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LOW COST RAILWAY TRACK SECURITY SYSTEM

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ABSTRACT

Railway is lifeline of India and its being the cheapest modes of transportation are preferred over all other means of transportation. Rail accidents occur more due to derailments than collision or fire in train. These derailments are due to cracks in the railway tracks .The major concern is to detect the cracks for quick remedial actions security system can be implemented with latest technologies. Therefore, this paper proposes the crack detection system in the rail tracks. This is to avoid Rail accidents by using latest communication technologies. Here, GSM communication protocols are used to convey the message of crack detection via SMS.

Keywords: 8051 Microcontroller, Crack detection circuit, GSM Modem, LCD, MAX 232.

I. INTRODUCTION

India has fourth largest railway networking the world exceeded only by those of the United States, Russia and China. Its operation covers 29 states and seven union territories and also provides limited International services to Nepal Bangladesh and Pakistan. It is one of the world's largest railway networks comprising 115,000 km (71,000 mi) of track over a route of 65,808 km (40,891 mi) and 7,112 stations. The first railway on Indian sub-continent ran over a stretch of 21 miles from Bombay to Thane. The idea of a railway to connect Bombay with Thane, Kalyan and with the Thal and Bhore Ghats inclines first occurred to Mr. George Clark, the Chief Engineer of the Bombay Government, during a visit to Bhandup in 1843. Thus the first section of the East Indian Railway was opened to public traffic, inaugurating the beginning of railway transport on the Eastern side of the subcontinent. These were the small's beginnings which is due course developed into a network of railway lines all over the country. By 1880 the Indian Railway system had a route mileage of about 9000 miles. **INDIAN RAILWAYS**, the premier transport organization of the country is the largest rail network in Asia and the world's second largest under one management. Indian Railways is a multi-gauge, multi-traction system.

Indian Railways runs around 11,000 trains everyday, of which 7,000 are passenger trains. Constitution of Rs.17,000 crore non-lapsable Special Railway Safety Fund (SRSF) to replace the arrears of aging assets of Railways over the next six years has been a historical move in this direction. A number of distressed bridges, old tracks, signaling system and other safety enhancement devices will be replaced during this period. As far as budget allocation for safety is concerned, Rs.1, 400 crore was allocated in the revised estimate for the year 2001-02 and Rs.2, 210 crore for the year 2002-2003. Extensive field trials of the Anti-Collision Device (ACD), indigenously developed by Konkan Railway, is going on and once deployed across the Zonal Railways, this innovative technology will help railways reduce accidents due to collision between trains.

Rail track security is naturally a concern for the authority. In all transport systems, particularly in case of railways, safety and reliability are of paramount importance. In recent years, with the development of railways [1], usage of the trains is constantly increasing. Derailment occur due to incorrect gauge, Broken rails, Defects in vehicles, etc. The Indian Railway Safety Act came into effect in January 1989[9]. It was designed to improve rail safety by managing rail safety regulatory frame work. The survey in 2011 until month of July comments that the frequency of accidents is going and in that year itself 11 accidents occur. To explain the root of trouble, the accidents in railways are owed to60% derailments and 90% crack troubles. In December 2006, the government announced the Railway Safety Act Review to further improve railway safety in India and to promote a safety culture within the railway industry while preserving and strengthening the vital role this industry plays in the Indian economy.

II. REVIEW OF TRACK SECURITY

The Indian Railway is the fourth largest network in the world carrying 18 million people to their destinations each day. More than 16,000 trains run on Railway tracks each day. But sadly 15% of all the railway accidents across the world (177) occurred last year happened in India. The *Report of High Level Safety Review Committee* of 2012 states that from 2007–08 to October 2011 railway accidents took 1019 lives and injured 2118 in India.
Indian Railways lack funds for investment. Accident rate is near about 300 accidents each year which is very high and need immediate attention. Though incidents of derailment and collision have reduced to a great extent but human error and fire are still posing a problem. Long range ultrasonic techniques are used for crack detection [6].Wireless sensor network technique [7] and electromagnetic system [8] are also used in detecting rail cracks. A suitable array of transducers is developed that is able to generate selected [3] guided wave modes in rails which allow a reliable long range inspection of the rail. The railways traverse the length and breadth of the country and carry over 30 million passengers and 2.8 million tons of freight daily. The review of train accidents of last 5 years for which data is available [5] indicates that a large number of accidents happen because of derailments and at level crossing.
A bar graph of collision and miscellaneous accidents is shown in Fig. 1.

Table1 Type of accidents and there frequencies

Number Of Train accidents						
Year	***collisions***	***derailments***	***Level Crossing accidents***	***Fire In Trains***	***Misc Accidents***	***total***
2009-10	9	80	70	2	4	165
2010-11	5	78	53	2	1	139
2011-12	9	55	61	4	2	131
2012-13	6	48	58	8	0	120
2013-14	4	52	51	7	3	117

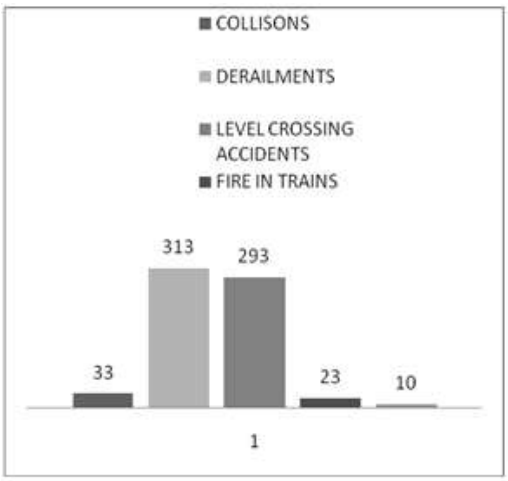

Fig.1. Bar chart of accidents and their frequency

III. STATUS OF RAILTRACK SECURITY SYSTEM

1.Derailment occur due to incorrect gauge, broken rails, defects in vehicles-defective springs, broken axles, speed too high, sudden application of breaks, etc.[4].

2. Ultrasonic technique used for long range crack detection [6].

3. With the help of Rotating Electromagnetic Field Crack Detection System, we can detect flat and internal cracks initiated from manufacturing defects with diameter less than 1mm [8].

4. Laser Proximity Detector used for collision avoidance and IR sensors identifies crack in Railway Track [3].

5. Image Processing Techniques have been explored to formulate solutions to the problem of railway crack detection and provides better accuracy; this method uses techniques like image segmentation, morphology and edge detection [2].

IV. PROPOSED TECHNIQUE

Fig.2 shows the block diagram of crack detection on railway tracks. The circuit uses standard power supply comprising of a step-down transformer from 230v to 12v and 4 diodes forming a Bridge Rectifier that delivers pulsating dc which is then filtered by an electrolytic capacitor of about 470microf to 100microF .The filtered DC being unregulated, IC LM7805 is used to get 5V constant at its pin number 3 irrespective of input DC varying from 9V to 14V.

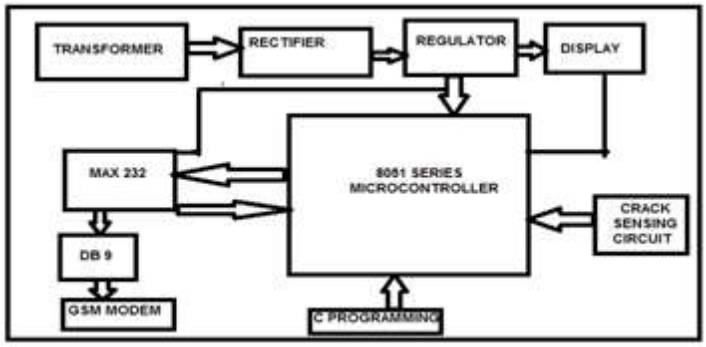

Fig.2. Block diagram for crack detection

The regulated 5V DC is further filtered by a small electrolytic of 10 microF for any noise so generated by circuit. One LED is connected of this 5V point in series with a resistor of 330ohm to the ground that is negative voltage to indicate 5V power supply availability.

A GSM modem is used to send the position (Latitude and Longitude) of the train from a remote place. It is a communication standard using time division multiple access technique. GSM modem works with 12V DC and its frequency range is 900MHz and the microcontroller works with 5V. Therefore, interfacing of this modem with microcontroller directly is not possible due to mismatch of voltage levels.

In view of above, GSM modem is interfaced with 8051 microcontroller through MAX232 with the help of RS232 cable for serial communication. MAX232 device is used to convert TTL logic level to RS232 level during serial communication of microcontroller to the GSM modem. The RS232 device is an interface between data terminal equipment and data communication equipment using serial binary data exchange. The RS232 cable is commonly available with the 9 or 25 pin wiring and has jumpers to provide handshaking pins for those devices that require it.

The GSM modem is interfaced to the 10&11 pins of the microcontroller using the MAX232 device for transmitting and receiving of the information serially. The LCD display is connected to the port0 of the microcontroller for displaying the information. A crystal oscillator is connected to the 18th and 19th pins of the microcontroller to generate clock pulses. The RESET button is connected to the 9th pin of the microcontroller for rebooting the controller when it is not working correctly.

When the GSM modem is connected to the microcontroller, then it communicates with a mobile via a UART protocol and requires three basic signals such as TXD, RXD and GND. The GSM modem is connected to the microcontroller; it controls the industrial appliances through an SMS. When the modem receives the SMS from an operational phone, serially that data is sent to the microcontroller. This microcontroller compares this data with the stored data. If the compared data match with the stored data, then the microcontroller generates corresponding signals to control the load.

Crack sensing circuit- Two rails forming part of track are made using pair of wire, connected with detachable jumper in between each wire/track. Removing detachable jumper creates a fault in respective path otherwise it is shorted by jumper wire to stimulate healthy track condition .Removing jumper's result in driving transistors delivering different logic to controller. The program after that takes over to send a SMS through GSM modem the status of track condition is displayed.

Software required is Kiel complier. The language used can be Assembly language or Embedded C. Compared to assembly language C code is more reliable. Desktop compilers produce an output object code for the underlying microprocessor, but not for other microprocessors that is the programs written in one of HLL like C will compile the code to run on the system for a particular processor like x86.

V. CONCLUSION

The developed circuit along with software can be used for implementation of the railway crack detection circuit and security system. The main component of the system is the Crack detection circuit. The GSM Modem helps to alert the railway authorities about the crack in the tracks. Hence it is expected that major train mishaps can be prevented and human life saved if this system is implemented.

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