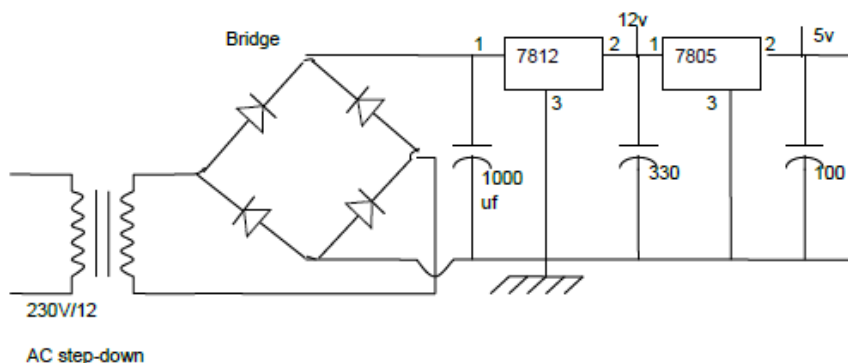


fig. 2. Power supply circuit

The voltage step downs from 230V to 12V using transformer, & bridge rectifier converts AC in to DC. The purpose of filtering unit is to filter out ripples from rectified output. Voltage Regulator plays an important role in any circuit; it provides constant DC voltage to the circuit. And there is another regulator IC7805 used in this system which provides 5V constant DC to the detection circuit.

AURDINO:

Arduino is a small microcontroller board with a USB plug to connect to computer and a number of connection sockets that can be wired up to external electronics, such as motors, relays, light sensors, laser diodes, etc., The actual microcontroller at its heart is the chip called Atmega328 as shown in fig.3.



Fig.3.Aurdino Board

INFRARED TRANSMITTER AND RECEIVER (IR SENSOR):

IR Sensor is shown in fig.4.it has a transmitter and receiver pair.The IR Transmitter sends an IR radiation which is reflected of a surface and falls up on a receiver . Due to the falling of light on the receiver a potential difference is created across the ends. This potential difference is recognized by a microcontroller as HIGH or LOW.

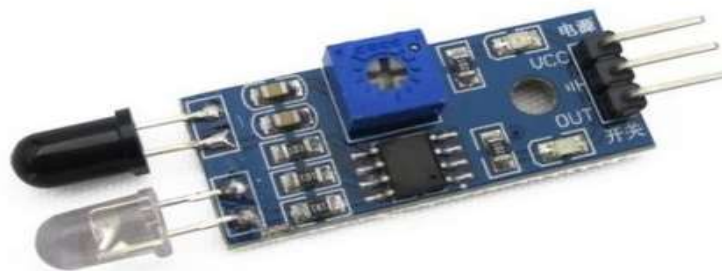


Fig.4.IR sensor module

GLOBAL POSITIONING SYSTEM (GPS):

A Global Positioning System device (GPS) to the distinct location (position) of a vehicle, person, or other asset to which it is affixed and to record the location of the vehicle at regular intervals. The recorded location statistics base can be stored within the tracking unit, or it may be transmitted to a concern using a cellular SMS.

RELAYS

A relay is an electrically operated switch. These are used where it is necessary to control a circuit by a separate low-power signal, or where several circuits must be controlled by one signal.

This design requires 2 relays, each of it controls 2 DC motors. when crack is detected, it receives the signal from the micro controller, and relay terminals gets open circuited and motor stops its movement.

SERIAL COMMUNICATORS:

Serial communication is the process of sending data one bit at a time, sequentially. The MAX232 used as a serial communicator in this design & it is a dual transmitter / dual receiver that typically is used to convert the RX, TX, CTS, RTS signals from sensors to Aurdino.

PASSIVE INFRARED SENSORS (PIR SENSORS) :

These are electronic devices which measures infrared light, radiating from objects in the field of vicinity. Movement of a human body with one temperature, passes in front of a source with different temperature, can be detected.

DC MOTORS:

This design requires 4 DC motors, and it operation relies on relay operation. In these 2 motors are connected to relay1, and another 2motors connected to relay2.

Motors movement is controlled by operation of relay contacts. The direction of motors based on relay operation is shown in table.1.

Relay 1	Relay 2	Direction of movement
ON	OFF	forward direction
OFF	ON	Reverse direction

Table.1.direction of motors movement

WORKING PRINCIPLE:

The principle involved in this crack detection is that light reaching the IR receiver is proportional to the intensity of crack. The robot runs on both the railway track to detect the cracks.

when the crack is detected by the IR sensor, Transmitter and Receiver assembly and sends the signal to the relay .The contacts of the relay gets normally open, then supply to the motors is switched off. Inherently robot stops its movement.

This position measured by the GPS module and this location longitude and latitude is sent tis sent to the personnel through an SMS. And this location can be tracked by using googl maps.

EXPERIMENTAL SETUP:

The robot for railway crack detection scheme experimental setup is shown in below fig.5. This set up is a prototype which was tested for small guage artificial railway tracks.

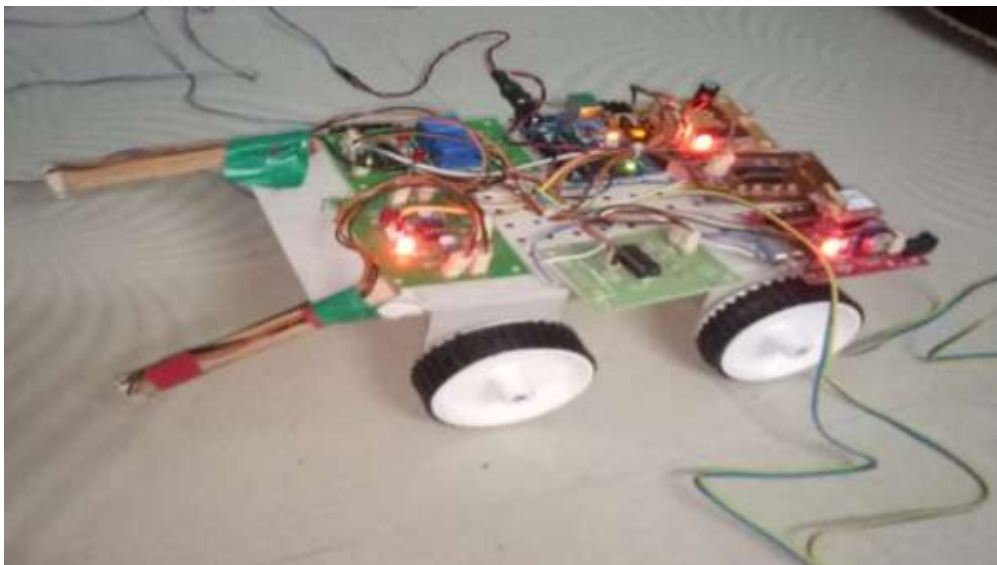


Fig.5.Robot for railway crack detection scheme

RESULTS:

A SMS is sent to the registered number, as shown in fig.6., when the crack is being detected in the form of google maps link. So that it facilitates that, the concern can get the exact location using google maps (fig.7). And also can take the necessary actions.

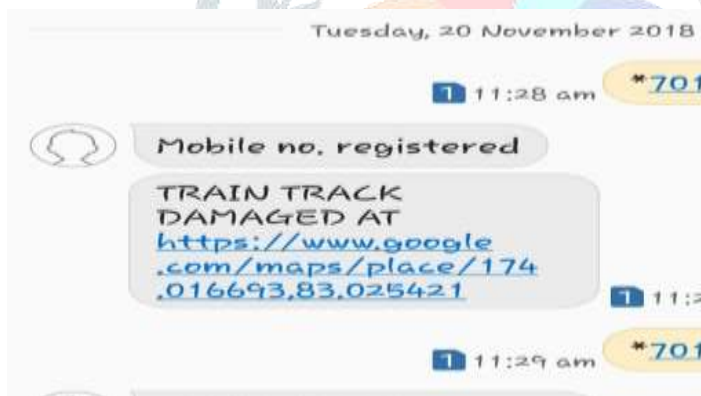


Fig.6. SMS image of CRACK crack detected location



Fig.6. image of CRACK crack detected location in google map

CONCLUSION:

IR Sensor based detection system can detect easily and gives exact location of the crack. The major advantage is that SMS can get to the preferred number. If the concerns changes their work shifts regularly, this method may be more advantageous.

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