ISSN 2394-3777 (Print)
ISSN 2394-3785 (Online)
Available online at www.ijartet.com

International Journal of Advanced Research Trends in Engineering and Technology (IJARTET)
Vol. 4, Special Issue 19, April 2017

RAILWAY TRACK CIRCUIT FAULT DIAGNOSIS USING ZIGBEE MODULE

S.Devi[1], M.Hemalatha[2], R.Subhashini[3], Mrs.B.Gowri Predeba[4]
[1, 2,3]UG Scholars and [4]Assistant Professor, Department of Electronics and Communication Engineering
Kings Engineering College, Anna University, India.

Abstract*—Timely detection and the identification of faults in the railway track circuits are crucial for the safety and availability of railway networks. In this paper, we have propose fault identification circuit at level crossings and certain specified types by using ZIGBEE MODULE along with various sensors like temperature sensor, humidity sensor, MEMS and Infrared sensor for identifying faults in the track circuit. Identified faults are informed quickly to the nearest stations and to the train operators using the ZIGBEE MODULE to avoid accidents.

Key words-Zigbee module, arduino UNO, sensors.

INTRODUCTION

Indian Railways are the largest rail-passenger transport in today's world and it is the backbone of the country's transport infrastructure. In India, most of the commercial transport is being carried out by the railway network because it is being cheapest mode of transportation preferred over all other means of transportation. The rapidly developing economy of India has resulted in an exponentially increasing demand for transportation in recent years, and this has resulted into an enormous rise in the volume of traffic in the Indian Railway network.

The principal problem has been the lack of proper maintenance of rails which have resulted in the formation of cracks in the rail track and other similar problems caused by antisocial elements which jeopardize the security of operation of rail transport. Analysis of the factors which causes these rail accidents, recent statistics show that approximately 60% of all the rail accidents have their cause as derailments, out of which about 90% is due to cracks or breaks in rails either due to natural causes (like excessive expansion due to heat) or due to anti-social elements. The term accident envelopes a wide spectrum of occurrences with or without significant impact on the system. Consequential train accidents include mishaps with serious repercussion in terms of loss of human life or injury, the damage to railway property or the interruption to rail traffic in excess of laid down threshold levels and values. These consequential train accidents include collisions, derailments, fire in trains, road vehicles colliding with train's miscellaneous train mishaps.

LITERATURE REVIEW

In general, there exist two main categories of techniques are currently used for the damage identification and for the condition monitoring of railway tracks.

Visual inspections: Visual inspection is the primary technique used for defect identifications in the tracks, and is effectively used in specialized disciplines. The successful implementation of this method generally requires the regions of the suspected damage to be known as a first step. The damage can be suspected by riding the trolleys all over the track and be readily accessible for physical inspection. But the visual Inspection could be costly, time consuming and ineffective for large and complex structural systems such as the rail track.

Neural network: Neural network based IR sensor approach to fault diagnosis in railway track circuits. Faults are detected by predicting the values that the sensors will measure and comparing these with the true values. Methods for fault classification is based on predicting the output of a system are common as well. Artificial neural networks have achieved the state-of-the-art performance on several pattern recognition tasks. One reason for these successes is the use of a strategy called end to end learning. This strategy is based on moving away from hand-crafted feature detectors and manually integrating prior knowledge into the network. Instead, networks are trained to produce their end results directly from the raw input data. Since the railway track network is a large network, neural network is not realistic to assume that additional monitoring devices will be installed on each track circuit.

PROPOSED SYSTEM

The sensors are employed at the track. When the supply is provided, the sensors will start to sense the values. An IR sensor is used to detect the breakage on the Railway tracks.

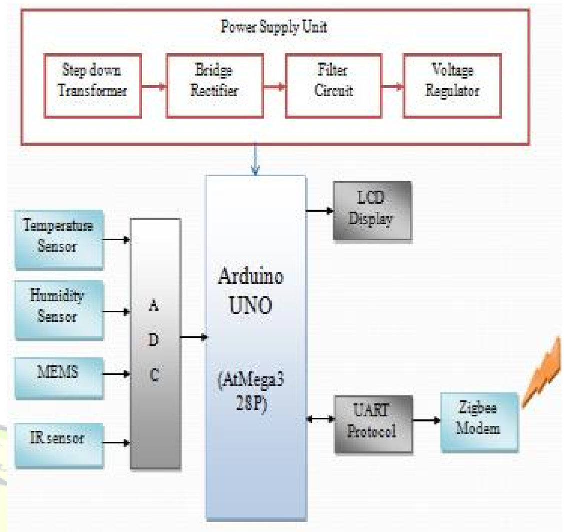
ISSN 2394-3777 (Print)
ISSN 2394-3785 (Online)
Available online at www.ijartet.com

International Journal of Advanced Research Trends in Engineering and Technology (IJARTET)
Vol. 4, Special Issue 19, April 2017

The module in the track consists of a MEMS sensor because of this sensor we can view crack position and MEMS output signals are continuously monitored by the Central Processing Unit. The analog output from sensor are fed to the filters for filtering purpose and after signal processing this outputs are given to the CPU. CPU continuously compares the output value with a pre defined range (normal vibration). If there is a fault in railway track, the vibration increases more than the normal range. When a high vibration is detected, MEMS output voltage increases from the normal range of voltage. If it has found a sudden increase of voltage from the normal range of values CPU notes it and sends alert messages to the control station immediately through Zigbee. Due to cracks on the rails either due to natural causes (like high expansion due to heat) tracks may gets damaged. For monitoring this problem we are used temperature sensor. The amount of water vapor in air can affect human comfort to control the train. For monitoring water vapor we are using humidity sensor. Zigbee module can be attached to the system to communicate the breakage point location to the nearest railway station. Then the recorded values by various sensors are monitored continuously. If any fault is identified, then the information will be informed to both the control room of the nearest station and to the train. So that, the accidents can be avoided quickly and easily. This pilot system not only provides tracking of track condition but also helps in avoiding collisions. It also provides the health status (structure) of tracks. The main advantage of this system is that, it can be used in any terrain and weather. This will save many human lives.

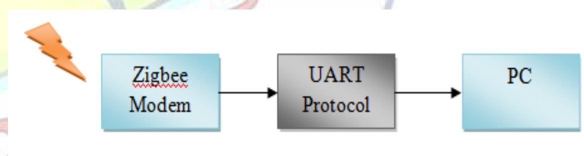
BLOCK DIAGRAM

TRANSMITTER:



The input from the sensors and the supply power is given to the arduino UNO. UART protocol is used between the arduino and the zigbee module, which is a wireless mesh network.

RECEIVER:



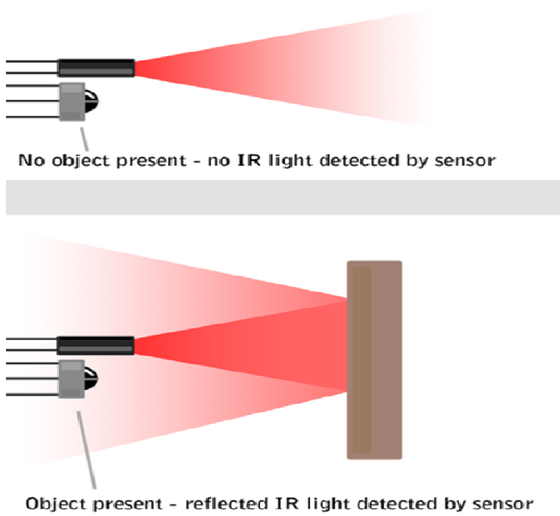
The 16x2 LCD display is used to display the current value predicted by the sensors. If the values of the sensors go beyond the threshold, then the alert message will be displayed in the computer at the receiver side.

INFRARED SENSORS:

EVERLIGHT'S Infrared Emitting Diode (IR333-A) is a high intensity diode , molded in a blue transparent plastic package. The device is spectrally matched with phototransistor, photodiode and infrared receiver module.

ISSN 2394-3777 (Print)
ISSN 2394-3785 (Online)
Available online at www.ijartet.com

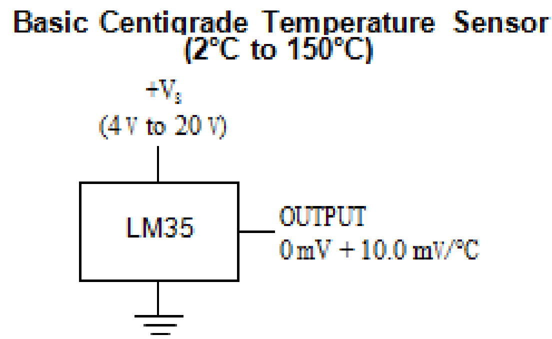
International Journal of Advanced Research Trends in Engineering and Technology (IJARTET)
Vol. 4, Special Issue 19, April 2017



The specific light sensor to detect a select light wavelength in the Infra-Red (IR) spectrum up to the wavelength of 700nm -1mm and the frequency of about 300GHz to 430THz. Usually the IR light passes in a straight line. If any object is detected as disturbance near the track, then the rays will be reflect back and the alert message will be send to the control station. It has high reliability and radiant intensity.

TEMPERATURE SENSOR:

The LM35 series are precision integrated-circuit temperature devices with an output voltage linearly-proportional to the Centigrade temperature. The LM35 device has an advantage over linear temperature sensors calibrated in Kelvin, as the user is not required to subtract a large constant voltage from the output to obtain convenient Centigrade scaling. The LM35 device does not require any external calibration or trimming to provide typical accuracies of ±¼°C at room temperature and ±¾°C over a full −55°C to 150°C temperature range. Lower cost is assured by trimming and calibration at the wafer level. The low-output impedance, linear output and precise inherent calibration of the LM35 device makes interfacing to readout or control circuitry especially easy. The device is used with single power supplies, or with plus and minus supplies. As the LM35 device draws only 60 µA from the supply, it has very low self-heating of less than 0.1°C in still air. The LM35 device is rated to operate over a −55°C to 150°C temperature range, while the LM35C device is rated for a −40°C to 110°C range (−10° with improved accuracy).

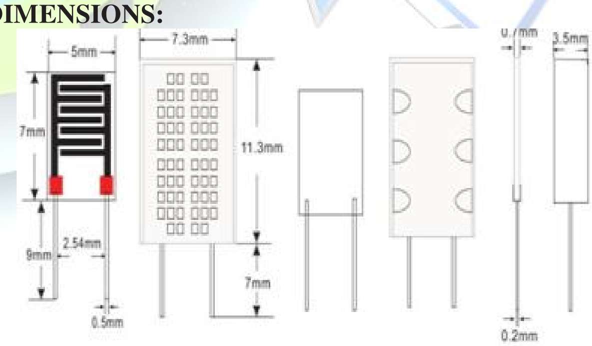


Design Requirements:

HUMIDITY SENSOR:

The amount of water vapor in air can affects human comfort to control the train. This leads to the slow operating of the train. So, for monitoring the water vapor we are using humidity sensors. The power supply given to this sensor is about 5V DC. The humidity sensor consumes power less than -3.0mA. It is operated at a humidity range of 30% to 90% RH. The storable temperature range is from -30°C to 85°C and the storable humidity range is within 95% RH. The humidity sensor will produce a standard output voltage of DC 1.980 mV (at 25°C, 60%RH). The levels of the sensors are given in two considerations. They are, the low humidity output voltage is 0.9V and the range is 30% RH. The high humidity output voltage is 3.4V and the range is 90% RH.

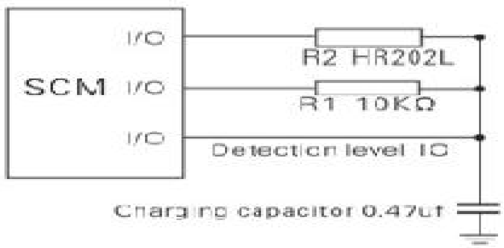
DIMENSIONS:



HR202L hygristor are the new moisture-sensitive components of organic polymer materials, has a sense of wet wide range, fast response, anti-pollution ability, without heating the cleaning and long-term use of reliable performances and many other features.

ISSN 2394-3777 (Print)
ISSN 2394-3785 (Online)
Available online at www.ijartet.com

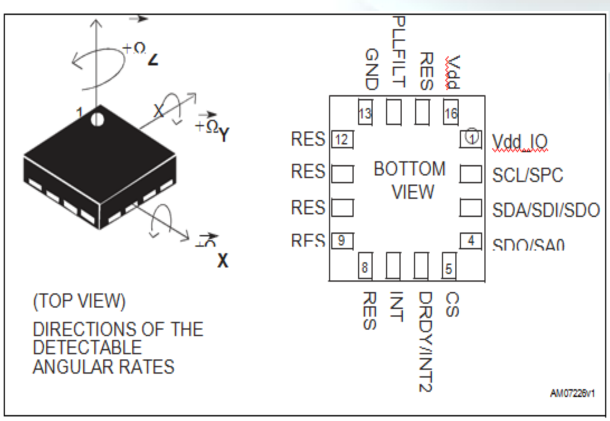
International Journal of Advanced Research Trends in Engineering and Technology (IJARTET)
Vol. 4, Special Issue 19, April 2017



The range of applications are like, they are Used to display the temperature and humidity meter, the temperature and humidity gift table, atmospheric environmental monitoring, industrial process control, agriculture, the measuring instruments and other applications.

MEMS:

MEMS is a Micro Elector Mechanical System. The A3G4250D is a low-power 3-axis angular rate sensor able to provide unprecedented stability at zero rate level and sensitivity over temperature and time. It has embedded power-down and sleep mode and also a embedded temperature sensor. It includes a sensing element and an IC interface capable of providing the measured angular rate to the external world through a standard SPI digital interface. An I2C-compatible interface is also available. The sensing element is manufactured using a dedicated micro-machining process developed by STMicroelectronics to produce inertial sensors and actuators on silicon wafers. The IC interface is manufactured using a CMOS process that allows a high level of integration to design a dedicated circuit which is trimmed to better match the sensing element characteristics.



The A3G4250D has a full scale of ±245 dps and is capable of measuring rates with a user- selectable bandwidth. The A3G4250D is available in a plastic land grid array (LGA) package and can operate within a temperature range of -40 °C to +85 °C. It has ultra-stable over temperature and time. The low-voltage-compatible IOs is about 1.8 V and has high shock survivability. [3] discussed about a project, in this project an automatic meter reading system is designed using GSM Technology. The embedded micro controller is interfaced with the GSM Module. This setup is fitted in home. The energy meter is attached to the micro controller. This controller reads the data from the meter output and transfers that data to GSM Module through the serial port. The embedded micro controller has the knowledge of sending message to the system through the GSM module.

PARAMETER	VALUE
Accuracy at 25°C	±0.5°C
Accuracy from –55 °C to 150°C	±1°C
Temperature Slope	10 mV/°C

ARDUINO UNO:

The Arduino Uno is a microcontroller board based on the ATmega328. It has 14 digital input/output pins (of which 6 can be used as PWM outputs), 6 analog inputs, a 16 MHz ceramic resonator, a USB connection, a power jack, an ICSP header, and a reset button. It contains everything needed to support the microcontroller; simply connect it to a computer with a USB cable or power it with a AC-to-DC adapter or battery to get started.

"Uno" means one in Italian and is named to mark the upcoming release of Arduino 1.0. The Uno and version 1.0 will be the reference versions of Arduino, moving forward. The Uno is the latest in a series of USB Arduino boards, and the reference model for the Arduino platform.

ISSN 2394-3777 (Print)
ISSN 2394-3785 (Online)
Available online at www.ijartet.com

International Journal of Advanced Research Trends in Engineering and Technology (IJARTET)
Vol. 4, Special Issue 19, April 2017

The Arduino Uno can be powered via the USB connection or with an external power supply.

Power: The power source is selected automatically. External (non-USB) power can come either from an AC-to-DC adapter (wall-wart) or battery. The board can operate on an external supply of 6 to 20 volts. If supplied with less than 7V, however, the 5V pin may supply less than five volts and the board may be unstable. If using more than 12V, the voltage regulator may overheat and damage the board. The recommended range is 7 to 12 volts.

Memory: The ATmega328 has 32 KB (with 0.5 KB used for the boot loader). It also has 2 KB of SRAM and 1 KB of EEPROM (which can be read and written with the EEPROM library).

Input and Output: Each of the 14 digital pins on the Uno can be used as an input or output, using pinMode(), digitalWrite(), and digitalRead() functions. They operate at 5 volts. Each pin can provide or receive a maximum of 40 mA and has an internal pull-up resistor (disconnected by default) of 20-50 kOhms. In addition, some pins have specialized functions:

Serial: 0 (RX) and 1 (TX). Used to receive (RX) and transmit (TX) TTL serial data. These pins are connected to the corresponding pins of the ATmega8U2 USB-to-TTL Serial chip.

External Interrupts: 2 and 3. These pins can be configured to trigger an interrupt on a low value, a rising or falling edge, or a change in value. See the attachInterrupt() function for details.

PWM: 3, 5, 6, 9, 10, and 11. Provide 8-bit PWM output with the analogWrite() function.

SPI: 10 (SS), 11 (MOSI), 12 (MISO), 13 (SCK). These pins support SPI communication using the SPI library.

LED: 13. There is a built-in LED connected to the digital pin 13. When the pin is HIGH value, the LED is on, when the pin is LOW, it's off.

AREF: Reference voltage for the analog inputs. Used with analogReference().

Reset: Bring this line LOW to reset the microcontroller. Typically used to add a reset button to shields which block the one on the board.

ZIGBEE:

Zigbee is a mesh network specification for low-power wireless local area networks(WLANs) that cover a large area. It is developed as a open global standard. Zigbee was designed to provide high data throughput in applications where the duty cycle is low and low power consumption is an important consideration. Its low power consumption limits transmission distances to 10-100 meters line of sight(LOS), depending on power output and environmental characteristics. (Many devices that use Zigbee are powered by battery.) Because Zigbee is often used in industrial automation and physical plant operation, it is often associated with machine –to-machine(M2M) communication and the internet of Things(ioT).

Zigbee is based on the Institute of Electrical and Electronics Engineers Standards Association's 802.15 specification. It operates on the IEEE 802.15.4 physical radio specification and in unlicensed radio frequency bands, including 2.4 GHz, 900 MHz and 868 MHz. The specifications are maintained and updated by the Zigbee Alliance. The technology defined by the Zigbee specification is intended to be simpler and less expensive than other wireless personal area networks (WPANs), such as Bluetooth or WiFi. Zigbee has a defined rate of 250 kbit/s, best suited for intermittent data transmissions from a sensor or input devices.

As of the writing, there are three Zigbee specifications: Zigbee, Zigbee IP and Zigbee RF4CE. Zigbee IP optimizes the standard for IPv6 full mesh networks and Zigbee RF4CE optimizes the standard for partial mesh networks. The CC2500 is a low cost 2.4 GHz transceiver designed for very low power wireless applications. The circuit is intended for the 2400-2483.5 MHz ISM (Industrial, Scientific and Medical) and SRD (Short

ISSN 2394-3777 (Print)
ISSN 2394-3785 (Online)
Available online at www.ijartet.com

International Journal of Advanced Research Trends in Engineering and Technology (IJARTET)
Vol. 4, Special Issue 19, April 2017

Range Devices) frequency band. CC2500 provides extensive hardware support for packet handling, data buffering, burst transmissions, clear channel assessment and link quality indication. It will be used together with a microcontroller and a few additional passive components.

CONCLUSION

To enable the safe operation of the railway network, this paper will be providing a proper solution. Thus the working of this system includes that, the inputs from the sensors and the supply power is given to the arduino UNO. UART protocol is used between the zigbee module and the arduino. The 16x2 LCD display is used to display the current value predicted by the sensors. If the values of the sensors go beyond the threshold, then the alert message will be displayed in the computer at the receiver side. Thus the consequential train accidents include collisions, derailments, fire in trains, road vehicles colliding with train's miscellaneous train mishaps can be avoided quickly and perfectly.

REFERENCES

[1] J. Chen, S. Kher, and A. Somani, "Distributed fault detection of wireless sensor networks," in *Proc. Workshop Dependability Issues Wireless Ad Hoc Netw. Sensor Netw.*, 2006.

[2] H. C. Cho, J. Knowles, M. S. Fadali, and K. S. Lee, "Fault detection and isolation of induction motors using recurrent neural networks and dynamic Bayesian modeling," *IEEE Trans Control Syst. Technol.*,Mar 2010.

[3] Christo Ananth, Kanthimathi, Krishnammal, Jeyabala, Jothi Monika, Muthu Veni, "GSM Based Automatic Electricity Billing System", International Journal Of Advanced Research Trends In Engineering And Technology (IJARTET), Volume 2, Issue 7, July 2015, pp:16-21

[4] A. M. Boronahin, Yu. V. Filatov, D. Yu. Larionov, L. N.Podgornaya and R. V. Shalymov. "Measurement system for railway track condition monitoring,".

[5] Fatima Imdad, Muhammad Tabish Niaz and Hyung Seok Kim, "Railway track structural health monitoring system,".