

Robotic Detection of Squats in Rails

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Abstract: This paper presents the design of crack finding robot for finding cracks in railway tracks. Here PIC16F877A microcontroller is interfaced with Robot, Zigbee, GPS, LCD and IR sensors. The IR sensors are used to find crack in the railway track, and then GPS is used to find the location. If the microcontroller detects the crack, it immediately gets the location information using GPS and sends that location and crack information to the control section. The control section displays the location in map. The LCD is used to display the current status of this system.

Keywords— Robot, Zigbee, GPS, IR Sensors, LCD, PIC Microcontroller

I. INTRODUCTION

Nowadays public is facing many threats from the railway department by which they are hesitating to plan a train journey. The main reason for this is due to the accidents that occur due to train. The movement of trains depends on railway tracks (rails). If there is a crack in these rails, it creates a major problem.

Most of the accidents in rail way are caused due to cracks in the railway tracks, which is not easy to identify. It takes more time to rectify this problem. In order to avoid this problem, we are using the crack detector robot, which detects the crack in the rails and gives the position of the defect.

When cracks are identified at the initial state the degradation is minor, the tracks can be easily treated by grinding a thin layer from the surface. Systematic and periodical inspections must be performed to keep the tracks in good condition.

The earlier method to find the squats was by manual checking which is very tiring and inaccurate. This method is not very accountable and a great deal of planning was required as they had to do the inspection when the tracks will be free of trains.

The current methods used to detect shortwave defects in the railway tracks include visual inspection are slow and laborious, and the results are dependent on the human operators. Thus there is a need to design an effective monitoring system that can assess the rail conditions more

frequently and accurately is necessary. Thus the automation of the error detection becomes important.

II. SYSTEM DESCRIPTION

The proposed system involves the design of crack finding robot for finding cracks in rail tracks. Here the microcontroller is interfaced with Robot, Zigbee, GPS, LCD and IR Sensor. The IR sensor senses the voltage variation from the cracks and gives the signal to the microcontroller. The microcontroller checks the voltage variations of the measured value with the threshold value. When the microcontroller detects the crack, it immediately gets the location information using GPS and sends that location and crack information to the control section. The control section displays the location in map. The LCD is used to display the current status of the robot.

A. Crack Detection

In the railway tracks a two axis robot is used to find the cracks. As it moves along if there is any cracks in the rails it detects and gives the information to the controlling section. An IR sensor is mounted on the two sides of the two axil robot. The IR radiation that is sent on one side will not be received by the other end if there is no crack in the railway track. When IR radiation is received in the other end the crack on the rail is confirmed. When the crack is detected the PIC Microcontroller will sent a message to the GPS to note the current location of the robot thus effectively finding the crack location. The data from microcontroller is serially transmitted to Zigbee module via MAX232.

B. Control Section

The Zigbee receiver gets the data from the robot. If the crack is detected then corrective action is taken and it is stored for future reference. The Zigbee module can be used as both transmitter and receiver. Zigbee is used for serial communication of the acquired data from the robot to the control section. The range of communication can be varied according to our need.

III. HARDWARE IMPLEMENTATION

A. Power Supply

The power supply must deliver a constant output regulated supply. A 230V/0-12V (1mA) transformer is used for this purpose. The primary of the transformer is connected through switch for protection. The secondary is connected to the diodes to convert 12V AC to 12V DC voltage. And filtered by the capacitors, which is further regulated to +5v, by using IC 7805.

B. LCD

A liquid crystal display (LCD) is a flat panel display, electronic visual display, or video display that uses the light modulating properties of liquid crystals (LCs). LCs does not emit light directly. LCD is used to display the results of the system operation such as sensed values, motor status etc....

Hitachi's HD44780 LCD is used here. It supports 80 characters. It consists of 14 pins with one controller.

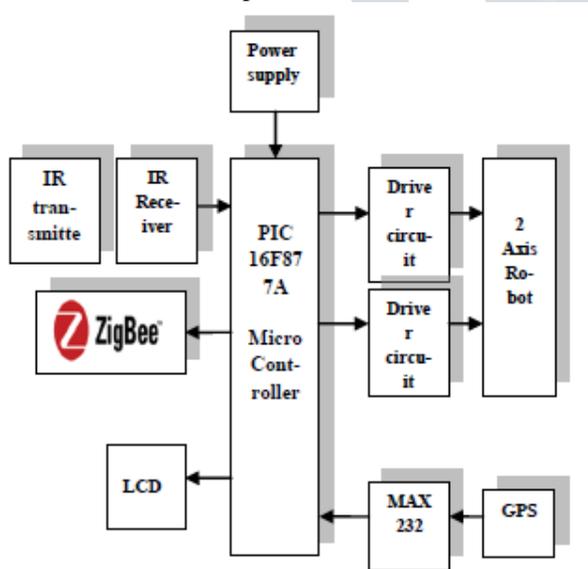


Fig1. Crack detection module

C. ZIGBEE

Zigbee is a suite of high level communication protocols using small, low-power digital radios based on an IEEE 802 standard for personal area networks. It is a wireless technology and operates in 2.4-2.482GHz in this system. The Zigbee module acts as both transmitter and receiver. The data from microcontroller is serially transmitted to Zigbee module via UART port.

D. IR Sensor

The IR sensor senses the voltage variation from the cracks and gives the signal to the microcontroller. The microcontroller checks the voltage variations of the measured value with the threshold value.

E. Driver Circuit

The ULN2003 is a monolithic high voltage and high current Darlington transistor arrays. It consists of seven NPN darlington pairs that features high-voltage outputs with common-cathode clamp diode for switching inductive loads. The collector-current rating of a single Darlington pair is 500mA. The darlington pairs may be paralleled for higher current capability. Applications include relay drivers, hammer drivers, lamp drivers, display drivers (LED gas discharge), line drivers, and logic buffers.

The ULN2003 has a 2.7kW series base resistor for each Darlington pair for operation directly with TTL or 5V CMOS devices.

F.Features

- 500mA rated collector current (Single output)
- High-voltage outputs: 50V
- Inputs compatible with various types of logic.
- Relay driver application

G. PIC 16F877A

In the 16F877A PIC Microcontroller, the 40 pins are made to use the peripherals functions. The specifications of this device is given bellow

High-Performance RISC CPU:

- Operating speed: 20 MHz, 200 ns instruction cycle
- Operating voltage: 4.0-5.5V
- Industrial temperature range (-40° to +85°C)
- 15 Interrupt Sources
- 35 single-word instructions
- All single-cycle instructions except for program branches (two-cycle)

Special Microcontroller Features:

- Flash Memory: 14.3 Kbytes (8192 words)
- Data SRAM: 368 bytes
- Data EEPROM: 256 bytes
- Self-reprogrammable under software control
- In-Circuit Serial Programming via two pins (5V)
- Watchdog Timer with on-chip RC oscillator
- Programmable code protection
- Power-saving Sleep mode
- Selectable oscillator options
- In-Circuit Debug via two pin

Peripheral Features:

- 33 I/O pins; 5 I/O ports
- Timer0: 8-bit timer/counter with 8-bit prescaler
- Timer1: 16-bit timer/counter with prescaler

Can be incremented during Sleep via external crystal/clock

- Timer2: 8-bit timer/counter with 8-bit period register, pre scaler and post scaler
- Two Capture, Compare, PWM modules
 - 16-bit Capture input; max resolution 12.5 ns
 - 16-bit Compare; max resolution 200 ns
 - 10-bit PWM
- Synchronous Serial Port with two modes:
 - SPI Master
 - I2C Master and Slave
- USART/SCI with 9-bit address detection
- Parallel Slave Port (PSP)
 - 8 bits wide with external RD, WR and CS controls
 - Brown-out detection circuitry for Brown-Out Reset

H. GPS

The Global Positioning System (GPS) is a U.S. space-based Global Navigation Satellite System. It provides reliable positioning, navigation, and timing services to worldwide users on a continuous basis in all weather, day and night, anywhere on or near the Earth.

GPS satellites broadcast signals from space that are used by GPS receivers to provide three-dimensional location (latitude, longitude, and altitude) plus the time.

The basic idea is to gauge GPS inaccuracy at a stationary receiver station with a known location. Since the DGPS hardware at the station already knows its own position, it can easily calculate its receiver's inaccuracy. In general, access to this correction information makes GPS receivers much more accurate than ordinary receivers.

I. MAX232

MAX 232 is a converter chip mainly for the purpose of microcontroller boards. It provides two channel RS232C port. It is a serial port interface device. In asynchronous transmission when there is no transfer the signal is high, transmission begins with the start (low) bit LSB first. Finally one stop bit (high).

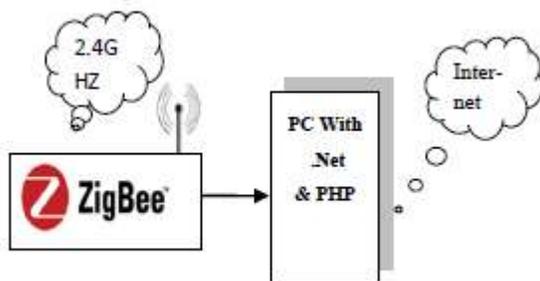


Fig2. Controller Section Module

J. PC

A Personal Computer is interfaced with the Zigbee for the storage of the received information. And it is also used for future monitoring.

IV. CONCLUSION

In the existing system manual work is needed for monitoring cracks in rails. But in our proposed system we are going to detect cracks in railway tracks automatically. Microcontroller PIC 16F877A is the heart of the system interfaced with the other components. The mechanism is controlled by the PIC Microcontroller. Software tools like Keil Compiler, Embedded C and .Net is preloaded to the source code into the microcontroller. In order to meet the specification and requirement the design is done.

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