Establishing a Multi-Application ADHOC Network for Smart city Design

M.Annapurna[1], S.Himabindu[2]

[1]PG Student, Department of ECE, ASCET, Gudur, Andhra Pradesh, India

[2]Assistant professor of Department ECE, ASCET, Gudur, AP, India

ABSTRACT- With the event and application of the net of things, mobile broadband network, next generation, cloud computing and etc, informatization encompasses a tendency of upper smarter stage. IBM Corporation in Gregorian calendar month 2008 issued the conception of "Smart Earth". The principle of good Earth is that, sensors are embedded within the railways, bridges, tunnels, roads, buildings, water systems, dams, industrial instrumentation and medical instrumentation, then physical facilities are often perceived, thus info technology extends into physical world[2], constructing a "Internet of Things". Moreover, net of Things are often connected with net to whole number the human society and physical system. People, machine, equipment, and etc are often managed within the integrated system through laptop and cloud computing, that the people's production and life are often managed additional exactly and dynamically to urge smarter, raise resource usage and productivity and improve the link between folks and nature. Some specialists have researched smarter town. "Smart City" is to create town smarter, conjointly to create the folks smarter within the town. This project aims at demonstrating a town automation system whereby all the homes within the town may be brought underneath one multi-tier duplex wireless adhoc network. The project uses RF Transceiver technology for achieving this.

Keywords- Gas Sensor, IR Sensor, GSM, Zigbee, ARM-7.

1. INTRODUCTION

City automation is a rapidly growing segment within the automation industry. City automation is applicable at various places within a city. Also the degree of automation can vary from simple announcement systems to much more sophisticated systems which can automatically control user devices, lighting and many more things. This project aims at demonstrating a city automation system wherein all the houses in the city can be brought under a single **multi-tier bidirectional wireless adhoc network**. The project uses RF Transceiver technology for achieving this. RF Transceiver is a short distance wireless communication technology which has found wide application in industries. RF Transceiver works on 2.4GHz or the ISM band which does not require any licensing and hence can be used by domestic customers. In our daily life there is a lot of information that are to be transferred from our home to a multiple centralized locations. These services include:

1. Water Billing and Tax: Communication between customer premises to public office

2. Safety Systems: Communication between homes and industries to emergency systems Such as Fire service, Hospitals

3. Security Systems: Communication between homes and industries to Security establishments such as Police Stations.

4. Information transfer and warning systems: Communications between homes and industries to Corporation/municipality offices, Tax houses, Central alerting houses.

5. Electricity Controlling System: Automatic Power shutdown to specified industries during power shortage or at regular power scheduling.

As many as all the bidirectional communication between different nodes can be established and communication between any node to any node is possible. So each node acts both as a transmitter and receiver. This becomes possible because of the use of RF Transceiver technology which has CSMA/CD capabilities; hence it can resolve any conflicts in the communication. Further as its bidirectional communication complete city automation can

be achieved by forming a RF Transceiver network, the network can sense gas leakage or even unauthorized intrusion. Likewise a variety of application can be done by establishing RF Transceiver network which is an advanced standard.
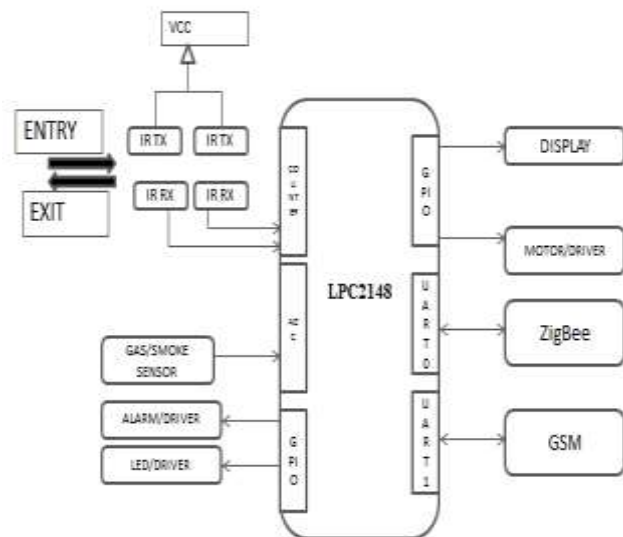
2. HARDWARE DESIGN

Fig 2 Block Diagram

LPC2148 Processor:

LPC2148 Microcontroller Architecture. The ARM7TDMI-S is a general purpose 32-bit microprocessor, which offers high performance and very low power consumption. The ARM architecture is based on Reduced Instruction Set Computer (RISC) principles, and the instruction set and related decode mechanism are much simpler than those of micro programmed Complex Instruction Set Computers (CISC). This simplicity results in a high instruction throughput and impressive real-time interrupt response from a small and cost-effective processor core. Pipeline techniques are employed so that all parts of the processing and memory systems can operate continuously. Typically, while one instruction is being executed, its successor is being decoded, and a third instruction is being fetched from memory. The ARM7TDMI-S processor also employs a unique architectural strategy known as Thumb, which makes it ideally suited to high-volume applications with memory restrictions, or applications where code density is an issue.

The key idea behind Thumb is that of a super-reduced instruction set. Essentially, the ARM7TDMI-S processor has two instruction sets:

• The standard 32-bit ARM set.
• A 16-bit Thumb set.

The Thumb set's 16-bit instruction length allows it to approach twice the density of standard ARM code while retaining most of the ARM's performance advantage over a traditional 16-bit processor using 16-bit registers. This is possible because Thumb code operates on the same 32-bit register set as ARM code. Thumb code is able to provide up to 65% of the code size of ARM, and 160% of the performance of an equivalent ARM processor connected to a 16-bit memory system
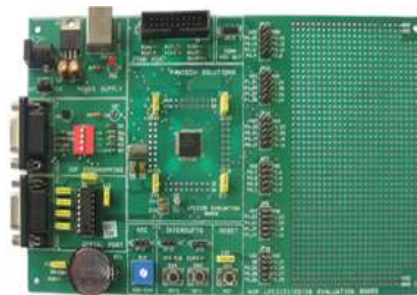

Fig 2.1 ARM7TDMI PCB board

IR Sensor:

IR-based motion detector is used to sense movement of people, animals, or other objects. They are commonly used in burglar alarms and automatically-activated lighting systems. They are commonly called simply "PIR", or sometimes "PID", for "passive infrared detector".

Operating principles:

All objects with a temperature above absolute zero emit heat energy in the form of radiation. Usually this radiation is invisible to the human eye because it radiates at infrared wavelengths, but it can be detected by electronic devices designed for such a purpose. The term *passive* in this instance refers to the fact that PIR devices do not generate or radiate any energy for detection purposes. They work entirely by detecting the energy given off by other objects. IR sensors don't detect or measure "heat"; instead they detect the infrared radiation emitted or reflected from an object.

Gas Sensor:

Fig 2.2 Gas Sensor.

Ideal sensor for use to detect the presence of a dangerous LPG leak in your car or in a service station, storage tank environment. This unit can be easily incorporated into an alarm unit, to sound an alarm or give a visual indication of the LPG concentration. The sensor has excellent sensitivity

combined with a quick response time. The sensor can also sense iso-butane, propane, LNG and cigarette smoke.

MQ-6 Smoke Sensor

In this project we are using this for identifying any smoke evolved from any substance. This will be monitored continuously by the data acquisition section and will be transmitted through the CAN network for the monitoring purpose.

3. GSM OVERVIEW

Global System for Mobile Communications or GSM (originally from Group Special Mobile) is the world's most popular standard for mobile telephone systems. The GSM Association estimates that 80% of the global mobile market uses the standard. GSM is used by over 1.5 billion people across more than 212 countries and territories. This ubiquity means that subscribers can use their phones throughout the world, enabled by international roaming arrangements between mobile network operators. GSM differs from its predecessor technologies in that both signaling and speech channels are digital, and thus GSM is considered a second generation (2G) mobile phone system. The GSM standard has been an advantage to both consumers, who may benefit from the ability to roam and switch carriers without replacing phones, and also to network operators, who can choose equipment from many GSM equipment vendors.

SMS Commands:

¬AT+CIMI
Note: scan IMSI
¬AT+CMGS="+919704040791"
¬AT+CMGR=1
¬AT+CMGD=1,4
Note: Delete it Note: Message

Global system for mobile communication (GSM) is a globally accepted standard for digital cellular Communication. GSM is the name of standardization Group established in 1982 to create a common European mobile telephone standard that would formulate specifications for a pan-European mobile cellular radio system operating at 900 MHz A GSM modem is a wireless modem that works with a GSM wireless network. A wireless modem behaves like a dial-up modem. The main difference between them is that a dial-up modem sends and receives data through a fixed telephone line while a wireless modem sends and receives data through radio waves. The working of GSM modem is based on commands, the commands always start with AT means Attention) and finish with a <CR> character. For example, the dialing command is ATD<number>; ATD3314629080; here the dialing command ends with semicolon. The AT commands are given to the GSM modem with the help of PC or controller. The GSM modem is serially interfaced with the controller with the help of MAX 232.

Global usage:

Originally GSM had been planned as a European system. However the first indication that the success of GSM was spreading further afield occurred when the Australian network provider, Telstra signed the GSM Memorandum of Understanding.

Frequencies:

Originally it had been intended that GSM would operate on frequencies in the 900 MHz cellular band. In September 1993, the British operator Mercury One-to-One launched a network. Termed DCS 1800 it operated at frequencies in a new 1800 MHz band. By adopting new frequencies new operators and further competition was introduced into the market apart from allowing additional spectrum to be used and further increasing the overall capacity. This trend was followed in many countries, and soon the term DCS 1800 was dropped in favor of calling it GSM as it was purely the same cellular technology but operating on a different frequency band. In view of the higher frequency used the distances the signals travelled was slightly shorter but this was compensated for by additional base stations. In the USA as well a portion of spectrum at 1900 MHz was allocated for cellular usage in 1994. The licensing body, the FCC, did not legislate which technology should be used, and accordingly this enabled GSM to gain a foothold in the US market. This system was known as PCS 1900 (Personal Communication System)

GSM network:

GSM provides recommendations, not requirements. The GSM specifications define the functions and interface requirements in detail but do not address the hardware. The reason for this is to limit the designers as little as possible but still to make it possible for the operators to buy equipment from different suppliers. The GSM network is divided into three major systems: the switching system (SS), the base station system (BSS), and the operation and support system (OSS).
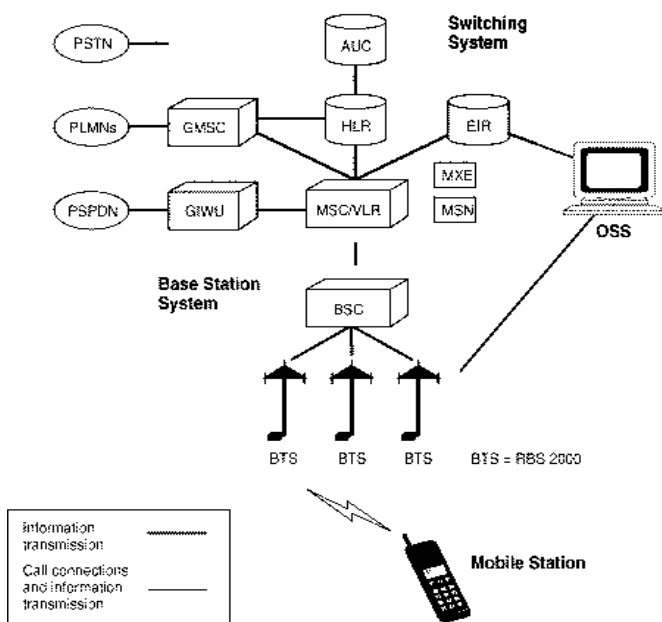

Fig 3 GSM Network Elements

4. ZigBee

ZIGBEE is a wireless technology developed as an open world customary to deal with the distinctive desires of affordable, low-power; wireless detector networks. The quality takes full advantage of the IEEE 802.15.4 physical radio specification and operates in unlicensed bands worldwide at the subsequent frequencies: a pair of.400-2.484GHz, 902-928MHz and 868.0-868.6MHz. The 802.15.4 specification was developed at the Institute of Electrical and natural philosophy Engineers (IEEE). The specification may be a packet-based radio protocol that meets the requirements of affordable, battery-operated devices. The protocol permits devices to intercommunicate and be power-driven by batteries that last years rather than

hours. The ZigBee protocol carries all the advantages of the 802.15.4 protocol with additional networking practicality.

The ZigBee protocol was designed by the ZigBee Alliance, a non-profit pool of leading semiconductor makers, technology suppliers, OEMs and end-users worldwide. The protocol was designed to produce OEMs and integrators with an easy-to-use wireless information answer characterized by low-power consumption, support for multiple network structures and secure connections. The ZigBee protocol was designed to hold information through the hostile RF environments that habitually exist in industrial and industrial applications. The ZigBee specification provides a security tool case approach to making sure reliable and secure networks. Access control lists, packet freshness timers and 128-bit encryption based on the NIST Certified Advanced Encryption Standard (AES) help protect transmitted data.

ZigBee allows broad-based readying of wireless networks with cheap, low-power solutions. It provides the power to last years on cheap batteries for a number of watching applications: lighting controls, AMR (Automatic Meter Reading), smoke and CO detectors, wireless measure, HVAC management, heating management, home security, environmental controls, material and shade controls, etc. A key part of the ZigBee protocol is that the ability to support meshes networks. In an exceedingly mesh network, nodes are interconnected with alternative nodes in order that a minimum of 2 pathways connect every node. Connections between nodes are dynamically updated and optimized in troublesome conditions. In some cases, a partial mesh network is established with a number of the nodes solely connected to at least one alternative node.

Mesh networks are localized in nature; every node is self-routing and ready to hook up with alternative nodes as required. The characteristics of mesh and ad-hoc routing offer bigger stability in ever-changing conditions or failure at single nodes.

5. Result

If there is any obstacle or any kind of particle comes in between the IR sensors, then the IR waves will get reflected and the reflected signals will be absorbed or captured by the photo diode and sends a signal to the PIC-microcontroller. PIC-microcontroller sends a message (theft has happened) to the public main office with the help of Zigbee and buzzes alarm. Public main office will send message to police station.

If there is any gas leakage happened, and then the gas sensor will send a signal to the microcontroller, then the microcontroller will send a message (Gas leakage) to the public main office and the buzzer buzzes and displays a message on the LCDs that Gas leakage has been occurred. Public main office will send message to fire station.
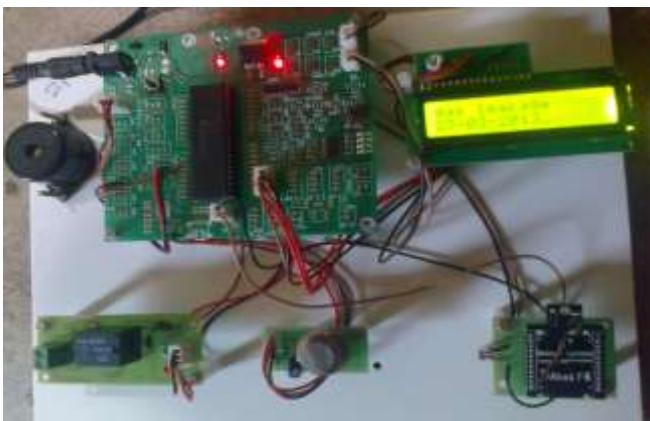
6. Conclusion

To demonstrating a city automation system where in all the houses in the city can be brought under a single multi-tier bidirectional wireless adhoc network. This project is also applicable to industries, banks, and others that require security and safety. Finally, a Smart city is established in a town with security and safety.

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AUTHORS

[1]M.Annapurna, Received Her B.E Degree In Electronics And Communication Engineering From SVEW, Karakambadi Road, Tirupati. Affliated To Jawaharlal Nehru Technological University (JNTU), Anantapur In 2013.She is Currently Persuing M.Tech Embedded Systems In Audisankara College Of Engineering And Technology (Autonomous), Gudur,Nellore(Dt).

[2]Himabindu Sathyaveti is Working as Assistant professor in ECE Dept, ASCET, Gudur, AP, India. She has been guiding UG & PG students since two years in this institution. She pursued her M.Tech from Karunya University, Coimbatore. She presented four papers in international journals & six international conferences. Her research areas of interest are Embedded systems and Signal Processing.

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