Improving Smart Home Security; Using Zigbee Based Communication

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Abstract- *The paper explains various security issues in the existing home automation systems and proposes the use of Zigbee based communication to improve home security. Safety from theft, leaking of raw gas and fire are the most important requirements of home security system for people. A traditional home security system gives the signals in terms of alarm. However, the ZIGBEE based security systems provides enhanced security as whenever a signal from sensor occurs, a signal message is sent to a desired PC to take necessary actions.*

The experiment conducted in this paper used a combination of sensors, microcontrollers and ZigBee communication to identify the leaking of raw gas and fire.

ZigBee had the data transmission characteristics suitable for this system, as data was sent quickly and accurately. A microcontroller interface circuit had produced to promote the ZigBee wireless communication. A display system had produced as an indicator of conditions around the house that could be carried anywhere. The transmission and reception were indicated by LCD data display. The LCD had represented sensors deployed around the house.

Keywords- Home automation, Smart homes, Wireless sensor networks, ZigBee.

I. INTRODUCTION

RESEARCHERS have been experimenting and improving the concept of smart home since the late 1970s. As technology advanced with time, electronic devices and internet became more popular and affordable, so the concept of home automation and people's expectation from a smart home has changed dramatically. Modern smart home is a sophisticated combination of various Ubiquitous Computing Devices and Wireless Sensor/Actor Networks. All these new user expectations, complicated electronics and unpredictable user behavior brought new security challenges to the home automation front.

The concept of home automation security has also evolved with time, sensors and actuators were integrated into the home to detect, alert and prevent intrusions. In the past, an average home had to deal with common slash and grab criminals, while a modern home has to deal with sophisticated and tech savvy attackers who know how to find vulnerabilities and manipulate the security devices to gain access or cause distress to the inhabitants.

Despite smart home security being critical there are some vulnerabilities in the existing systems. Over the years researchers demonstrated various security issues associated with the devices and technology used in modern smart homes. The wireless sensor networks deployed in modern smart homes for device to device communication is vulnerable to various Routing and Wormhole attacks. Popular communication technologies like ZigBee used in smart homes are susceptible to Replay attacks. All these factors contributed to the rapid rise in home burglaries over the past decade and demonstrates the importance of Home Security in the modern world. Our previous works in smart home security explains the changing role of modern home security systems and defines the role of a modern home automation system as, one capable of identifying, alerting and preventing intrusion attempts in a home at the same time preserving evidence of the intrusion or attempted intrusion so that the perpetuator or erpetuators can be identified and prosecuted.

II. PROPOSED SYSTEM

Security monitoring system requires data transmission system fast receiving data and accurate at a certain distance, so that users can and easy to understand, so that users can take important immediate action. The system must not be hacked by anyone, no matter in various ways including on input source power, the content of data transmission, content of receiving data and location of security sensor device's main processor is stored. The system must also have characteristics such as humidity resistant, high temperature resistant and robust, so that data transmission process and data receiving will not fail. Many of other security systems have some limitations on the usage of sensor devices.

These problems will result in limitations of the security system. However, it is inevitable that a security system requires extensive use of sensors for the system to operate efficiently and be able to detect objects in every area of the house.

Security is a prime concern in our life. Security of factory is almost standardized nowadays. Safety from leaking of gas and fire are the most important requirements of home and factory security system for people. A conventional security system gives the signals in terms of alarm. Whereas, the proposed system uses zigbee technology to alert about the gas leakage and flame via calling and higher alarm sound.

Whenever there is a gas leakage in the surrounding areas of this node, this will be detected by the sensor. The sensor consists of Tin dioxide chemical material which has the property that when a gas is detected the resistance of that material will fall from 50kΩ to 3.5kΩ. Then a large current flow occurs through this to the microcontroller. Then the Microcontroller activates the Buzzer and displayed the leakage location on LCD. At the same time the ZigBee sends the location details to the coordinator through an antenna.

During home fire the carbon monoxide and the ambient temperature levels in the area of the fire will go up and inversely the humidity in and around the area will go down. If there is no change in humidity, temperature or carbon monoxide levels, the algorithm warns the user about a possible attack attempt which the user can verify.

Each twelve second average of the temperature, humidity and carbon monoxide sensor readings are compared to detect fire. If there is more than 2^{o} difference between the twelve second average temperatures and more than 3% difference in twelve second average humidity then the triggered fire alert is validated. It takes around 24 hours for the carbon monoxide sensor to stabilize, so carbon monoxide readings are only considered once the system had been activated for at least 24 hours. The proposed system implements 9 gas sensors, temperature and humidity sensors to detect fire in the home. When there is a Gas leakage in the home without sufficient change in humidity, ambient temperature or carbon monoxide levels. The warning informs the user about a possible fire alarm manipulation which user can verify on sight through zigbee communication.

When the proposed system detects the high temperature in the air then it immediately alert by higher alarm sound (Buzzer) or by sending message through zigbee to specify PC. This system is built with open source hardware (AT89C52) and Micro C language for programming microcontroller (AT89C52). The advantage of this proposed detection and alerting system over the conventional method is that it gives fast response time and accurate detection of an emergency and in turn leading faster diffusion of the critical situation via calling to specify node for the system and higher alarm sound.

Receiving section: The receiving section consists of a Coordinator and PC. The Coordinator has ZigBee module to receive the information from the terminal nodes through an antenna. This collected data will send to the PC using a serial communication called RS-232.

III. SYSTEM COMPONENTS

ZigBee: ZIGBEE is new wireless technology guided by IEEE 802.15.4 Personal Area Network standard . It is primarily designed for the wide range controlling applications and to replace the existing non-standard technologies. It currently operates in 868 MHz band at a data rate of 20Kbps in Europe, 914MHz band at 40kbps in USA, and the 2.4GHz ISM bands Worldwide at a maximum data-rate of 250kbps. It is used to verify whether user's truncation is possible or not. One of the main advantages of this ZIGBEE communication is that it provides a noise free communication, the amount of noise added in this type of communication is very less compared to the other wireless communications.

Gas Sensor: Gas sensor is used to detect the gas leakage. The electrical properties of the sensor would change with variations in gas concentration [4]. Sensitive material of MQ-6 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. MQ-6 gas sensor has high sensitivity to Propane, Butane and LPG, also response to Natural gas. The sensor could be used to detect different combustible gas, especially Methane; it is with low cost and suitable for different applications.

Temperature Sensor: A temperature sensor is a device, typically, a thermocouple or RTD, that provides for temperature measurement through an electrical signal. A thermocouple (T/C) is made from two dissimilar metals that generate electrical voltage in direct proportion to changes in temperature.

Humidity Sensor: The ratio of moisture in the air to the highest amount of moisture at a particular air temperature is called relative **humidity**. Relative **humidity** becomes an important factor, when looking for comfort. **Humidity sensors work** by detecting changes that alter electrical currents or temperature in the air.

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.

16x2 LCD Display: A liquid crystal display (LCD) is a thin, flat electronic visual display that uses the light modulating properties of liquid crystals (LCs). LCs does not emit light directly. They are used in a wide range of applications, including computer monitors, television, instrument panels, aircraft cockpit displays, signage, etc.

AT89C52 Microcontroller: The AT89C52 is a low-power, high-performance CMOS 8-bit microcomputer with 8K bytes of Flash programmable and erasable read only memory (PEROM). The device is manufactured using Atmel's high-density nonvolatile memory technology and is compatible with the industry-standard 80C51 and 80C52 instruction set and pin out. The on-chip Flash allows the program memory to be reprogrammed in-system or by a conventional nonvolatile memory programmer. By combining a versatile 8-bit CPU with Flash on a monolithic chip, the Atmel AT89C52 is a powerful microcomputer which provides a highly-flexible and cost-effective solution to many embedded control applications

The above are the system components used in the proposed system which identifies the leakage of gas and fire.

IV. RESULT ANALYSIS

The below figure illustrates the Block diagram of the proposed improved smart home security system with microcontroller, Gas, Temperature and humidity sensors which will be helpful in getting the readings of the respective terms. And readings to be taken using a LCD display, With Zigbee readings are captured with in the receiver section.

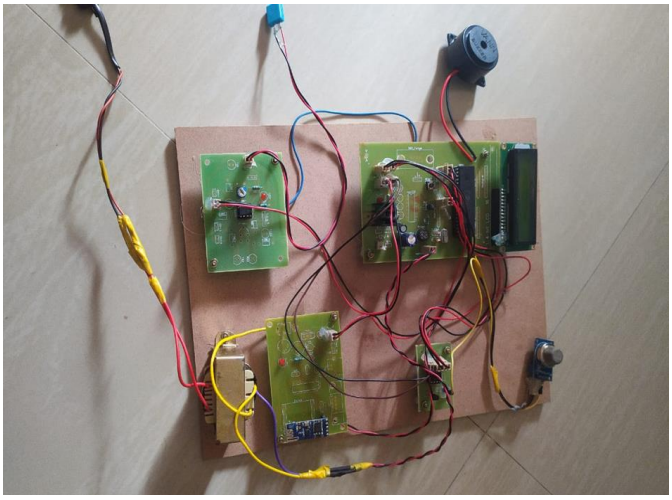


Fig: Block diagram of Transmitting and receiver sections with a microcontroller of Smart home security

Fig : A 16 x2 LCD Display displaying the temperature, smoke and humidity

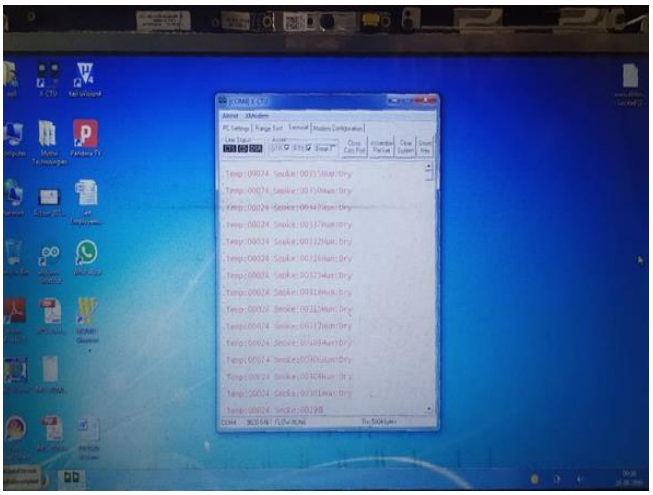
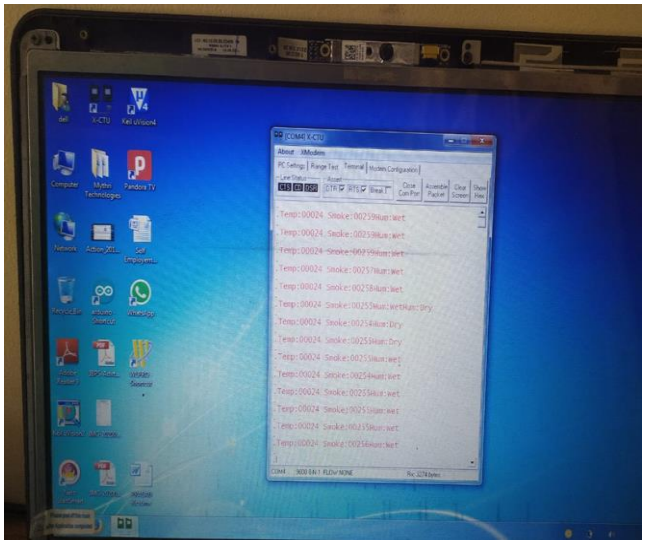


Fig : Temperature, Smoke and Humidity readings are captured via Software using Zigbee Communication.



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