Automatic Fault Identification and Remote Monitoring System for Efficient Electrical Services in Indian Railways

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***Abstract*—The main Objective of the paper is to reduce the Electrical Servicing Time in Train coach. The major components of the Paper is Microcontroller, Proximity sensor, LDR, Relay Driver Boards and Zigbee. At present in railways, the service person has to check all the Electrical Items i.e., Fan, Tube light and Lamp manually. Due to this Manual Operation to service the entire train it takes lot of time. To overcome this we proposed an Automatic Analyze system using PC and advanced Zigbee Technology. The system can easily identify and update the database in the computer i.e. working status of each electrical item in each Compartment. So that the Concern Person can take necessary action, automatically it will save the Service time and makes work very easy.**

***Keywords*—Proximity sensor, Zigbee and Ambient light sensor.**

I. INTRODUCTION

Indian railway is most important transportation. Our paper is used to reduce the electrical servicing time in train compartment. An advanced way of controlling and monitoring train parameters using multichannel sensor technology [1]. Design of multi-functional street light control system based on at 89s52 single-chip microcomputer [2]. Automatic street light intensity control and road safety module using embedded system [3]. Actuator fault tolerant control for an artificial pancreas [4]. It is useful to manage the time and detecting the fault of electrical equipment in real time without requiring of physical manpower. Now a day in railways, the service person has to check all the electrical equipments i.e., fan, tube light and lamp manually. Real time service restoration in distribution networks-a practical approach [5].to overcome this we proposed an automatic analyzation of electrical system using sensor and the informations are transfer into pc using advanced zigbee technology. Development of zigbee based street light control system [6] and fault detection based on motor start transients and shaft harmonics measured at the RTU electrical service [7].the system can easily identify and update the database in the computer i.e. working status of each electrical item in each compartment. An open-source communications protocol for railway vehicles [8] that concern person can take necessary action, automatically it will save the service time and makes work very easy. In each train coach having separate zigbee to transfer the details of the electrical items .

II. EXISTING SYSTEM

Indian railway is the one of the biggest transportation system compare to other transport like bus, car. Railway is owned and operated by the Government of India through the Ministry of Railways. Since it is a largest transport system, in this detecting a problem of the electrical equipment is too difficult. Man power is most important part in Indian Railways to identifying the fault of the electrical appliances. Now a day electricians are analyzing the electrical items for each compartment separately. It has taken more time to identify the fault.

III. PROPOSED SYSTEM

This method will overcome the difficulties faced by the existing methods such as cost, time, man power etc…The proposed system gives the efficient way of automating trains using Sensor Technology along with other modules to reduce human operational errors, time management and cost management. At present in railways, the service person has to check all the Electrical Items i.e., Fan, Tube light and Lamp manually. To avoid this kind of problem we proposed an Automatic Analyzation of electrical system using sensor and the informations are transfer into PC using advanced Zigbee Technology.

If any fault is occurred in the electrical system, it will display in 16x2 Liquid Crystal Display (LCD) by using Zigbee transmitter. Here we are using the components ATMEL microcontroller, proximity sensor, LDR, relay, transmitter. By using proximity sensor we are analyzing the operation of the fan. By using of LDR (Light Dependent Resistor) we are analyzing the operation of lamp which is in the condition of OFF or ON.

A. Methodology

The Entire automated system can be divided basically into three parts:

- Zigbee Module
- Microcontroller Unit
- Sensor Unit

B. Zigbee

This is an FSK Transceiver module, which is designed using the ChipconIC (CC2500). It is a true single-chip transceiver zigbee pin diagram shown in fig 1, it is based on 3

wire digital serial interfaces and an entire Phase-Locked Loop (PLL) for precise local oscillator generation .so the frequency could be setting. It can use in UART / NRZ / Manchester encoding / decoding. It is a high performance and low cost module. It gives 30 meters range with onboard antenna.

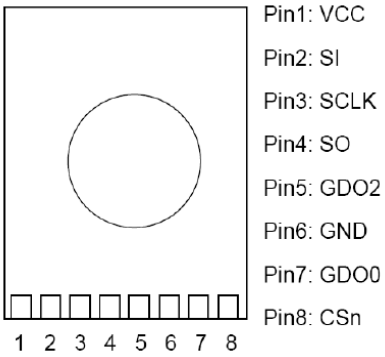

Fig. 1. Zigbee Pin diagram

In a typical system, this trans-receiver will be used together with a microcontroller. It provides extensive hardware support for packet handling, data buffering, burst transmissions, clear channel assessment, link quality indication and wake on radio. It can be used in 2400-2483.5 MHz ISM/SRD band systems zigbee shown in fig. 2. (Eg. RKE-two way Remote Keyless Entry, wireless alarm and security systems, AMR-automatic Meter Reading, Consumer Electronics, Industrial monitoring and control, Wireless Game Controllers, Wireless Audio/Keyboard/Mouse). It could easily to design product requiring wireless connectivity. It can be used on wireless security system or specific remote-control function and others wireless system. Operating Range is 30 meters without requiring any external antenna.

Fig. 2. Zigbee

C. Micro controller

A microcontroller is a complete microprocessor system built on a single IC. Microcontrollers were developed to meet a need for microprocessors to be put into low cost products. Building a complete microprocessor system on a single chip substantially reduces the cost of building simple products, which use the microprocessor's power to implement their function, because the microprocessor is a natural way to implement many products. This means the idea of using a microprocessor for low cost products comes up often. But the typical 8-bit microprocessor based system, such as one using a Z80 and 8085 is expensive. Risk analysis to determine locations for way train inspection systems [9] used both 8085 and Z80 system needs some additional circuits to make a microprocessor system. Each part carries costs of money. Even though a product design may require only very simple system, the parts needed to make this system as a low cost product.

To solve this problem microprocessor system is implemented with a single chip microcontroller. This could be called microcomputer, as all the major parts are in the IC. Most frequently they are called microcontroller because they are used they are used to perform control functions. Zigbee with RS232 interface board is shown in fig 3.

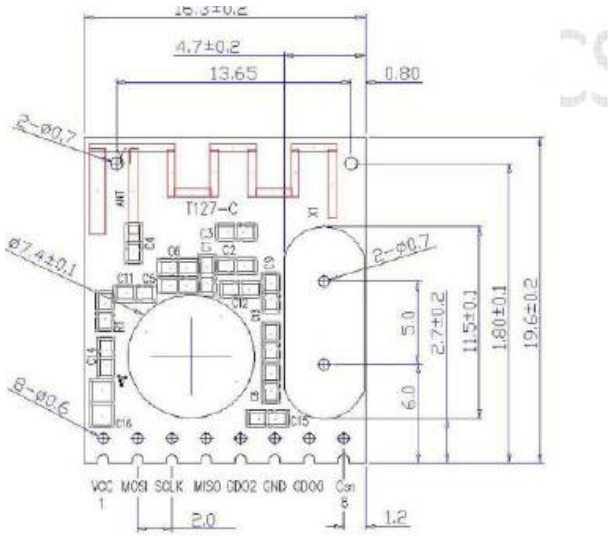

Fig. 3. Zigbee with RS232 interface board

The microcontroller contains full implementation of a standard MICROPROCESSOR, ROM, RAM, I/0, CLOCK, TIMERS, and also SERIAL PORTS. Microcontroller also called "system on a chip" or "single chip microprocessor system" or "computer on a chip". .A microcontroller is a Computer-On-A-Chip, or, if you prefer, a single-chip computer. Micro suggests that the device is small, and controller tells you that the device' might be used to control objects, processes, or events. Another term to describe a microcontroller is embedded controller, because the microcontroller and its support circuits are often built into, or embedded in, the devices they control.

It replaces Scanning, Debounce, Matrix Decoding, and Serial transmission circuits. Many low cost products, such as Toys, Electric Drills, Microwave Ovens, VCR and a host of other consumer and industrial products are based on microcontrollers. The block diagram of the proposed system is shown in fig 4.

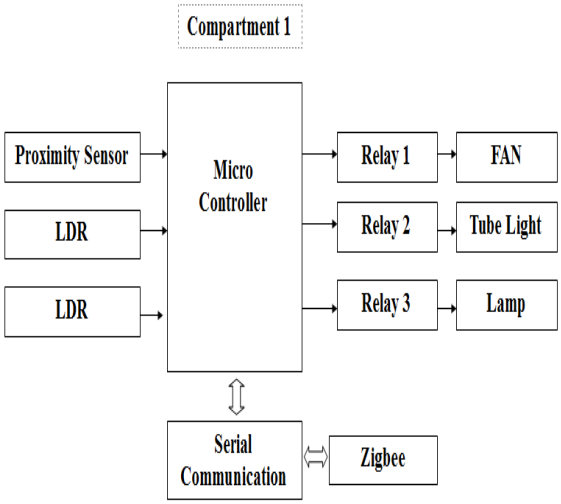

Fig. 4. Block diagram of proposed system

The Execution processes of this paper follow as:

- Zigbee is interfaced with ATMEL Microcontroller (ATMEGA16A PU1413) and PC. Sensor unit also connected with Microcontroller.
- PC with Zigbee: This is the assembly Microcontroller is placed in between the Sensor and Zigbee.
- PC sends the request to the Zigbee which is placed in the train compartment. At that time Fans and Lamps are automatically ON by using relay circuit.
- Sensor modules check the fans by the usage of proximity sensor and lamps are checked by the usage of LDR (Light Dependent Resistor).
- On-line condition monitoring and fault diagnosis - a survey [10] used to identified results of each compartment are combined together and send that results to the Zigbee which is placed in a main compartment.
- An efficient way of monitoring & controlling the train parameters using pic18f4550 controller [11].
- Zigbee transfer the results to the PC placed in the service centre. Then only PC shows the identified fault of the electrical equipment in which compartment based on survey on street lighting system based on vehicle movements [12].

D. Proximity sensor

A Proximity sensor can detect objects without physical contact. A proximity sensor often emits an electromagnetic field or beam and look for changes in the field. The diagram of the proximity sensor is shown in fig 5. The object being sensed is often referred to as the proximity sensor's target. Different proximity sensor targets demand different sensors. For example, a capacitive or photoelectric sensor might be suitable for a plastic target and inductive proximity sensor requires a metal target. Based on railway track condition monitoring using FBG and FPI fiber optic sensors [13] and Mainline and transmit train impact load detector [14] we use the proximity sensor that measures current flow between the sensing electrode and the target provides readouts in appropriate engineering units. Usually, one side of the voltage source or oscillator connects to the sensing electrode, and the other side connects through a current-measuring circuit to the target, which generally is a metal part at earth or ground potential. We are using NPN and PNP types. It has the features such as, digital output is standard and analog output is available. It has 0 - 5 VDC, up to 300mA current and 0.5mm to 70mm (0.02 to 2.76 in.) sensing range. It was used extensively for mining and other industrial applications and uses include de-mining (the detection of land mines), the detection of weapons such as knives and guns, especially in airport security, geophysical prospecting, archaeology and treasure hunting. Metal detectors are also used to detect foreign bodies in food, and in the construction industry to detect steel reinforcing bars in concrete and pipes and wires buried in walls and floors.

Fig. 5. Proximity Sensor

E. Ambit Light Sensor

Arduino Light Sensor is based on the principle of semiconductor photoelectric effect. The sensor can be used to detect the intensity of ambient light. Combined with SCM controller or Arduino controller can realize light measurement, light control and photoelectric conversion. You can make Light Sensor related interactive works with a 3p sensor connecting line. The ambient light sensor circuit is shown in fig 6.

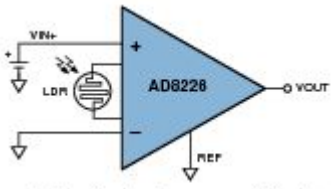

Fig. 6. Ambient sensor circuit

An ambit light sensor with a function of IR sensing and a method of fabricating the same are provided. The ambit light sensor includes a substrate, an ambit light sensing structure,

an infrared ray (IR) sensing structure, and a dielectric layer. The ambit light sensing structure is located over the substrate for sensing and filtering visible light. The IR sensing structure is located in the substrate under the ambit light sensing structure for sensing IR. The dielectric layer is located between the ambit light sensing structure and the IR sensing structure. It has basic features such as ~1k Ohm light resistance and ~10k Ohm dark resistance. Then the max voltage is 150V max power is 100mW. Ambient light sensor used to detect the light or brightness in a manner to human eye and used to found in industrial lighting. It is also applied for consumer electronics, automotive systems and conserves battery power. Advanced signal processing techniques for fault detection and diagnosis in a wind turbine induction generator drive train [15]. The performance of the ambient light circuit in dark and light condition is shown in fig 7.

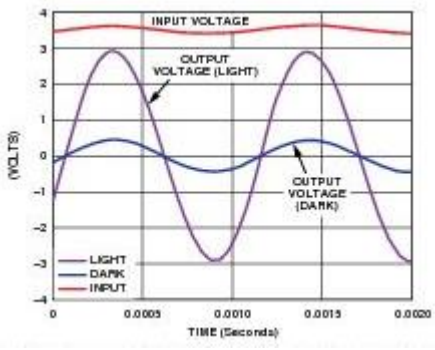

Fig. 7. The performance of the circuit in dark and light condition

IV. SOFTWARE

There are two types of software used to analyze and transmit the information of electrical equipments such as,

A. Code Vision AVR

Code Vision AVR is a C cross-compiler, Integrated Development Environment and Automatic Program Generator designed for Atmel AVR family of microcontrollers. The program is a native 32 bit application that runs under the Windows 995, 98, NT 4, 2000 and XP operating systems.

The C cross-compiler implements nearly all the elements of the ANSI C language, as allowed by the AVR architecture, with some features added to take advantage of specificity of the AVR architecture and the embedded system needs. The compiled COFF object files can be C source level debugged, with variable watching, using the Atmel AVR Studio debugger.

The Integrated Development Environment (IDE) has built-in AVR Chip In-System Programmer software that enables the automatical transfer of the program to the microcontroller chip after successful compilation/assembly. The In-System Programmer software is designed to work in conjunction with the Atmel STK500, Kanda Systems STK200+/300, Dontronics DT006,Vogel Elektronik VTEC-ISP, Futurlec JRAVR and MicroTronics' ATCPU/Mega2000 development boards. For debugging embedded systems, which employ serial communication, the IDE has a built-in Terminal.

Besides the standard C libraries, the Code Vision AVR C compiler has dedicated libraries such as,

- Alphanumeric LCD modules
- Philips I2C bus
- National Semiconductor LM75 Temperature Sensor
- Philips PCF8563,PCF8583, Dallas Semiconductor DS1302 and DS1307 Real Time Clocks
- Dallas semiconductor 1 wire protocol
- Dallas semiconductor DS1820/DS18S20 Temperature sensors
- Dallas semiconductor DS1621 Thermometer/Thermostat
- Dallas semiconductor DS2430 and DS2433 EEPROMs
- SPI
- Power Management
- Delays
- Gray code conversion

Code Vision AVR also contains the Code Wizard AVR Automatic Program Generator that allows you to write, in a matter of minutes, all the code needed for implementing the following functions:

- External memory access setup
- Chip reset source identification
- Input/output Port initialization
- External interrupts initialization
- Timers/counters initialization
- Watchdog Timer initialization
- UART initialization and interrupt driven buffered serial communication
- Analog comparator initialization
- ADC initialization
- SPI interface initialization
- I2C Bus,LM75 Temperature Sensor, DS1621 Thermometer/Thermostat and PCF8563, PCF8583, DS1302, DS1307 Real time clocks initialization
- 1 wire bus and DS1820/DS18S20 Temperature Sensors initialization
- LCD module initialization

The simulation and hardware output of the paper is shown in fig 8 and 9 respectively.

B. Embedded C

A set of language extensions for the C Programming language by the C standard committee to address commonality issues that exist between C extensions for different embedded systems. Historically, embedded C programming requires nonstandard extensions to the C language in order to support exotic features such as fixed-point arithmetic, multiple distinct memory banks, and basic I/O operations. It includes a number of features not available in normal C, such as, fixed-point arithmetic, named address spaces, and basic I/O hardware addressing.

V. RESULT

This proposed method gives an accuracy result, from which equipment has a fault. It is used to reducing human errors and time. Sensors are vital part of the design an

embedded system with more reliable and less power consumption for train operations.

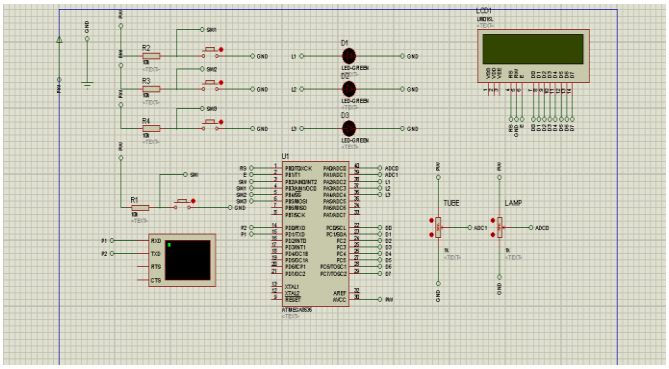

Fig. 8. Simulation Output

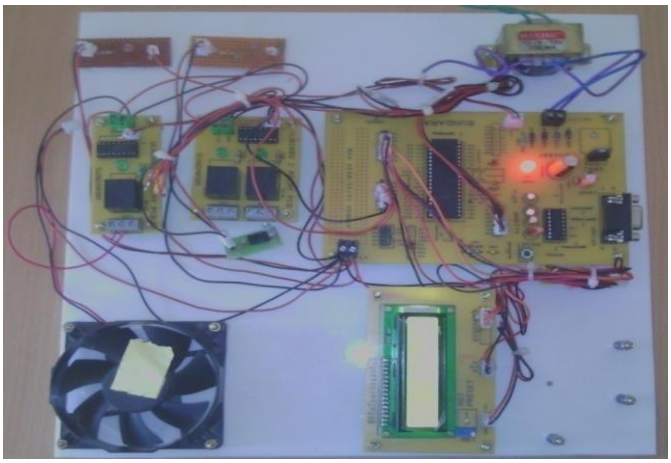

Fig. 9. Hardware Output

This technology using PROTEUS gives solution and this research work will make a great change in railway system and provides benefit to the Government. Our paper focuses design and implementation of automatic fault detection of electrical equipment in railway system. In recent scenario, all the public and private sector go for automation in their process.

VI. CONCLUSION

All train parameters, rail flaw inspection and other parameters could be controlled by advent of Multi-core Embedded Processor. If there is any problems in such a flaw in electrical items in train coach the problems of the equipment can be identified. Zigbee monitoring data will be wirelessly sent to Multi-core Embedded Processor and then further proceed. This proposal gives better accuracy, very fastest operation in real-time where the human life is very important. Our proposed model is facing a new challenge to further improve the reliability of rail testing techniques, while seeking for new and emerging technologies in automation engines that aid the detection of rail defects. This paper can further be developed to detect faults in engine in trains. Also this paper can be implemented in industries, household are any public places to detect fault in electrical appliances.

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