

# Design and Develop an Embedded System to Interact Human with the Environmental Settings to Regulate the Conditions Inside Home

**<sup>1</sup>Kokkula Srivani; <sup>2</sup>Prof. A. K. Rathod & <sup>3</sup>G. Purna Chandra Rao**

1. M.Tech, SVS Institute of Technology, Warangal, Hasanparthy, Bheemaram, Hanamkonda, Telangana 506015.
2. Professor, SVS Institute of Technology, Warangal, Hasanparthy, Bheemaram, Hanamkonda, Telangana 506015.
3. Associate Prof, SVS Institute of Technology, Warangal, Hasanparthy, Bheemaram, Hanamkonda, Telangana 506015.

## ABSTRACT-

*A smoke detector or smoke alarm is a device that detects smoke and issues a alarm to alert nearby people that there is a potential fire. They can detect fire in their early stages and give you those precious minutes to enable you and your family to leave your house in safety. Wireless communication enables transfer of data or signals over part of the entire communication network. Wireless implementation of sensor network ensures safety in terms of saving lives and property. In this paper wireless sensor network is realized using ARM 7 based microcontroller. The LPC2148 is a very popular ARM7 microcontroller with 512 KB flash, 64 KB of RAM and with several I/O peripherals. When potential fire is detected, the smoke sensor sounds an alarm .It also transmits a signal wirelessly to other sensors in the network. The microcontroller form the main unit of the system .It receives input from the sensors and wirelessly sends information to other sensors in the network to sound an alarm thereby preventing any disaster from occurring. GNU ARM/Keil compiler will be used for building the applications. LPC2148 development board will be used to test the built application. Additional sensors and wireless nodes will be used to demonstrate the complete setup.*

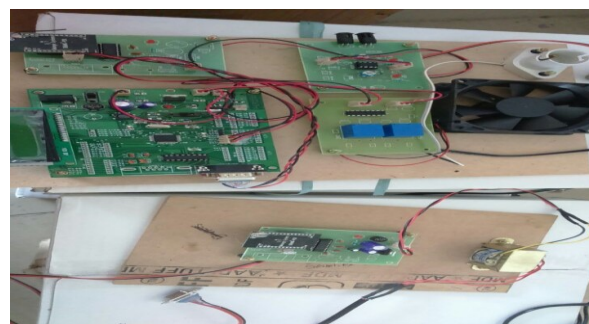
## INTRODUCTION

Sensor networks become more and more popular as cost of sensor gets cheaper and cheaper. The sensor network is a wireless network formed by a group of sensors deployed in same region, which can be used to measure air pressure, temperature, acceleration, etc. Sensors transmit signals via radio signal. Since sensors are now small and cheap, they can be deployed on a large scale. They become more and more important for applications like security, traffic monitoring, agriculture, battlefield, etc. Most of those sensors are powered by batteries. The lifespan of an energy-constrained sensor is determined by how fast the sensor consumes energy. Sensors use energy to run circuitry and send radio signals. The later is usually a function of distance and takes a large portion of the energy. Researchers are now developing new routing mechanisms for sensor networks to save energy and prolong the sensor lifespan. Four primary routing mechanisms are direct transmission, minimum energy transmission, static clustering and dynamic clustering. Sensor lifespan is an important performance index for comparison of different routing mechanisms. So far, the comparison between routing mechanisms is based on simulation results. Very few analytical results are available. A wireless sensor device is a battery-operated device, capable of sensing physical

quantities. In addition to sensing, it is capable of wireless communication, data storage, and a limited amount of computation and signal processing. Advances in integrated circuit design are continually shrinking the size, weight and cost of sensor devices, while simultaneously improving their resolution and accuracy. At the same time, modern wireless networking technologies enable the coordination and networking of a large number of such devices. In this paper a system was implemented which provides security control system for smoke and fire detection using wireless sensor network (WSN). A Wireless Sensor Network (WSN) consists of a large number of wireless sensor devices working collaboratively to achieve a common objective. A WSN has one or more sinks (or Base Stations) which collect data from all sensor devices. These sinks are the interface through which the WSN interacts with the outside world. The basic premise of a WSN is to perform networked sensing using a large number of relatively unsophisticated sensors, instead of the conventional approach of deploying a few expensive and sophisticated sensing modules. The potential advantage of networked sensing over the conventional approach can be summarized as greater coverage, accuracy and reliability at a possibly lower cost. WSNs can also facilitate controlling of physical environments from remote locations with better accuracy. Sensor nodes have various energy and computational constraints because of their inexpensive nature and ad-hoc method of deployment. In this paper for sensing the smoke, smoke sensors are used. Sensitivity of smoke is usually accomplished in several ways. Either ionization, photoelectric or a combination of both depends on the type of detector. The source of power for wireless smoke detectors found in the home is powered by disposable

batteries. Although the National Fire Protection Association (NFPA) recommends a smoke alarm be installed in every room, it is more common to have interconnected smoke alarms throughout the house. If you wish to comply with the NFPA recommendation, most wireless smoke alarms will allow you to add additional units wherever you think they are required. Generally, when one alarm is activated, all the alarms will sound. Smoke alarms save lives, property loss. It's simply an early warning system that protects you, your family and your property. Any investment returns benefits an untold number of times simply because you'll never know when it's needed until it's needed. The two most used wireless smoke detectors are the photoelectric and the ionization models. They are optical detection and physical process devices, respectively. The ionization models react rapidly to the presence of flames and are more useful when a fast moving fire is present. Smoky, smoldering fires are sensed more readily by the optical smoke alarm devices. Dual sensor smoke alarms will contain elements of both technologies. The USFA recommends a combination of photoelectric and ionization smoke detectors which can be achieved with a dual sensor type. There are also alarms that support the hearing impaired.

## HARDWARE IMPLEMENTATION:



## ARM7

The ARM7 family includes the ARM7TDMI, ARM7TDMI-S, ARM720T, and ARM7EJ-S processors. The ARM7TDMI core is the industry's most widely used 32-bit embedded RISC microprocessor solution. Optimized for cost and power-sensitive applications, the ARM7TDMI solution provides the low power consumption, small size, and high performance needed in portable, embedded applications.

The ARM7EJ-S processor is a synthesizable core that provides all the benefits of the ARM7TDMI low power consumption, small size, and the thumb instruction set while also incorporating ARM's latest DSP extensions and enabling acceleration of java-based applications. Compatible with the ARM9™, ARM9E™, and ARM10™ families, and Strong-Arm® architecture software written for the ARM7TDMI processor is 100% binary-compatible with other members of the ARM7 family and forwards-compatible with the ARM9, ARM9E, and ARM10 families, as well as products in Intel's Strong ARM and x scale architectures. This gives designers a choice of software-compatible processors with strong price-performance points. Support for the ARM architecture today includes:

- Operating systems such as Windows CE, Linux, palm and SYMBIAN OS.
- More than 40 real-time operating systems, including qnx, Wind River's vxworks and mentor graphics' vrtx.
- Co simulation tools from leading eda vendors
- A variety of software development tools.

## ZIGBEE:

There are a multitude of standards like Bluetooth and Wi-Fi that address mid to high data rates for

voice, PC LANs, video, etc. However, up till now there hasn't been a wireless network standard that meets the unique needs of sensors and control devices. Sensors and controls don't need high bandwidth but they do need low latency and very low energy consumption for long battery lives and for large device arrays. There are a multitude of proprietary wireless systems manufactured today to solve a multitude of problems that don't require high data rates but do require low cost and very low current drain. These proprietary systems were designed because there were no standards that met their application requirements. These legacy systems are creating significant interoperability problems with each other and with newer technologies. The ZigBee Alliance is not pushing a technology; rather it is providing a standardized base set of solutions for sensor and control systems. The physical layer was designed to accommodate the need for a low cost yet allowing for high levels of integration. The use of direct sequence allows the analog circuitry to be very simple and very tolerant towards inexpensive implementations. The media access control (MAC) layer was designed to allow multiple topologies without complexity. The power management operation doesn't require multiple modes of operation. The MAC allows a reduced functionality device (RFD) that needn't have flash nor large amounts of ROM or RAM. The MAC was designed to handle large numbers of devices without requiring them to be "parked". The network layer has been designed to allow the network to spatially grow without requiring high power transmitters. The network layer also can handle large amounts of nodes with relatively low latencies. ZigBee is poised to become the global control/sensor network standard. It has been designed to provide the following features.

1. Low power consumption, simply implemented

2. Users expect batteries to last many months to years

Consider that a typical single family house has about 6 smoke/CO detectors. If the batteries for each one only lasted six months, the home owner would be replacing batteries every month!

1. In contrast to Bluetooth, which has many different modes and states depending upon your latency and power requirements, ZigBee/IEEE 802.15.4 has two major states: active (transmit/receive) or sleep. The application software needs to focus on the application, not on which power mode is optimum for each aspect of operation.

2. Even mains powered equipment needs to be conscious of energy. ZigBee devices will be more ecological than their predecessors saving megawatts at it full deployment.

Consider a future home that has 100 wireless control/sensor devices,

Case 1: 802.11 Rx power is 667 mW (always on) @ 100 devices/home & 50,000 homes/city = 3.33 megawatts

Case 2: 802.15.4 Rx power is 30 mW (always on) @ 100 devices/home & 50,000 homes/city = 150 kilowatts

Case 3: 802.15.4 power cycled at .1% (typical duty cycle) = 150 watts

3. Low cost to the users means low device cost, low installation cost and low maintenance.

4. ZigBee devices allow batteries to last up to years using primary cells (low cost) without any chargers (low cost and easy installation). ZigBee's simplicity allows for inherent configuration and redundancy of network devices provides low maintenance.

5. High density of nodes per network

6. ZigBee's use of the IEEE 802.15.4 PHY and MAC allows networks to handle any number of

devices. This attribute is critical for massive sensor arrays and control networks.

7. Simple protocol, global implementation ZigBee's protocol code stack is estimated to be about 1/4th of Bluetooth's or 802.11's. Simplicity is essential to cost, interoperability, and maintenance. The IEEE 802.15.4 PHY adopted by ZigBee has been designed for the 868 MHz band in Europe, the 915 MHz band in N America, Australia, etc; and the 2.4 GHz band is now recognized to be a global band accepted in almost all countries.

I) ZigBee/IEEE 802.15.4 - General Characteristics

- Dual PHY (2.4GHz and 868/915 MHz)
- Data rates of 250 kbps (@2.4 GHz), 40 kbps (@ 915 MHz), and 20 kbps (@868 MHz)
- Optimized for low duty-cycle applications (<0.1%)
- CSMA-CA channel access yields high throughput and
- low latency for low duty cycle devices like sensors and
- controls
- Low power (battery life multi-month two years)
- Multiple topologies: star, peer-to-peer, mesh
- Addressing space of up to: -
- 18,450,000,000,000,000 devices (64 bit IEEE
- address) - 65,535 networks
- Optional guaranteed time slot for applications requiring
- low latency
- Fully hand-shaked protocol for transfer reliability
- Range: 50m typical (5-500m based on environment)

- II) Zig Bee/IEEE802.15.4 - Typical Traffic Types
- Addressed
- Periodic data
- Application defined rate (e.g., sensors)
- Intermittent data
- Repetitive low latency data
- Allocation of time slots (e.g., mouse) Each of these traffic types mandates different attributes
- from the MAC. The IEEE802.15.4 MAC is flexible enough to handle each of these types.
- Periodic data can be handled using the beaconing system whereby the sensor will wake up for the beacon, check for any messages and then go back to sleep.
- Intermittent data can be handled either in a beaconless system or in a disconnected fashion. In a disconnected

## 5. CONCLUSIONS

### A) Wireless Technology

Cable is expensive, less flexible than RF coverage and is prone to damage. For new facilities, implementing a wireless infrastructure may be more cost effective than running cable through industrial environments, especially if the space configuration may change to support different storage space allocation or flexible manufacturing stations.

### B) ZigBee Communication

Real-time ZigBee communication include a significant improvement in order accuracy (>99%), the elimination of paperwork, replacement of time-consuming batch processing by rapid real-time data processing, prompt response times and improved service levels. Complementing a real-time data collection system

with automated data entry by bar code scanning or another automatic data collection technology improves the accuracy of information and eliminates the need for redundant data entry, which provides another set of time and cost-saving advantages

### C) ARM Controller

- Low power Consumption
- Low cost
- Execution speed is faster

### D) Future Scope

The smoke detector system can be enhanced by connecting it with a personal computer for monitoring and controlling purposes and using the GSM (Global System for Mobile Communications) to send and receive an SMS (short message Service) from the place of the detector to the involved person. Therefore, improve the chances for reducing the risks to life and property

## 6. REFERENCES

- [1] Molla Shahadat Hossain Lipu, Md. Lushanur Rahman, Tahia Fahrin Karim, Faria Sultana, "Wireless Security Control System & Sensor Network for Smoke & Fire Detection" , 2010 IEEE
- [2] Full-Scale House Fire Experiment for InterFIRE VR, Report of Test, A.D. Putorti Jr and J. McElroy, November 2, 1999, Revised April 10, 2000.
- [3] 2003 NFPA world safety conference 'May 20 2003' Smoke Detection system performance. Dan Gottuk..
- [4] Fire Detection Systems [www.osha.gov](http://www.osha.gov).

[5] Application of Wireless Sensor Mote for Building Risk Monitoring, N. Kurata, B. F. Spencer, Jr, and M. Ruiz- Sandoval, Presentations/P8.pdf, (2003).

[6] On Random Event Detection with Wireless Sensor Networks, P. K. Dutta, Master's Thesis, Ohio State University, 2004.