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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.

1. 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.

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2. LITERATURE REVIEW

The development of vehicle health monitoring systems must be fostered by recent improvements in wireless sensor networking approaches. These have the capability of being used to monitor railway signaling systems and tracks. Because most sensor nodes have limited power batteries, energy economy is one of the most significant design factors for WSNs. The authors previously developed the EA-TDMA protocol, which is an energy-efficient cluster-based adaptive time-division multiple access medium-access-control protocol for communication between sensors in a railway compartment. This work presents E-BMA, a novel protocol for medium traffic that delivers even better energy efficiency by reducing idle time during the contention period. The EA-TDMA and E-BMA protocols are appropriate for general wireless data transfer in addition to railway applications. This study presents both analytical and simulation data for the energy consumption of TDMA, EA-TDMA, BMA, and E-BMA protocols to show the power of the EA-TDMA and E-BMA protocols. Railway wagon monitoring systems continue to progress at a remarkable rate in order to maintain a reliable, safe, and secure operation, despite the rising demand for railway services.

Lack of railway infrastructure safety and security monitoring increases the chance of train collisions, derailments, terrorist threats, and train wagon malfunctions, among other things. The lateral instability inherent in the wagon's steering design, as well as the railway wagon's response to individual or combined track abnormalities, severely limit the performance of rail vehicles running on tracks. Railway track imperfections must be kept within safe operating margins by following the rules and implementing appropriate repair programs. Inspection and monitoring of track geometry improves train operation safety and reduces vehicle and track dynamic interaction with humans..

3. 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.

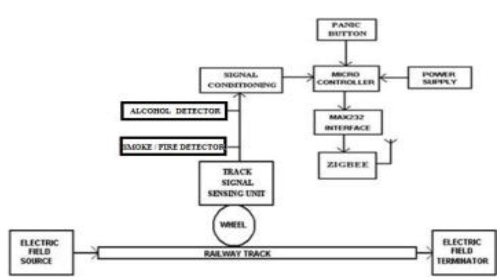

Fig. 1 - Block Diagram of Wagnor Unit.

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.

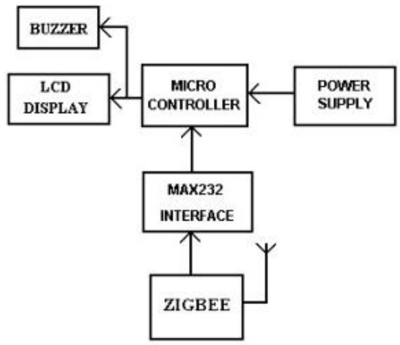

Fig. 2 - Block Diagram of Monitoring Unit.

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.

4. HARDWARE DETAILS

4.1. Arduino

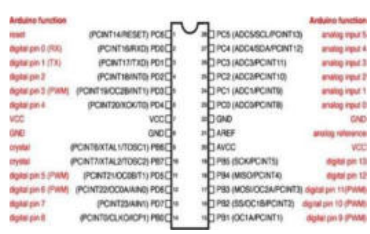

Fig. 2 - Pin Diagram of Arduino

The pin diagram of the Arduino UNO is shown in Figure 3. The AT89S52 is a CMOS 8-bit microcontroller with 4K bytes of In-System Programmable Flash memory that is low-power and high-performance. The device is made with Atmel's high-density nonvolatile memory technology and has a lot of features. It also uses the industry-standard 80C51 instruction set and pin-out. The on-chip Flash memory permits the program memory to be reprogrammed in-system or via a nonvolatile memory to the programmer.

The AT89S52 has 4K bytes of Flash, 128 bytes of RAM, 32 I/O lines, a Watchdog timer, two data pointers, two 16-bit timer/counters, a full duplex serial port, on-chip oscillator, and clock circuitry architecture. Furthermore, the AT89S52 is built with static logic for operating at zero frequency and includes two software-selectable power-saving modes. The CPU is turned off in Idle Mode, while the RAM, timers/counters, serial port, and interrupt system continue to work. The Power-down mode saves the RAM data but freezes the oscillator, stopping all other chip functions until the next external interrupt or hardware reset.

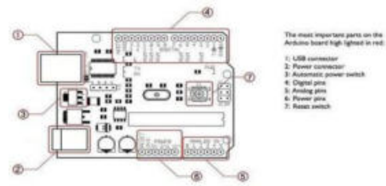

Fig. 4 - Parts in Arduino Board.

4.2. MAX 232

The MAX232 is a Maxim Integrated Products integrated circuit that translates signals from an RS-232 serial port to signals appropriate for use in TTL compatible digital logic circuits. It was initially introduced in 1987. The MAX232 is a dual driver or receiver that transforms RX, TX, CTS, and RTS signals for a variety of applications. The drivers use on-chip charge pumps and external capacitors to create RS-232 voltage level outputs from a single + 5 V supply. This makes it handy for implementing RS-232 in devices that do not require any voltages outside of the 0 V to + 5 V range, as the power supply design does not need to be complicated because it is only used to drive the RS-232. The receivers' RS-232 inputs are reduced to typical 5 V TTL levels. The typical threshold of these receivers is 1.3 V, with a typical hysteresis of 0.5 V. The MAX232 pin diagram is shown in Figure 5.

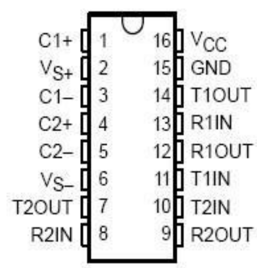

Fig. 5 - Pin Diagram of MAX232 .

4.3. ZIGBEE PROTOCOL

ZigBee is a set of high-level communication protocols for wireless personal area networks (WPANs) that use small, low-power digital radios, such as wireless headphones that connect to cell phones through short-range radio. The ZigBee specification defines a technology that is meant to be simpler and less expensive than existing WPANs, such as Bluetooth. Radio frequency applications that demand a low data rate, extended battery life, and secure networking can benefit from this. The ZIGBEE communication protocol is depicted in Figure 6.

Despite the inexpensive cost of the radios, the ZigBee Qualification Process requires a thorough examination of the physical layer's needs. Because all radios created from that semiconductor mask set would have the identical RF characteristics, this amount of benefits about the Physical Layer has several benefits.

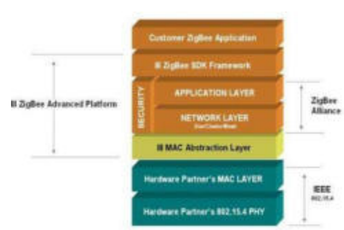

Fig. 6 - ZIGBEE Protocol Layers.

5. 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.

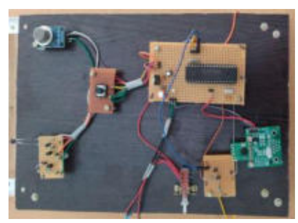

Fig. 8 - Hardware Connection of Railway Wagnor Unit.

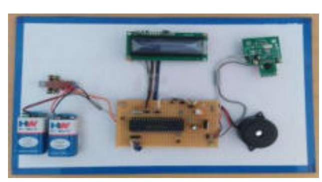

Fig. 9 - Hardware Connection of Railway Monitoring Unit.

6. 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.

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