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Department of Electronics & Communication Engineering

Academic Year 2014-15

Annexure I

1. Project Title: A Zigbee Based Embedded System For Controlling Accidents In Trains

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1. Abstract & Objective

1.1 Abstract

The railway system is an important transportation system in our country. Most of the trains in our country are the induction trains and hence there a chance of fire mishaps. Fire on a running train is more catastrophic than on a stationary one, since fanning by winds helps spread the fire to other coaches very soon after the accident. Moreover, passengers sometimes jump out of a running train on fire resulting in increased casualties. These fire accidents are causing serious threat to lives of people.

Security in travel is primary concern for everyone. Now a day's fire accidents are most often occurring in trains. When these accidents are occurring in remote areas or during night times the loss or damage being caused is at higher rates. The damage is heavier due to improper reach of service at right time due to improper communication. This time delay is causing heavier damage. Thus eliminating the time between when an accident occurs and when first responders are dispatched to the scene decreases the damage. One approach to eliminate the delay is by identifying the fire accident and notifying the concerned authorities, loco pilot and passenger with in no time. Passengers will be notified by ringing the buzzer and loco pilot will be notified showing the message in the LCD display fitted in the engine along with alarm.

The fire may occur in any form of activities such as short circuit in the electrical wires, prohibited activities of carrying diesel, petrol, gas stoves and smoking nearby them will cause fire accidents. To control these we do not have an intensive work force. To overcome this, a system of having automatic sensor monitoring, fire alarm warning and fire extinguishing are based on ZIGBEE wireless sensor network technology. It also gives message about the train in which bogi the accident took place byharmful gas or heat that is detected by sensors.

1.2 Motivation

Safety has come to be recognized as the key issue for the railways and one of its special attributes. No railway system can survive by ignoring this vital aspect as safe and timely transit is not only significant for passenger traffic but also for transportation of materials in today's highly competitive environment. So this system will work effectively when fire occurs.

Now a day's large number of fire accidents are occurring which causes severe pain to the mankind and loss to the government. So by using the safety systems like detection of smoke and temperature, automatic foam releasing, ZIGBEE technologies we can reduce fire accident deaths in trains. The government property can also be saved using this safety system.

Main aim of our project:

1. To avoid fire accidents in train.

2. To save the human lifes

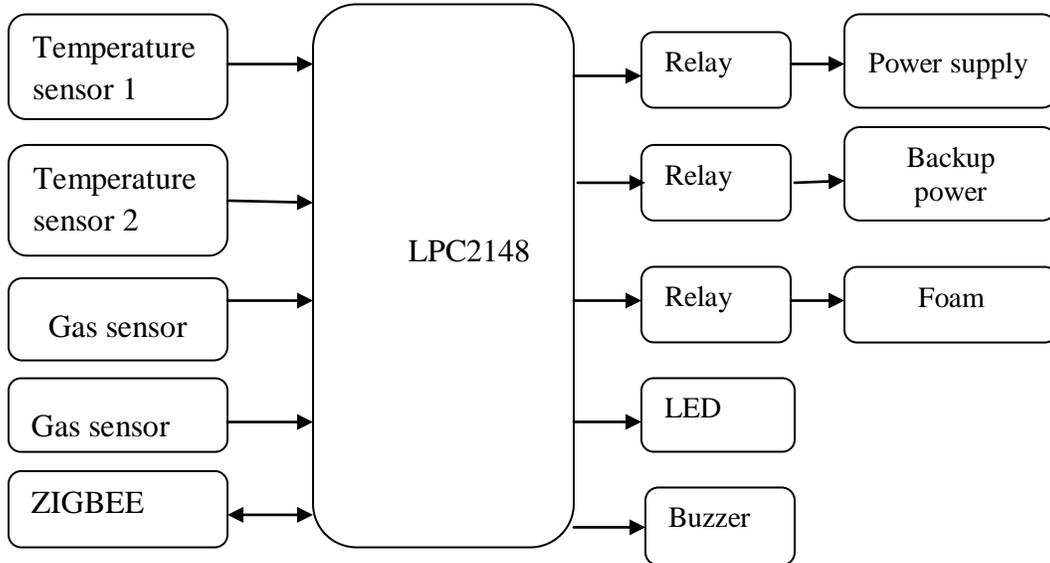3.To reduce the involvement of fire fighters

1.3 Objective

Fire accidents are increasing day to day in trains which results in loss of property and lives of the people. The fire spreads very quickly throughout the train and causes great damage before the firefighting systems activation. Hence, a new fire safety system is proposed to prevent fire accidents in trains using wireless sensor networks. By implementing this fire safety system in train, we can detect the fire accidents and can bring the fire under control in the initial stage only without the involvement of the firefighters which reduces the cost of rescue operations. By using the Wireless Sensor Networks, we will be able to know when a fire is started and how it is spreading. So, our main purpose is to safe the people's life and property.
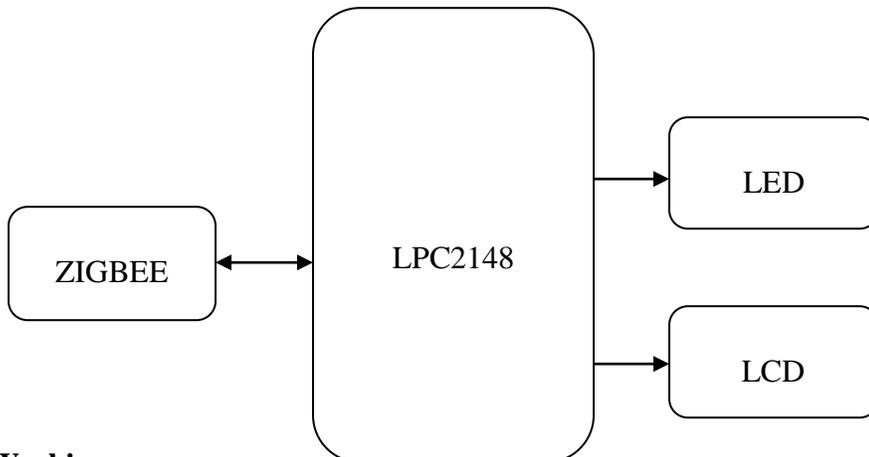
2. Block Diagram & Technical Specifications

2.1 Block Diagram and Working:
2.1.1. Block Diagram:

Coach module:-

```
Temperature          ┌──────────┐      ┌────────┐      ┌──────────────┐
sensor 1      ──────▶│          │─────▶│ Relay  │─────▶│ Power supply │
                     │          │      └────────┘      └──────────────┘
Temperature          │          │      ┌────────┐      ┌──────────────┐
sensor 2      ──────▶│          │─────▶│ Relay  │─────▶│   Backup     │
                     │          │      └────────┘      │   power      │
                     │ LPC2148  │      ┌────────┐      └──────────────┘
Gas sensor    ──────▶│          │─────▶│ Relay  │─────▶│    Foam      │
                     │          │      └────────┘      └──────────────┘
Gas sensor    ──────▶│          │─────▶│  LED   │
                     │          │      └────────┘
ZIGBEE       ◀──────▶│          │─────▶│ Buzzer │
                     └──────────┘      └────────┘
```

Driver module:-

```
                     ┌──────────┐
                     │          │      ┌────────┐
                     │          │─────▶│  LED   │
                     │          │      └────────┘
ZIGBEE       ◀──────▶│ LPC2148  │
                     │          │      ┌────────┐
                     │          │─────▶│  LCD   │
                     │          │      └────────┘
                     └──────────┘
```

2.1.2. Working:

The block diagram is shown above which consist of the smoke and temperature sensors along with the ZIGBEE module for the information passage to the driver module and coach

4

module. We also have the LCD display for the purpose of displaying the geometrical coordinates. In addition to above mentioned blocks we have other fire reducing system such as foam release and backup power. And one more block diagram is shown below which consist of LED and LCD. We have the LCD that displays the information to the driver about the train condition.

The project is designed with ARM7 processor. The project consist two modules

1. Coach module
2. Driver module

Coach module consist microcontroller based system which takes inputs from temperature sensor and gas sensors. Depending on the outputs of sensors our system can work, if the sensor input reaches the critical value then it gives high signal to the microcontroller. Then it performs four operations at a time immediately power off main supply, on the backup power, releases the foam, send information to the driver through ZIGBEE.

Driver module can take the input from coach module through ZIGBEE.And activates the BUZZER and position of the accident is displayed on LCD. Then driver can stop the train and take the actions. This system will detect and control the fire accidents on running train. In-house parameters such as temperature and gas in the each coach can be monitored in real time. It detect the fire and sends signal to the driver simultaneously it releases foam, which reduces intensity of fire and alert the passengers and driver by using buzzers and LEDs. Information about location of accident is send to the driver through ZIGBEE to the LCD.

2.2 Technical Specifications:

2.2.1. Arm Controller:

Arm is a 32-bit Reduced Instruction Set Computer (RSIC). Instruction set architecture named as Advanced RISC machine and, before that Acorn RISC machine. The ARM architecture mostly used 32-bit instruction set architecture.

Features

- 32-bit RSIC processor core (32-bit instructions)
- 37 pieces of 32-bit integer registers (16 available)
- Pipelined (includes 3 stages)
- Cached (depending on implementation)
- Von Neumann-type bus structure (ARM7) and Harvard (ARM9)
- 8 or 16 or 32-bit data types
- 7 modes of operation

- Simple structure and reasonably good speed to power consumption.•

LPC2148 is the heart of system. Used in all three modules. It controls all the functions. It is the widely used IC from ARM-7 family. It is manufactured by Philips and it is pre-loaded with many inbuilt peripherals making it more efficient and a reliable option for the beginners as well as high end application developer.

It has the following features:

- 8 to 40 kB of on-chip static RAM. 32 to 512 kB of on-chip flash program memory.
- 128 bit wide interface/accelerator enables high speed 60 MHz operation.
- In-System/In-Application Programming (ISP/IAP) via on-chip boot-loader software
- Single flash sector or full chip erase in 400 ms and programming of 256 bytes in 1ms
- Total 64 I/O pins

2.2.2. Temperature sensor LM35:

The LM35 series are precision integrated circuit temperature sensor, whose output voltage is linearly proportional to the Celsius temperature. The LM35 thus has an advantage over linear temperature sensors calibrated in degrees Kelvin, as the user is not required to subject a large constant voltage from its output to obtain convenient Celsius scaling

CHOOSE $R_1 = (-V_S)/50 \ \mu A$
$V_{OUT} = +3.000 \ mV \ AT \ +300°F$
$= +750 \ mV \ AT \ +75°F$
$= -500 \ mV \ AT \ -50°F$

2.2.2. MQ-3 Gas Sensor

Sensitive material of MQ-3 gas sensor is SnO2, which with lower conductivity in clean air. When the target combustible gas exist, the sensor's conductivity is higher along with the gas concentration rising. Please use simple electro circuit, Convert change of conductivity to correspond output signal of gas concentration. MQ-3 gas sensor has high sensitivity to LPG, Propane and Hydrogen, also could be used to Methane and other combustible steam, it is with low cost and suitable for different application

2.2.3. ZIGBEE

ZIGBEE protocols are intended for use in embedded applications requiring low data rates and low power consumption. ZIGBEE's current focus is to define a general-purpose, inexpensive, self-organizing, mesh network that can be used for industrial control, embedded sensing, medical data collection, smoke and intruder warning, building automation, home automation, etc. The resulting network will use very small amounts of power so individual devices might run for a year or two using the originally installed battery.

2.2.4. Liquid Crystal Display

LCD is a type of display used in digital watches and many portable computers. LCD displays utilize to sheets of polarizing material with a liquid crystal solution between them. An electric current passed through the liquid causes the crystals to align so that light cannot pass through them. LCD technology has advanced very rapidly since its initial inception over a decade ago for use in laptop computers. Technical achievement has resulted in brighter displace, higher resolutions, reduce response times and cheaper manufacturing process.

2.2.5. Buzzer

A buzzer or beeper is an audio signaling device, which may be mechanical, electromechanical, or piezoelectric. Typical uses of buzzers and beepers include alarm devices, timers and confirmation of user input such as a mouse click or keystroke.

2.2.6 Light Emitting Diode

Light emitting diode is also just like buzzer giving alert information to the passengers in the smoke or fire arises, but the only difference is that the buzzer gives the audio information where as

the led gives the visual information about various aspects like smoke sensor activation, ZIGBEE system working
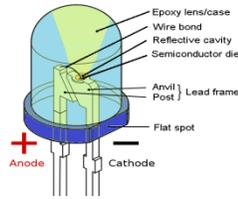
## 2.2.7 Fire Reducing System Using Relays

A mechanical relay does this through the use of an electromagnet - a magnet that is only "on" when there's power running through it - that pulls a set of spring loaded contacts to make or break the connection and achieve the on-off effect. This is called the "coil" or trigger wire - the other wire coming out of the coil is connected to ground. Whenever you apply power to the other coil wire (the trigger), the relay is on. As soon as power to this trigger is turned off, the relay turns off
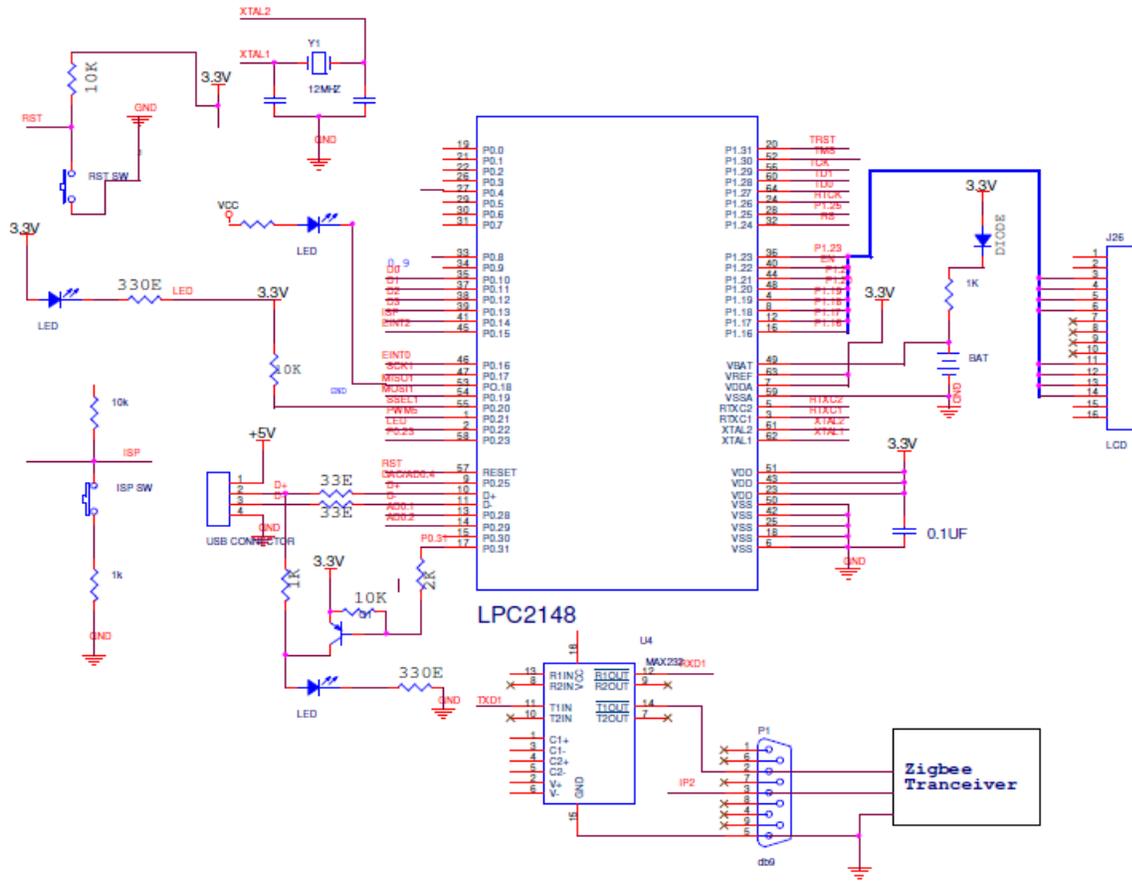
2.2.8. Overall Schematic:

schematic diagram of coach module
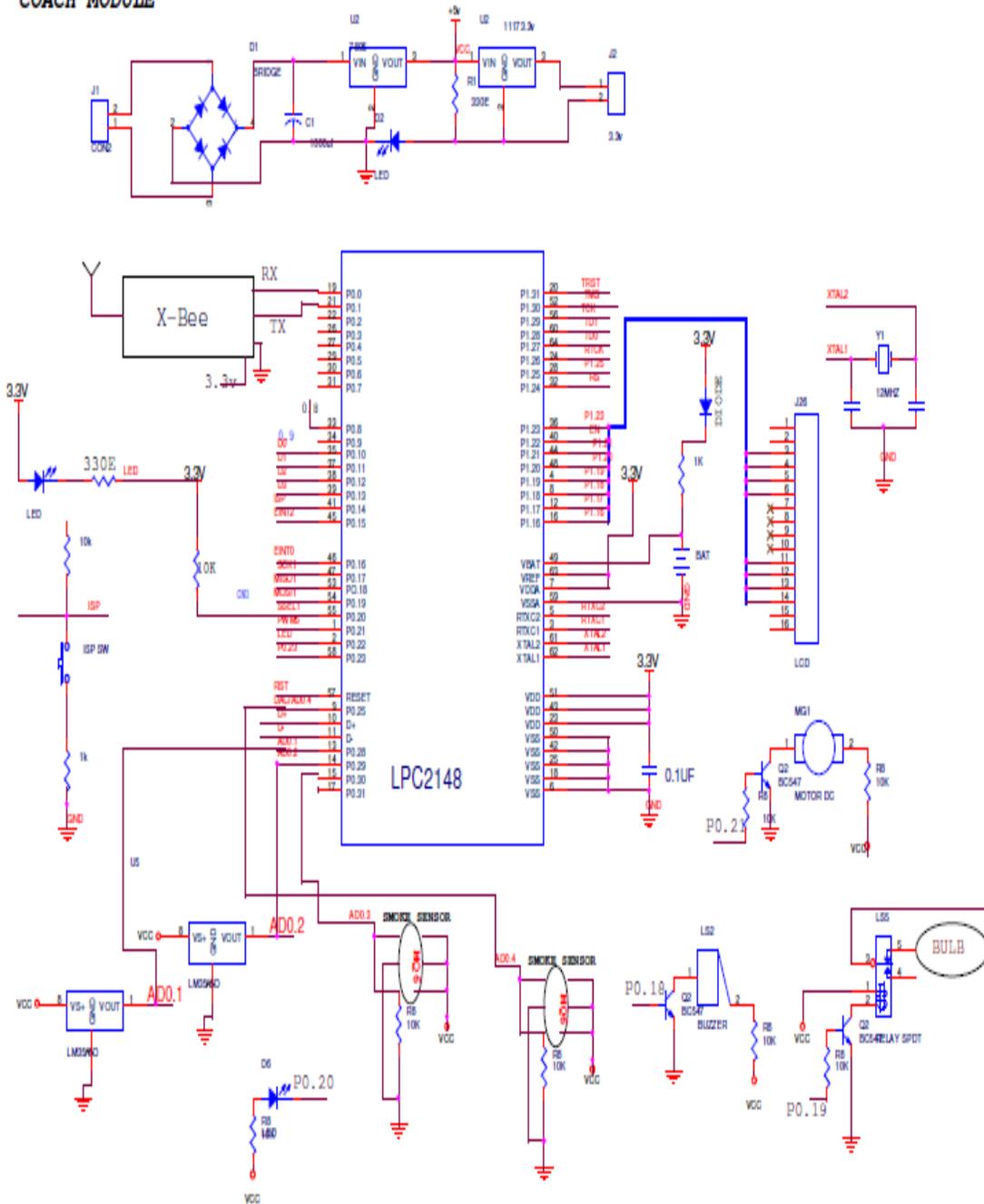
Schematic diagram of drivermodule

DRIVER MODULE

2.3. Result and analysis :

This system will focus on the system that will detect and control the fire accidents on running train. Based on the parameters such as temperature and gas in the each coach can be monitored in real time. From the information collected by the sensor system, decisions for LED, alarming, and automatic foam system can be made more quickly by the relevant system or engine driver through ZIGBEE. After receiving the signal, the engine driver will stop the train and take necessary action

The entire system is shown below. This system consists transmitter and receiver. Transmitter consists ARM, two temperature sensors and two gas sensors, buzzer, LCD, bulb, fan.

Figure 5.1:

System for controlling fire accidents in trains

Here entire operation is controlled by the LPC2148. Bulb is used for the indication of power off. Fan is used for indication of the foam. If there is no problem in train then displays "No Problem In The Train" on driver module as shown below.

Driver module display

If the temperature and gas sensor does not cross the critical value then it send low signal to the microcontroller then it sends signal to the driver module as No problem in train.

Now at first if there is no response for the sensors it means that temperature not increased more than critical level and gas sensor not more than critical value than the following results are shown in below.
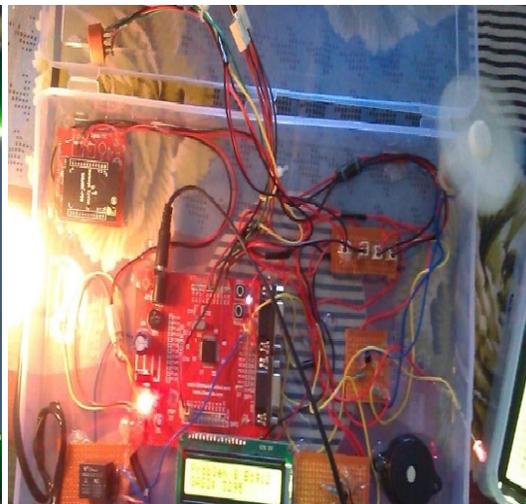
Sensors at Initial State

Now the smoke sensor can be activated by exposing the smoke sensor to smoke or may be little ethanol gas which rings the buzzer and LED glows or the temperature sensor can be activated by exposing thetemperature sensor temperature than rings the buzzer and LED glows.

Smoke sensor 2 activated   **Out put of the system**

The same happens with the smoke sensor 1 and temperature sensors 1 and 2 and at the same time information is passed to the driver coach through ZIGBEE.Below.

Displaying Information at Coach and Driver Module

Thus using the sensor network comprising of different sensors we can detect the smoke or fire arising and activate the necessary saftey systems.

3. Conclusion

3.0. Conclusion

Now-a-days the passengers are facing severe problems due to the numerous fire accidents happening posing a threat to their lives. Also government is incurring loss of property. Hence using the smoke sensors and temperature sensors, indicating systems like LCD, LED and relays accidents deaths can be reduced to a great extent. Property can also be saved without damage.
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