



SECURITY SYSTEM IN INDUSTRIES USING ZIGBEE TECHNOLOGY

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Abstract— Now – a – days the importance of oilfield is increasing broadly. In plant Oil exhauster's are continuously working for 24hours. As the problem of petroleum stolen by switching off the mains, oil transmission line being stolen by rotating the valve, fire generated in the industries and oil exceeding are exists,. Therefore, these require corresponding corrective actions and security system. The security system is described in this paper. System structure of wireless security adopts two-level structure. The first level consists of remote controller which includes buzzer alarm for power failure, leakage of oil by rotating the pump. The second level is consisting of a wireless receiver connected to personal computer in the system. The wireless receiver is designed using ZigBee technology. It can improve the level of oilfield' security.

In this paper, a ZigBee transmitter is placed at the site location and another ZigBee receiver is placed at control panel. Information received at the receiver will be sent to the PC. The security people will take appropriate action according to the problem failure like power failure, fire generated, oil overflow and valve operated and the acknowledgement will be received by the receiver at the control unit after rectification of the above problems.

In addition to ZigBee Transceiver, LPC2148 (ARM7) microcontroller used for receiving sensors output and sending control signals to the Buzzer and ZigBee transceiver.

Index Terms— LPC2148 (ARM7) Microcontroller, ZigBee Transceivers, IR sensors, Buzzer, Limit Switch, Power Indication unit, Fire sensor

I. INTRODUCTION

To alert the security people working in oil industries from problems like thieves, oil maximum level, power failure

and change in position of control valve using ZigBee technology.

Now a day's every system is automated in order to face new challenges. In the present days automated systems have less manual operations in terms of flexibility, reliability and accurate. Due to this increase in demand every field prefers to automate control systems. This scenario implies to industries where so many parameters need to look after. Automation based on advanced electronics technologies giving fruitful results in every aspect. Combination of technologies in various areas and embedding into one system can be very useful to automate a particular scenario. In this case we have designed a system which can monitor the onsite and also analyse some important on field paramagnets.

This system assists security people to great extent to monitor and inspect the entire site. This is realized by making use of ZigBee technology for communications. It is guided by IEEE 802.15.4 Personal Area Network standard. It is primarily designed for the wide ranging controlling applications and to replace the existing non-standard technologies.

II . SYSTEM REPRESENTATION

The security system in industries using ZigBee technology is shown in fig.1.

Transmitter Section

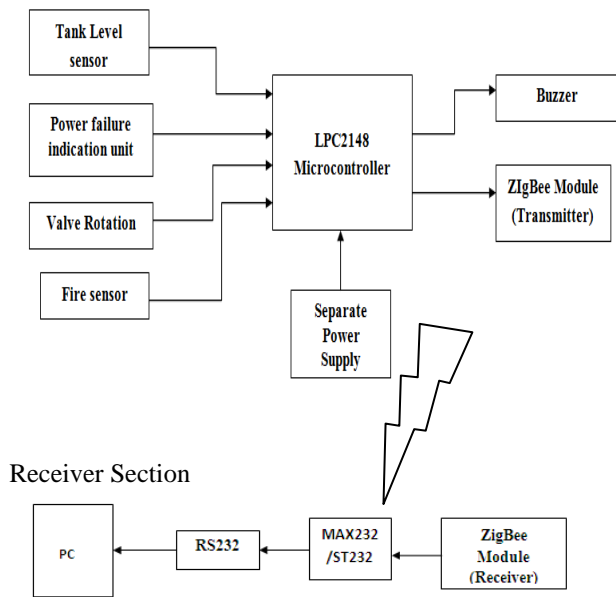


Fig.1: Security system in industries using ZigBee Technology

The transmitter section consists of following hardware components.

- LPC2148 (ARM7 Microcontroller)
- ZigBee Transceiver (transmitter)
- Regulated power supply.
- Sensors units.

In the case the system will consists of two modules one is present at the remote location and other will be placed at the control room which is connected to the PC. Here the embedded module present at the remote location is used to detect 4 problems in this system. One is the overflow of the oil, second one is power failure and the third one is related to the theft of the oil which can be done by using the opening the valve of the oil pump. Detection of first problem is done by using IR sensors and the second problem can be solved by sending feed back of the power supply to the microcontroller module and the third one can be done by using the limit switch.

Here whatever the problem occurred at the remote location that information is sent to the microcontroller module which will alert the security people by giving the alarm sound and at the same time the same information will be send to the other ZigBee module which is present at the control room which connected to the PC. That PC will be consisting of GUI which will indicate the type of problem occurred and time of occurred. Here the sending of information to the PC is for the sake of displaying the official noting down of the type of the problem and time of occurred and it will be use full for saving this data more

secured if that pc is controlled by system administrator. Where other people can not the change the information send the PC.

III. MEASUREMENT, CONTROL AND COMMUNICATION

A. Sensors

The various sensors used in this system are listed below

- Tank level sensor(IR Sensors)
- Valve Rotation Unit(Limit Switch)
- Fire Sensor (NTC103)
- Power failure indication Unit.

Tank level sensor (IR sensors):

Principle:

IR LED emits infrared radiation. This radiation illuminates the surface in front of LED. Surface reflects the infrared light. Depending on reflectivity of the surface. Amount of light reflected varies. This reflected light is made incident on reverse biased IR sensor. When photons are incident on reverse biased junction of this diode, electron-hole pairs are generated, which results in reverse leakage current. Amount of electron-hole pairs generated depends on intensity of incident IR radiation. More intense radiation results in more reverse leakage current. This current can be passed through a resistor so as to get proportional voltage. Thus as intensity of incident rays varies, voltage across resistor will vary accordingly

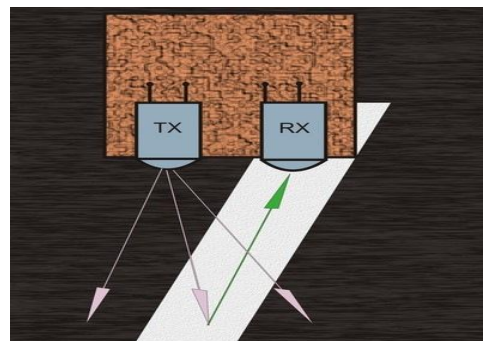


Fig 2: Working principle of IR sensors

Valve rotation unit (limit switch):

Limit switches automatically monitor and indicate whether the movement limits of a particular device have been exceeded. A standard industrial limit switch is an electromechanical device that contains an actuator linked to a series of contacts. When an object meets the actuator, the limit switch triggers the contacts to either form or break an electrical connection. Limit switches are

commonly employed in a wide range of applications and under a variety of operating conditions due to their ease of installation, relatively straightforward design, ruggedness, and reliability.



Fig 3: Limit Switch

Fire sensor:

In this the fire sensor is a thermistor (NTC 103). The thermistor is a resistance thermometer whose resistance changes as the temperature changes. A small change in temperature results in a large change in resistance. Thermistors can measure temperatures from -40F to 302F. The relationship between a thermistor’s resistance and temperature is nonlinear. As the temperature changes slightly, the resistance changes sharply. Putting the measured resistance into particular equations directly gives the temperature. It is essential to calibrate the thermistor before use.



Fig 4: NTC103 Thermistor

Features of NTC 103K

- Small precision type
- Excellent thermal cycle endurance
- Rapid time response quality

B Output Devices to LPC2148 Microcontroller:

- Buzzer
- ZigBee Transceiver

Buzzer

Piezo buzzer is an electronic device commonly used to produce sound. Light weight, simple construction and low

price make it usable in various applications like car/truck reversing indicator, computers, call bells etc. Piezo buzzer is based on the inverse principle of piezo electricity discovered in 1880 by Jacques and Pierre Curie. It is the phenomena of generating electricity when mechanical pressure is applied to certain materials and the vice versa is also true. Such materials are called piezo electric materials. Piezo electric materials are either naturally available or manmade. Piezoceramic is class of manmade material, which poses piezo electric effect and is widely used to make disc, the heart of piezo buzzer. When subjected to an alternating electric field they stretch or compress, in accordance with the frequency of the signal thereby producing sound.



Fig 5: Buzzer

The above image shows a very commonly used piezo buzzer also called piezo transducer operating at DC voltage. Encapsulated in a cylindrical plastic coating, it has a hole on the top face for sound to propagate. A yellow metallic disc which plays an important role in the producing sound can be seen through the hole.

ZigBee Transceiver

Tarang- F4

Tarang modules are designed with low to medium transmit power and for high reliability wireless networks. The modules require minimal power and provide reliable delivery of data between devices. The interfaces provided with the module help to directly fit into many industrial applications. The modules operate within the ISM 2.4-2.4835 GHz frequency band with IEEE 802.15.4 baseband.

Features and Benefits:

- Point to point, point to multi point, and Mesh and peer-to-peer topologies on proprietary stack.
- Direct Sequence Spread Spectrum technology.
- Each direct sequence channel has 64K unique network addresses.
- Transmit Power: 0 dBm.

- RF data rate: 250 kbps.
- Acknowledgement mode communication with retries.
- Power saving modes.
- Source / destination addressing.

C LPC2148 ARM7 Microcontroller

In this paper, the LPC2148 micro-controller is used which is based on a 32/16 bit ARM7TDMI-S CPU core. They have real-time emulation and embedded trace support that combines the micro-controller with embedded high speed flash memory of 512 KB. A 128-bit wide memory interface and unique accelerator architecture enable 32-bit code execution at the maximum clock rate. For critical code size applications, the alternative 16-bit Thumb mode (16bit instruction set) reduces code by more than 30 % with minimal performance penalty.

Due to their tiny size and low power consumption, LPC2148 are ideal for applications where miniaturization is a key requirement, such as access control systems and point-of-sale systems. It has serial communications interfaces ranging from a USB 2.0 Full Speed device, multiple UARTS, SPI, and SSP to I2Cs. It has on-chip SRAM of 8 KB up to 40 KB. This makes these devices very well suited for communication gateways and protocol converters, soft modems, voice recognition and low end imaging, providing both large buffer size and high processing power.

Various 32-bit timers, dual 10-bit ADC(s), single 10-bit DAC, PWM channels and 45 fast GPIO lines with up to nine edge or level sensitive external interrupt pins make these microcontrollers particularly suitable for industrial control and medical systems.



Fig 6: LPC2148 Microcontroller

D ZIGBEE Technology

ZigBee technology is a low data rate, low power consumption, low cost, wireless networking protocol targeted towards automation and remote applications. The ZigBee wireless networking standard fits into a market

that is simply not filled by other wireless technologies. The market category ZigBee serves is called, “wireless sensor networking and control”, or simply “wireless control”. ZigBee is a standard networking protocol aimed at the wireless control market.

ZigBee Features

- Low power consumption, simply implemented
- Users expect batteries to last many months to years.
- ZigBee/IEEE 802.15.4 has two modes they are active (transmit/receive) and sleep
- Low cost (device, installation, maintenance)
- Security
- Reliability
- Flexibility
- Very small protocol stack
- Interoperability and worldwide usability

ZigBee Device types

Every device in a ZigBee network is one of three types: a ZigBee Coordinator (ZC), a ZigBee Router (ZR), or a ZigBee End-Device (ZED)

ZigBee Coordinator

ZigBee coordinator forms the root of the network tree and might bridge to other networks. There is exactly one ZigBee coordinator in each network since it is the device that started the network originally. It is able to store information about the network, including acting as the Trust Centre & repository for security keys. If a network is not secure, Coordinator acts as a router. In a ZigBee network there is one and only one coordinator per network.

ZigBee Router

Use a ZigBee Router to enhance the mesh in the network. ZigBee Routers can extend the range of the network and increase its reliability. ZRs like the ZigBee Coordinator route packets, and also allow other nodes to join the network.

ZigBee End-Device

ZigBee End-device contains just enough functionality to talk to the either the ZigBee Coordinator or Router. Use a ZigBee End-Device if the node must be battery-operated and sleep during network inactivity.

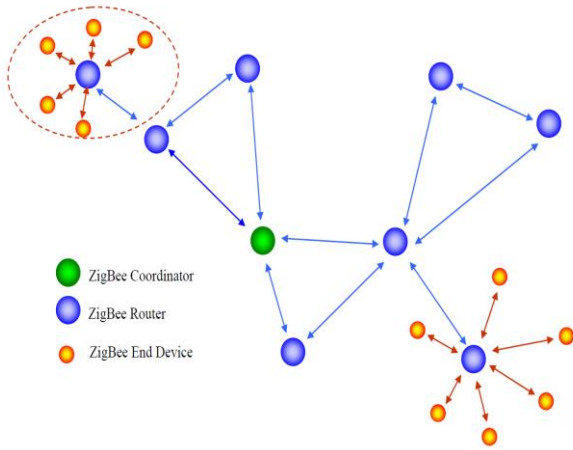


Fig 8: ZigBee Device types

IV. OVERALL SYSTEM BOARD

Figure shows the Hardware Connections of the system which consists of LPC2148 (ARM7) Microcontroller, ZigBee Transceivers, +5V DC Power Supply Unit, Buzzer, IR sensors, Limit Switch, Fire sensor, Power failure Indication Unit (Power Mains ON/OFF).

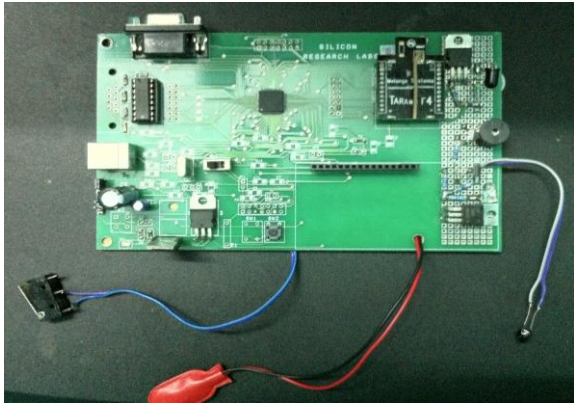


Fig 7: LPC2148 Controller with Sensors and ZigBee Board

V. EXPERIMENTAL RESULTS

The system will consists of two modules one is present at the remote location and other will be placed at the control room which is connected to the PC. Here the embedded module present at the remote location is used to detect 4 problems in this system.

- Oil exceeding in the tank
- Power failure
- Theft of oil by rotating the valve of the oil pump
- Fire generated

Detection of first problem is done by using IR sensors and the second problem can be solved by sending feed back of the power supply to the microcontroller module and the third one can be done by using the limit switch at oil pump and if any fire generated in the industries can sensed by fire sensors.

Whenever any problem occurred then for corresponding problem buzzer gives an alarm sound and due to security people may get alert and at same information will be send to the other ZigBee module which is present at the control room which connected to the PC. Here the sending of information to the PC is for the sake of displaying the official noting down of the type of the problem and time of occurred and it will be use full for saving this data more secured if that pc is controlled by system administrator.

The output can be viewed through Hyper Terminal Window which is shown in figure 5.3.If any problem occurred that can be recorded in the PC and based on this a necessary will be takes place.

In order to see output, a Hyper Terminal window is used which is shown in above figure.

Setting up Hyper Terminal

- To connect the ZigBee Transceiver board to a host PC via a RS232 serial cable, we should use a simulated terminal. There are many tools available. A most widely used one is the MS-Windows' Hyper terminal.

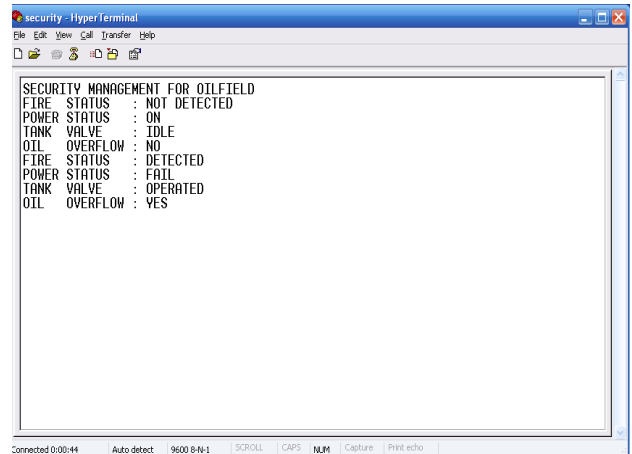


Fig .9: Output results

VI. CONCLUSION AND FUTURESCOPE

A Conclusion

The system “Security System for Oil Industries using ZigBee Technology” has been successfully designed and tested. It has been developed by integrating features of all the hardware components used. Presence of every module

has been reasoned out and placed carefully thus contributing to the best working of the unit. Secondly, using highly advanced IC's and with the help of growing technology the paper has been successfully implemented

B Future Scope

The future scope of the system can be extended by using Advanced ZigBee's which can transfer data over long distances and also the thieves can be monitored by CCTV cameras placed at the appropriate locations in Oil Industries. For monitoring purpose it requires high speed digital signal processors.

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