Wireless Sensors Network and GSM Based Smart Home System and Some Other Applications

Vijay Laxmi Kalyani, Surbhi Shrimali

Vijay Laxmi Kalyani, *Assistant Professor, Department of Electronics and Communication, Govt.Mahila Engineering College, Ajmer, Rajasthan, India,*

vijaylaxmikalyani@yahoo.com

Surbhi Shrimali,*B.Tech Scholar, Department of Electronics and Communication, Govt.Mahila Engineering College,*

Ajmer, Rajasthan, India,

surbhishrimali281195@gmail.com

Abstract— In today's scenario, safer home security is required. As the technology is too much advanced, so it's time for us to be more technical related to the home security.

The main theme of this paper is Technology for intelligible and smart home. The Efficient design and implementation of wireless sensor networks has become a hot area of research in recent years, due to the vast potential of sensor networks to enable applications that connect the physical world to the virtual world. There is we use a remote home security system using W SN and GSM technology.

Till now, many types of sensors have been used for security purpose but in this paper some other technologies are also used for more efficient and accurate security systems like using the Remote Keyless System used for door lock and unlock just as in key system of cars and an android application for message alert Lockitron.

Keywords—Home security system, GSM, Microcontroller, wireless sensor network, various types of sensors, mobile application, e-keys, remote keyless system.

I.INTRODUCTION

Home security has been a concern of worldwide. Home security systems are for automating, improving security, safety, communication, comfort and energy saving. A smart home based on WSN is using solid deployment of sensors to provide insinuate and precise monitoring[1].

In these days, home security has become an important issue due to high rate of crimes. In the beginning, the security system is quite basic and only offers simple password lock. Hence we would like to enhance our security system with different kinds of sensors.

Thus we have incorporated temperature sensor, smoke detectors, and motion sensor. But now to be more technical

we can use many other ways to make our home more intelligible and secure. The wireless systems are preferred because implementation and maintenance of wired systems are time consuming, error-prone and costly while wireless sensor network is small in size and battery powered. To make more efficient we can provide power to them through solar panel or rechargeable batteries. Thus wireless sensor network has brought a new level of building monitoring systems. This

monitoring system is established on the combination of several sensors, and it has the ability of broadcasting data via wireless communication. GSM network has the advantages of mature technology, wide covering area, long communication distance, and sound communication effect and so on.

The remote home security system presented in this paper combines so many advantages of WSN and GSM. Firstly, wherever the users are, once some dangerous instance happens in home, such as gas leaking or thief intruding, this system can send alarm short message to the users through GSM network immediately, informing people the possible dangerous circumstances in home. Secondly, the wireless sensor network established in home has the features of ease establishment, without use of cable, and low-power consumption. Intelligent home, also known as the smart residential home, is moving towards the wireless remote control, multi-media control, and high-speed data transmission. At present, the application of intelligent home wireless communication technologies mainly include: IrDA infrared technology, Bluetooth and ZigBee technology, and so on. IrDA is a short distance for the half-duplex point-to-point communication. Because it is inconvenient and of high error rate, so IrDA not applicable to the family network

In this paper, some other applications are also given to make smarter home which are cost effective and having less power consumption. So using these technology we can save life of people living in those buildings.

II. WIRELESS SENSOR NETWORK ARCHITECTURE

A wireless sensor network sensor node devices spread over a large field. It is a combination of wireless sensing + data networking. It seems like a straight forward combination of modern technology. A wireless sensor network (WSN) are spatially distributed autonomous sensors to monitor physical or environmental conditions, such as temperature, sound, pressure, etc. and to cooperatively pass their data through the network to a main location. WSN is flexible and portable which is composed of a large amount of miniature self-organizing wireless sensor nodes, where each node is connected to one (or several) sensors. Three kinds of technologies are combined in WSN so that it can detect, collect and deal with the object information in its covering area, and send data to the observer, these are sensor, micro-mechatronics and wireless communication. Each such sensor network node has typically several parts: a radio transceiver

with an internal antenna or connection to an external antenna, a microcontroller, Analog to digital converter and an energy source (for which a rechargeable battery can be used).

In WSN, data collecting node modules are connected with pyroelectric infrared detector, temperature sensor, smoke detector, gas sensor etc. any other sensors separately. When any of the above sensors detect related to their sensing technologies like When the pyroelectric infrared detector finds that some people introduces into the house abnormally, then they will send encoded alarm signal to the home control center through the wireless
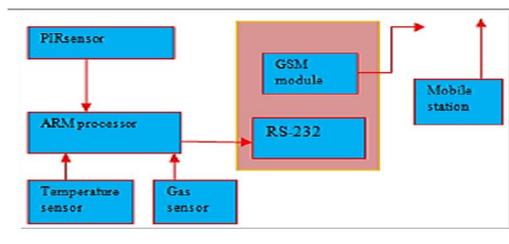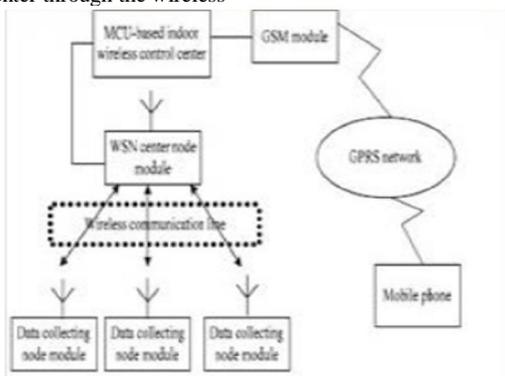

Fig (1): Node architecture of WSN

sensor network established in home. Once the wireless control center receives alarm signal, it will send alarm short message to the users through the GSM module and GSM network immediately.

III. SYSTEM ARCHITECTURE

In the system cameras are used. The SMS and MMS are sent to the mobile phones. The household appliances can be remotely controlled by SMS. Zig Bee module is used for

household appliances. Fig. 1. shows the block diagram of the system Through MMS modules and ZigBee module it can send information and instructions. And Expand access plate to smoke, infrared, gas and other domestic security state sensor. MMS module makes the system controller send the family security status information to mobile phone users.

Users send and receive text messages of instruction [10].

Fig (2): block diagram of the System

When the pyroelectric infrared detector finds that some people intrudes into the house abnormally; or when the temperature sensor detects too high indoor temperature and at the same time, the smoke sensor detects over proof smoke concentration; or when the gas sensor detects over proof combustible gas concentration, the sensors will send encoded alarm signal to the home control center through the wireless sensor network established in home. Once the wireless control center receives alarm signal, it will send alarm short message to the users through the GSM module and GSM network immediately

Zigbee module is responsible for the system motherboard with the expansion of household appliances between the board and cross-linking of data. In Fig.2. It is consists of the MCU-based home wireless control center, one WSN center node module, and several data collecting nodes, GSM module, GSM network and mobile phone. The WSN data collecting node modules are connected with pyroelectric infrared detector,

To understand the architecture of wireless sensor network based home security system, the author describes the main components or devices as follows:

III.I. SENSOR
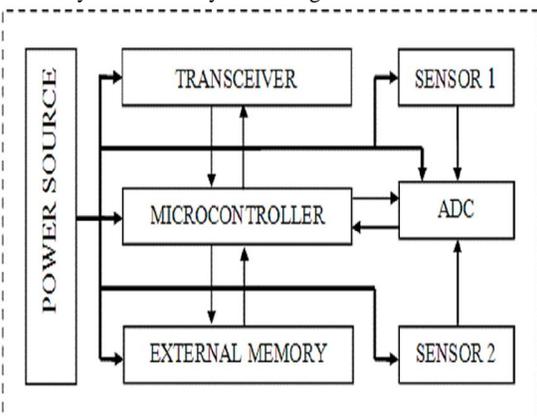
A sensor is a device that detects or measures a real-world condition, such as motion, heat or light and converts it to an equivalent analog or digital representation [2]. There are currently
Thousands of potential sensors ready to be attached to a wireless sensing platform [3]. The various types of sensors that can be used for security system are given below:

1. Contact sensor:

Contact or magnetic sensors are one of the most common types of security alarms. They are installed on doors or windows in two parts. One part houses a magnet or magnetic current, the other houses a switch that turns on when near the magnetic.

If the two are separated, the switch flicks off, the circuit is broke, and the control panel initiates the alarm. When the security system is armed, this type of alarm is activated by both normal entry (i.e., with a key or through any unlocked windows) and forced entry, making it a versatile, highly useful security alarm when you want to prevent any type of

entrance into your home. Once armed, a signal is sent to the smart home control panel if the door is opened.

2. Photobeam alarms

Photobeam alarms use basic, focused light beams. When the beam is broken, the alarm sounds. Photobeams are useful for indoor security, particularly if you have a specific room you want to protect (they are also flexible in use for small businesses). They are less useful outdoors, when windows, animals, and objects may accidentally trip the alarm.

3. Motion sensor

PIR refers to Passive Infrared Motion, a technology designed to detect movement before it activates a security alarm. The infrared sensor picks up temperature changes in the nearby air — if the change is great enough, the sensor sends the signal. This is particularly useful for outdoor alarms, where shifting branches or shrubs will not affect temperature changes, but a large heat source like a human will.

Like many motion-based sensors, a delay is often built into the alarm, so that owners who accidentally trigger the alarm can enter a security code before the siren sounds.

4. Ultrasonic sensor:

Ultrasonic detectors are very similar to PIR sensors, but instead of detecting heat they use sound waves that sense any type of movement. While ultrasonic detectors are not as useful in outdoor systems, they can easily cover an entire room indoors, detecting an intruder throughout a given space.

If you have a pet then these sensors are not practicable. Microwave detectors are very similar to these ultrasonic sensors, but may prove less expensive, since the microwaves can pass through walls and monitor multiple rooms at one time.

5. Window (shock) alarm:

Shock alarms are used almost exclusively on windows, and work especially well on windows that may be shattered or broken to admit entry into your house. The alarm detects either the sharp sound of breaking glass or the vibrations that accompany broken windows, depending on the type. This option is suitable for windows where magnetic switches will not work. Once a window is broken the smarthouse sensor sends a signal back to your smart home panel. Operates in a similar manner to door contacts and sends notifications to smart house control systems. These sensors are basically used to enhance your windows home security levels.

6. Control panel siren:

Control panel alarms are basic sensors that detect if someone is tampering with the panel. Some criminals try to disarm control panels in efforts to gain entry to the house. The sensor, often a magnetic or shock version, picks up on the disturbance and sounds the alarm.so this sensor will detect the tempering with panel and send a signal to the home control center.

7. Environmental/Detector alarm:

Detector alarms focus more on protecting people from the environment than from burglars. The most common type is the legally required smoke detector, which sounds an alarm in the presence of significant smoke. However, security alarm systems also offer integrated alarms for carbon monoxide detection and advanced smoke detectors with both **smoke and heat sensors** for better protection. Since these alarms tie into your control panel, they can also send messages to the Security Company or appropriate organizations if they detect dangerous conditions.

8. Panic alarm:

Panic alarms or "hold up" alarms are a subset of the security alarm sector. They are often installed in a single, easily reached location but may also be portable. Homeowners and others can personally activate them in the case of a burglary or a personal attack. While some activate loud sirens to discourage attack, many send a silent signal for help.

9. Temperature sensor

In this temperature sensor circuit, a Thermistor works as the heat sensor. When temperature increases, its resistance decreases, and vice versa. At normal temperature, the resistance of the Thermistor (TH1) is approximately 10 kilo-ohms, which reduces to a few ohms as the temperature increases beyond 100 C. The circuit uses readily available components and can be easily constructed on any general-purpose PCB.
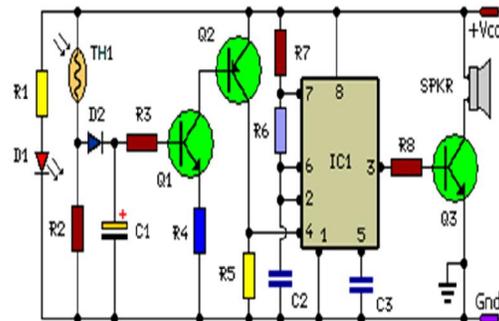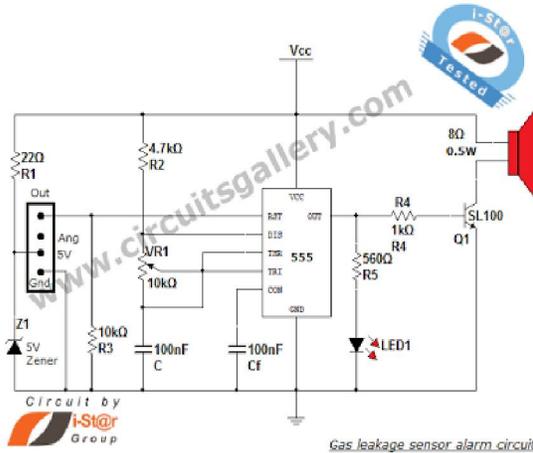

Fig (3): Circuit Diagram

10. Gas Leakage Sensor

This is a **LPG gas leakage sensor circuit** that detects the outflow of LPG gas and alerts the user via audio and visual indications. This is a gas sensor module SEN 1327. QM 6 gas sensor is used in this SEN 1327 module. The output signal

from this gas sensor module is used to drive a 555 timer as table multivibrator. Here **555 timer** works as a tone generator, the frequency of tone can be altered by varying the preset VR1.

Fig(4) : Circuit Diagram
Source: www.circuitsgallery.com

An example of a ground floor layout and recommended locations for different types of alarm sensors and the main control panel is presented below:

Fig (5) : Ground Floor Layout

III.II.   GSM MODULE

GSM module is based on SIM900A Quad-band GSM/GPRS module. This module allows us to benefit from small dimensions and cost-effective solutions [4]. The GSM receiving module acts as a gateway in this architecture. This receiving module can be a GSM or GPRS modem, mobile phone or any SMS sending or receiving device. This device connects with computer and microcontroller through USB or serial cable.

 However, it is high cost and high power consumption. Y. Zhao has developed a low cost GSM/GPRS based wireless home security system which includes wireless security sensor

nodes and a GSM/GPRS gateway [1]. It has the following features:
(a) low cost
(b) low power consumption
(c) simple installation
(d) fast response
(e) simple user interface
Thus, the owner of house, who is maintaining the work on laptop, will be notified with short messaging service (SMS) from the server via GSM module system in a few seconds. Alternatively, it can be improved with Bluetooth technology which is embedded in most of mobile laptop today.

III.III. MICROCONTROLLER

Microcontroller (μ) is the brain of this architecture because it controls the entire component in the measurement unit directly. The μ uses AT (Attention) commands to access GSM modem [1].
Microcontroller performs the main task in the sensor nodes i.e. processing the data and controlling the functions of the other components. The best choice for embedded systems is to use microcontrollers because of the services providing by them, like it can connect to other devices more flexible and power consumption is less [5].
There are typically three types of microcontrollers used in wireless sensor network application. They are Microchips, AVR series and MSP430 series.
Here we use AVR series microcontroller.

1. AVR series:
The AVR microcontroller is also fallows the Harvard architecture. ATMega128L microcontroller is widely used in sensor nodes [5]. The features for AVR are explained below.

* AVR microcontroller is a powerful interrupt structure for AVR interrupt execution is enabled for four clock cycle minimum. Then the program is executed.
* The ATMEGA128 offer 133 powerful instructions. Each instruction takes one or two 16bit words.
* AVR is based with programs and is stored data separately for performing and parallelism.
* The general purpose input output ports are bi-directional. These AVR's has a built in ADC (Analog to Digital Comparator) and Analog Comparators.
* It also fix power sleep modes they are idle, ADC noise reduction, power-save, power-down, stand by and extended stand by.
* In this microcontroller each instruction occupies one or two cycles and it also consist of fetch and execute cycle.

III.IV. ZIGBEE

Zigbee is a new, wireless personal area network technology based on IEEE 802.15.4, with a transmission range of 100+ meters. ZigBee based communication devices consume very little power and hence the life of battery1000+ days is common. ZigBee has advantages compared to Bluetooth when used in WSN because it has more coverage area, less power consumption, and secure networking. ZigBee operates in the industrial, scientific and medical radio bands - 868 MHz in Europe, 915 MHz in the USA and 2.4 GHz in most other countries in the rest of the world[10].

Now we will see how we can use a mobile application or Bluetooth technology for the alert messages.

IV. LOCKITRON: INTER CONNECTED SMART HOME DOOR-LOCK

Lockitron is a device which can lock and unlock deadbolt locks via remote control, typically a smartphone .The device is made by Apigy, a start-up based in Mountain View, California [6].

The device fits over the lock control mechanism on the inside of a door, and the door can then be unlocked via an app on the phone, or via web page control. Phones with Bluetooth Low Energy (4.0) can also automatically unlock a door when an authenticated is nearby. Thus Bolt by Lockitron uses Bluetooth Low Energy which means that Lockitron will keep working even in the event of power or internet outages. But the main point is that the phone should be in the bluetooth range of lockitron so that it can lock or unlock the door. This can be a disadvantage also, thus use of app on the phone is a better option.

Virtual "keys" can also be created for guests or repair contractors etc., which allows access to the home. The virtual keys can be distributed over the internet on demand, and can also be revoked on demand. The door can also be locked or unlocked via an SMS "key" for those without smartphones [6].

Lockitron also supports integration with Doorbot, a doorbell system that sends video and voice from the door to a smartphone. It can also integrate with Lumawake, and will automatically lock your doors when Lumawake detects you are asleep.

The new version of Lockitron incorporated a number of improvements over the original Lockitron deadbolt including built-in WiFi, replacing a wired base station, built-in auto-unlock technology through Bluetooth Low Energy as well as a simplified installation by making Lockitron a device that fits over a preexisting deadbolt lock.

Features of lockitron:

* Control from anywhere

Bolt optionally connects to the internet with Bridge. With Bridge we can control and receive notifications from Bolt anywhere in the world.

* Powerfully smart

Lockitron Bolt uses four AA batteries which last for up to six months. Bolt will even let you know by email when they are running low.

* Easily customizable

With Bridge we can control Bolt through our incredibly simple API endpoints.

* IOS and Android

Lockitron Bolt is compatible with iOS or Android out of the box. With Bridge, other phones can use Lockitron through simple mobile website.

Fig (6) : Lockitron

Once installation done, hold the Lockitron at an angle to the door, slip it over the tabs on the C plate, rotate until it's vertically straight up and down with the door edge, and it's mounted.
Next, we downloaded the app, which guided us through the process of setting up Lockitron's software. After entering our Wi-Fi network credentials, the app asked to connect our Lockitron with Apigy's cloud service by taking a picture of a barcode attached to the device chassis.

V. KEVO MOBILE APP

The app is used for initial setup, sending, disabling and deleting eKeys, viewing history of lock activity, and setting up other configurable features and options. The Kevo App runs in the background on your device so there is no need to open the app to enter your home [8].

The Kevo Mobile App is available on the Apple App Store and on Google Play for selected Android 5.0 Lollipop devices.

Fig (7) kevo mobile app

VI. E-KEY :

An eKey is an encrypted electronic key. The eKey moves the physical key into the digital world and significantly improves home access experience [8]. With the Kevo app, we can enjoy the security and convenience of complete key management:

- Send an eKey to anyone, anywhere, anytime
- Temporarily disable or permanently delete any user from the Kevo system
- eKeys never expire and can be reassigned from one person to the next
- New free, unlimited Guest eKeys.
- This eKey allows to pre-set time constraints for the recipient.

Besides these mobile application and Bluetooth technology, a Remote Keyless System can also be used for smart and intelligible home.

VII. REMOTE KEYLESS SYSTEM

A keyless entry system or remote keyless system   is an electronic lock that controls access to a building or vehicle without using a traditional mechanical key. The term keyless entry system originally meant a lock controlled by a keypad located at or near the driver's door, that required pressing a predetermined (or self-programmed) numeric code for entry. In some other cars, Pressing a button on the keyless remote unlocks all of the car doors. Another button locks the car [9]. Similarly we can use this technology for home security system , which can make our home smarter.

Fig (8): Remote Keyless System

1. Function :

Keyless remotes contain a short-range radio transmitter, and must be within a certain range, usually 5–20 meters (15–60 ft), of the home to work. When a button is pushed, it sends a coded signal by radio waves to a receiver unit in the home, which locks or unlocks the door. An alarm or siren can be used to get the locking or unlocking of door [9].

2. Programming :

Remote keyless entry fobs emit a radio frequency with a designated, distinct digital identity code. In as much as "programming" fobs is a proprietary technical process, it is typically performed by the automobile manufacturer. In general, the procedure is to put the home computer in 'programming mode'. Once in 'programming mode' one or more of the fob buttons is depressed to send the digital identity code to the home's onboard computer. The computer saves the code and the home door is then taken out of programming mode [9].

3. Security :

Keyless ignition does not by default provide better security.

VIII. CONCLUSION

Home security system is an essential mean of protecting our home from illegal invasion. As we know, in today's scenario, the crime is at its peak so we have to be more advanced to make our home more secure .

The topics covered in this paper are efficient use of wireless sensors for home security purpose and use of many other advanced technologies to make the people feel more secure related to their home security which are Remote Keyless System, Lockitron and Kevo Mobile App. So we concluded that these technologies for home security are very intelligible that people will relax while going out to their home.

REFERENCES

[1] Jer-Vui Lee, Yea-Dat Chuah and Chin-Tin Chai, "A Multilevel Home Security System (MHSS)" International Journal of Smart Home Vol. 7, No. 2, March, 2013

 [2] "Architecture of GSM based WSN for Greenhouse Monitoring System in Ambient Intelligence Environment," International Journal of Computer Applications (0975 – 8887) Volume 63– No.6, February 2013

[3] System Architecture for Wireless Sensor Networks By Jason Lester Hill

[4] www.robosoftsystems.co.in/wikidocs

[5] www.ukessays.com

[6] www.lockitron.com

[7] appleinsider.com (Review: Lockitron Internet-connected smart door lock)

[8] www.kwikset.com

[9] en.m.wikipedia.org/wiki/Remote_keyless_system

[10] Nelofar Tyagi, Ashish Joshi, Sangya Singh, Comparative Approach to Remote Home Security System Based on Wireless System Network and GSM International Journal of Scientific & Engineering Research, Volume 4, Issue 6, June-2013 2437,ISSN 2229-5518

[11] www.circuitsgallery.com