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A Smart Sensor Signal Assisting System for Railway Compartment

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A B S T R A C T

The India Railways travel scheme is the longest in the world and has the highest number of trains compared to other developed countries. Millions of people transported by train every day. Thus there is not even the slightest bit of security in the train compartments (wagon) that people travel on. To date, there is no communication device to detect the dangers posed by train carriages. If there is a sudden fire in the train compartments, a leak of poisonous gases, if someone drinks alcohol or pulls the emergency chain, the railway control room is not likely to know. The danger of doing so could not be avoided. We are introducing an information device as a solution to these problems. The power of WSN technology to monitor the railway wagon health condition and the vertical displacement of railway wagons has yet to be fully explored. The different sensors like fire, smoke, alcohol, acoustic are molded in each compartment, and the output of the sensors is connected with a wireless communication module such as Xbee10. The emergency data is communicated to the control room through a wireless network. In the control room of the train, there is exist a display unit as well as alerting system. The display unit shows the information about each wagon's parameters. The alerting system enabled if any conflicts happened in any wagon of the train. This system also includes monitoring the railway track cracks based on EM waves. The smart wireless communication schemes are used to communicate the information about cracks to control the unit for preventing accidents

Keywords: train health monitoring, crack detection and WSN protocol.

Introduction

The demand for railway services was enriched, railway watching systems continue to advance at a stimulating pace to keep up reliable, safe, and secure operation. A railway infrastructure is that the lack of safety and security watching runs the risk of train collision, train mischance, terrorist threats, and failures within the train wagons, etc. The performance of railway vehicles are running on tracks is very ample by the lateral instability inherent to the planning of the wagon's steering and therefore the response of the railway compartment to individual or combined track irregularities. Railway track irregularities have to be compelled to be unbroken inside safe operational margins by enterprise acceptable maintenance programs. Monitoring vehicle characteristics in real time from track measure information been addressed by numerous analysis organizations. Wireless detector networks (WSNs) area unit wide wont to monitor railway tracks and irregularities, notice abandoned objects in railway stations, develop intrusion detection systems, secure railway operations, and monitor tunnels.

Literature Review

Recent advances in wireless sensor networking techniques have to be encouraged interest in the development of vehicle health monitoring systems. These have the power for use in the monitoring of railway signaling systems and railway tracks. Energy efficiency is one of the most important design factors for the WSNs as the typical sensor node sare equipped with limited power batteries. In earlier research, an energy-efficient cluster-based adaptive time-division multiple access medium-access-control protocol, named EA-TDMA, has been made by the authors for the purpose of communication between the sensors placed in a railway compartment. This paper proposes another new protocol named E-BMA, which achieves even better energy efficiency for medium traffic by minimizing the idle time during the contention period. In addition to railway applications, the EA-TDMA and E-BMA protocols are suitable for general wireless data communication purposes. Both analytical and simulation results for the energy consumption of TDMA, EA- TDMA, BMA, and E-BMA have been presented in this paper to demonstrate the power of the EA-TDMA and E-BMA protocols. With the increased demand for railway services, railway wagon monitoring systems continue to advance at a remarkable pace to maintain reliable, safe, and secure operation.

The lack of safety and security monitoring of railway infrastructure runs in the risk of train collision, train derailment, terrorist threats, and failures in the train wagons, and etc. The performance of rail vehicles running on tracks is very limited by the lateral instability inherent to the design of the wagon's steering and the response of the railway wagon to individual or combined track irregularities. Railway track irregularities need to be kept within the safe operating margins by undertaking appropriate maintenance programs as per the guidelines. Track geometry inspection and monitoring enhances train- operating safety and reduced vehicle and track dynamic interaction with people.

PROPOSED SYSTEM

The potential of WSN technology to monitor the railway wagon health condition and the vertical displacement of railway wagons has yet to be fully explored. The different sensors like fire, smoke, alcohol, acoustic are molded in each compartment and the output of the sensors is connected with wireless communication modules such as Xbee10. The emergency data is communicated to the control room through a wireless network. In the control room of the train, there is exist a display unit as well as alerting system. The display unit shows the information about each wagon's parameters. The alerting system enabled if any conflicts happened in any wagon of the train. This system also includes monitoring the railway track cracks based on EM waves. The smart wireless communication schemes are used to communicate information about cracks to the control unit for preventing an accident. The zigbee in monitoring unit receives the information from wagnor unit. The output of the zigbee is applied to the input of microcontroller through MAX232.The microcontroller activates the buzzer to produce the alarm sound and the information about the compartment is displayed using liquid crystal display unit. In this system consists of two main sections one is wagnor section and another one is monitoring section. The wagnor unit consists of alcohol sensor, Smoke sensor, Fire sensor, panic button, Zigbee, AT89S52 microcontroller, MAX232 and power supply unit. The receiver consists of Zigbee, MAX232, LCD, AT89S52 microcontroller, buzzer and power supply unit.

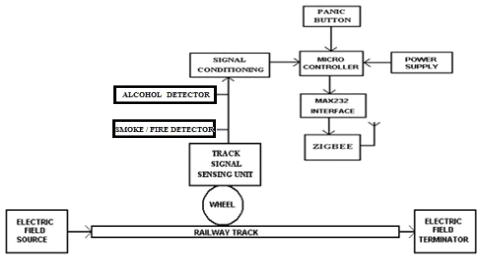

Fig. 1 - Block Diagram of Wagnor Unit.

In this section different sensors can be used to detect various parameters like smoke, fire, alcohol from the all rail compartments. The thermistor can be used to detect the fire and it produces the electrical voltage according to input sensing heat due to fire. The MQ-6 sensor can be used to detect the smoke as well as alcohol and it produces the electrical voltage according to their input. In this section different sensors can be used to detect various parameters like smoke, fire, alcohol from the all rail compartments. The thermistor can be used to detect the fire and it produces the electrical voltage according to input sensing heat due to fire. The MQ-6 sensor can be used to detect the smoke as well as alcohol and it produces the electrical voltage according to their input. The panic button is used to stop the train motion and operated by passenger from the place where in any compartment. These sensors outputs are applied to the input of AT89S52 microcontroller through signal conditioner i.e., transistor driver.

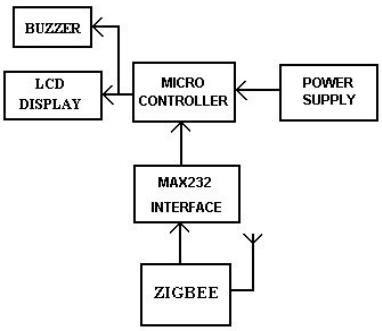

Fig. 2 - Block Diagram of Monitoring Unit.

Railway track and wheels can made up of heavy ion metal. This ion metal has heavy conduction material. The electric field source is applied to the input of track which act as a conduction medium. The wheels of train on the track and it conduct the electric field. The field is applied to the input of microcontroller through transistor driver.

When the track is cracked the electric field doesn't conduct it shows the damaged condition of track. The microcontroller doesn't receive the input signal when the track is cracked condition. The information about all the wagnor as well as track parameters are communicated from microcontroller to control section through Zigbee protocol. The IC MAX232 is placed between microcontroller and Zibee for matching the voltage level of both devices.

HARDWARE DETAILS

- ***Arduino***

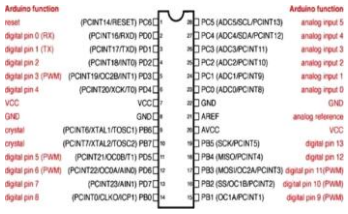

Fig. 2 - Pin Diagram of Arduino

Fig 3 representing the pin diagram of Arduino UNO. The AT89S52 is a low-power and high-performance CMOS 8-bit microcontroller with 4K bytes of In-System Programmable Flash memory. The device is manufactured using Atmel's high-density nonvolatile memory technology with many functions and is compatible with the industry- Standard 80C51 instruction set and pin-out. The on-chip Flash allows the program memory to be reprogrammed in- system or by a conventional nonvolatile memory to the programmer by its application.

The AT89S52 provides the 4K bytes of Flash, 128 bytes of RAM, 32 I/O lines and Watchdog timer, two data pointers, two 16-bit timer/counters, a five vector two-level interrupt architecture is a full duplex serial port and on-chip oscillator, and clock circuitry architecture. In addition, the AT89S52 is designed with static logic for a operation down to zero frequency and supports two software selectable power saving modes. The Idle Mode stops the CPU while allow the Random Access Memory, timer/counters, serial port, and interrupt system to continue functioning. The Power-down mode saves the RAM contents but freezes the oscillator, disabling all other chip functions are the next external interrupt or hardware reset is very useful for optimization.

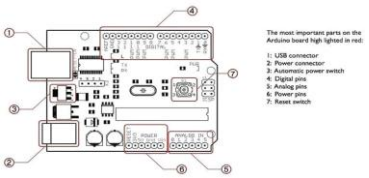

Fig. 4 - Parts in Arduino Board.

- ***MAX 232***

The MAX232 is an Integrated Circuit, first created in 1987 by Maxim Integrated Products, that converts signals from an RS-232 serial port to signals suitable for use in TTL compatible digital logic circuits. The MAX232 is having dual driver or receiver and typically converts the RX, TX, CTS and RTS signals for many purposes. The drivers provide RS-232 voltage level outputs from a single + 5 V supply via on-chip charge pumps and external capacitors. This makes it useful for implementing RS- 232 in devices that otherwise do not need any voltages outside the 0 V to + 5 V range, as per the power supply design does not need to be made more complicated because just for driving the RS-232 in that case. The receivers reduce have RS-232 inputs, to standard 5 V TTL levels. These receivers having a typical threshold of 1.3 V, and a typical hysteresis of 0.5 V. Fig 5 representing the pin diagram of MAX232.

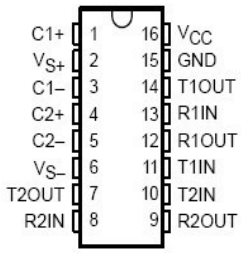

Fig. 5 - Pin Diagram of MAX232 .

- ***ZIGBEE PROTOCOL***

ZigBee is a specification for a suite of high level communication protocols using small, low-power digital radios for wireless personal area networks (WPANs), such as wireless headphones connecting with cell phones via short-range radio. The technology is defined by the ZigBee specification is intended to be simpler and less expensive than other WPANs, such as Bluetooth. This is targeted at radio frequency applications that require a low data rate, long battery life, and secure networking. The Fig 6 representing ZIGBEE communication protocol.
Even though the radios themselves are low expensive, the ZigBee Qualification Process involves a full validation of the requirements of the physical layer. This amount of benefits about the Physical Layer have multiple benefits, since all radios derived from that semiconductor mask set would enjoy thesame RF characteristics.

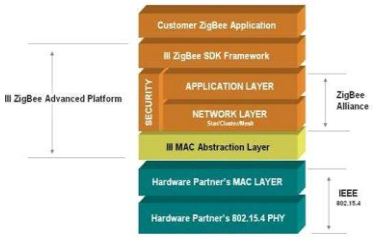

Fig. 6 - ZIGBEE Protocol Layers.

RESULT

The output of the smart sensor signal assisting system for railway compartment is obtained by the following hardware connection.

Fig. 7 - Connection of Railway Wagnor Unit.

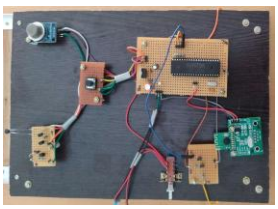

Fig. 8 - Hardware Connection of Railway Wagnor Unit.

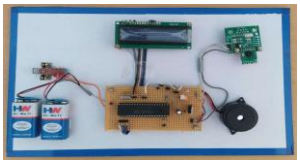

Fig. 9 - Hardware Connection of Railway Monitoring Unit.

CONCLUSION

In this system successfully done for detecting and alerting of different hazard parameters from each railway wagnor as well as track and it communicates the information about the wagnor to engine control wagnor. The bridge monitoring system also included in this unit. The train operator turn look for display unit when alert sound enabled. The LCD display unit is fixed in engine wagnor which shows the information about the different wagnor hazard measurements.

Acknowledgements

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