ZIGBEE BASED HOME AUTOMATION CONTROL OF ELECTRICAL APPLIANCES AND DETECTION OF GAS IN SMART HOMES

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Abstract: In wireless communication technology to increase the connectivity of devices within the home for the purpose of home automation. The Wireless Home Automation System (WHAS) is to provide those with special needs with a system that can respond to control the on/off status of electrical devices, such as lamps, fans, television etc, in the home. This system is designed for homes to enable people with different type's disabilities the control of appliances and device within their home environment. In this system, the LPG leakage is detected through the sensor and information is sent to the user by Short Message Service (SMS) and simultaneously the customer is given an alert using a GSM module. GSM SIM 800L and Arduino for controlling a relay module were utilized here. In this system analyzed today's security issues. This system helps to overcome the problem of complexity and provides easiest way to secure the homes and offices. Also used Passive Infrared Sensor (PIR) for security purpose and the motion can be detected by checking for a sudden change in the surrounding IR pattern. The Zigbee RF Modem from Digi International is a wireless transceiver. The Zigbee uses a fully implemented protocol for data communications that provides features needed for robust network communications in a wireless sensor network (WSN). Features such as addressing, acknowledgements and retries help ensure safe delivery of data to the intended node also control the all the electrical appliance in smart homes through GSM by using android phone from any location.

IndexTerms - **Zigbee, Home Automation, Wireless Sensor Network (WSN), GSM.**

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1. INTRODUCTION

Zigbee is an IEEE 802.15.4 based specification for a suite of high-level communication protocols used to create personal area networks with small, low-power digital radios, such as for home automation, medical device data collection, and other low-power low-bandwidth needs, designed for small scale projects which need wireless connection. Hence, Zigbee is a low-power, low data rate, and close proximity (i.e., personal area) wireless ad hoc network. The technology defined by the Zigbee specification is intended to be simpler and less expensive than other wireless personal area networks (WPANs), such as Bluetooth or more general wireless networking such as Wi-Fi. Applications include wireless light switches, home energy monitors, traffic management systems, and other consumer and industrial equipment that require short-range low-rate wireless data transfer. Its low power consumption limits transmission distances to 10–100 meters line-of-sight, depending on power output and environmental characteristics. Zigbee devices can transmit data over long distances by passing data through a mesh network of intermediate devices to reach more distant ones. Zigbee is typically used in low data rate applications that require long battery life and secure networking (Zigbee networks are secured by 128 bit symmetric encryption keys.) Zigbee has a defined rate of 250k bit/s, best suited for intermittent data transmissions from a sensor or input device.

Wireless Sensor Network (WSN) is being implemented to monitor and broadcast information from different applications [2]. It is being developed in various fields such as homes and hospitals. WSN consists of a large number of wireless sensor devices working together to achieve a common objective. A wireless sensor device is a battery-operated device that has the capability of sensing physical quantities [2], provides efficient wireless communication and data storage. Moreover, a WSN has one or more base-stations that gather information all the sensor devices. The base stations provide an interface through which the WSN interacts with the outside world [2]. This work designs and implements a wireless sensor network inside a house that provide users with special needs essential and basic control within a home environment. The proposed work enables the user to perform his/her daily activities by remotely monitoring and controlling home appliances without depending on others. The input and output are automatically adjusted depending on the user's special needs and environment. The smart home area network (HAN) technology offers users a wide range of services. Users that integrate HANs into their homes can monitor and/or control their appliances remotely and within the house using smart phones or control panels. However, most of the monitoring and control system in the HAN technology are not feasible to people with disabilities such as visually impaired, deaf, and handicapped. A blind person cannot see whether the window is open/close, similarly a deaf person cannot hear the fire alarm. A handicapped person (with hand disability) one the other hand cannot use his/her phone to check if the refrigerator door is open or closed. Hence, most of the existing HAN technologies are aimed at healthy people. Other specialized devices are developed; however, the

devices operate only based on one specific disability. This work proposes a framework that enables the integration, monitoring, and control of events within a HAN. This work also proposes a device that integrates with HAN that is targeted for people with special needs such as deaf and blind people.

2. OVERVIEW OF SYSTEM

The system has various functions to help elderly and people with special needs. The system consists of a base station, sensor nodes that contain RFID tags, accelerometer and buzzer. Each node monitors a specific home appliance. The system introduces a ZigBee-based smart home monitoring system that supports multiple users. The system allows users to monitor their home appliances simultaneously. The work in discussed a system that recognizes and monitors the daily activities of living of elderly people on wheelchairs using triaxial accelerometer. A study was conducted on a spinal cord injury user who needs to communicate with other people through text-voice conversation and control the home appliances.

A) ZIGBEE TECHNOLOGY

ZigBee is a radio frequency (RF) communications standard based on IEEE 802.15.4. The Zigbee coordinator is responsible for creating and maintaining the network. Each electronic device (i.e. Washing Machine, Television, Lamp etc in the system is a Zigbee device managed by the coordinator. All communication between devices propagates through the coordinator to the destination device. The wireless nature of ZigBee helps overcome the intrusive installation problem with the existing home automation systems identified earlier. The ZigBee standard theoretically provides 250kbps data rate, and as 40kbps can meet the requirements of most control systems, it is sufficient for controlling most home automation devices. In this system used three zigbee S2C modules for wireless communication with each other in home automation zone and controlling the electrical appliance.

B) GSM TECHNOLOGY

GSM is a mobile communication modem; it is stands for global system for mobile communication (GSM). In this system, GSM module is a miniature cellular module which allows for GPRS transmission, sending and receiving SMS and making and receiving voice calls. Low cost and small footprint and quad band frequency support make this module perfect solution for any project that require long range connectivity. After connecting power module boots up, searches for cellular network and login automatically. On board LED displays connection state (no network coverage - fast blinking, logged in - slow blinking). A GSM module (SIMCOM 800L) is a specialized type of modem which accepts a SIM card, and operates over a subscription to a mobile operator, just like a mobile phone. Used for cell phone based projects. GSM module has been emphasized in this project by sending SMS to user regarding the leakage and for alerting. A text message is sent to the consumer during leakage and also if the fire occurs. The complete operation is displayed over 16×2 LCD display.

C) DF Player Mini

The DFPlayer Mini is a small and low price MP3 module with a simplified output directly to the speaker. The module can be used as a stand alone module with attached battery, speaker and push buttons or used in combination with an Arduino UNO or any other with RX/TX capabilities.
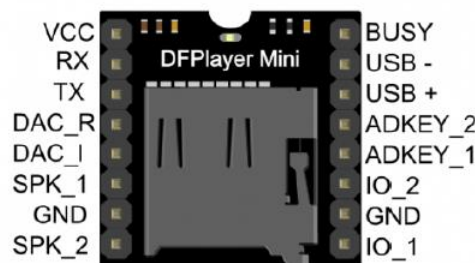

Figure 2.1 DFPlayer Mini

Specification

- Supported sampling rates (kHz): 8/11.025/12/16/22.05/24/32/44.1/48
- 24 -bit DAC output, support for dynamic range 90dB , SNR support 85dB
- fully supports FAT16 , FAT32 file system, maximum support 32G of the TF card, support 32G of U disk, 64M bytes NORFLASH
- A variety of control modes, I/O control mode, serial mode, AD button control mode
- Advertising sound waiting function, the music can be suspended. when advertising is over in the music continue to play
- Audio data sorted by folder, supports up to 100 folders, every folder can hold up to 255 songs

3 BLOCK DIAGRAM OF ZIGBEE BASED HOME AUTOMATION SYSTEMS

This system is designed for homes to enable people with different types of disabilities for the control of appliances and device within their home environment. The user performs his/her daily activities by remotely monitoring and controlling home appliances without depending on others. Zigbee is used to establish the wireless communication between the device and electrical appliances with master node and wireless sensor node communicate with the master controller node using Zigbee.

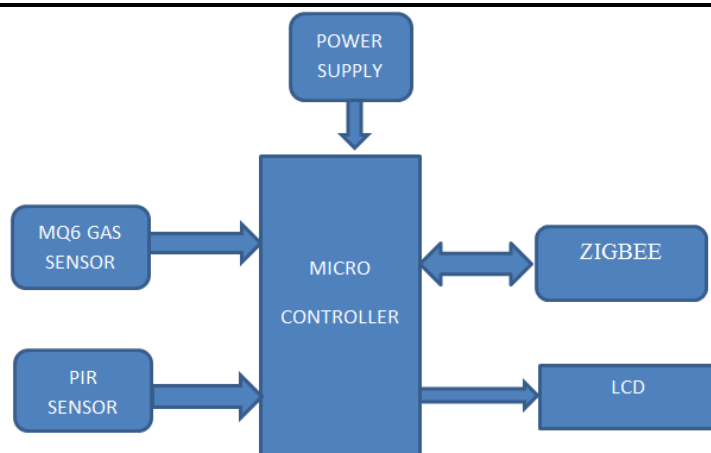In this system consist of three unit i) Sensor unit ii) Remote unit iii) Relay unit

Figure 3.1: Sensor Unit System

3.1 Sensor unit system

Figure 3.1 shows the sensor unit system

In this sensor unit system, LCD display is output device whereas Gas sensor and PIR sensor are input devices. Zigbee module is connected to master controller and wireless nodes. The another stage of security is using PIR sensor if any person continuous to enter the home then will get detected by PIR sensor speaker is ON and SMS send to user by using GSM. Microcontroller is base of the system; the input given to microcontroller and output of microcontroller is given to sim800L and LCD display. In this system, MQ6 gas sensor is used. If the LPG gas concentration is greater than 30ppm, then pulse is fed to microcontroller and simultaneously switches on the buzzer. Also logic high pulse given as an interrupt to microcontroller, microcontroller sends message "LPG Detected" to required cell number via GSM module and the same will be displayed on LCD.
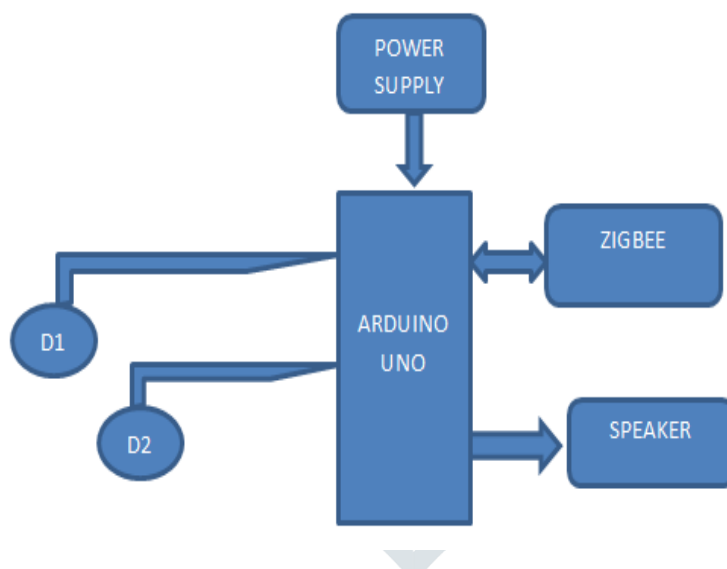
3.2 Remote Unit system

Figure 3.2: Remote unit system

Remote unit system consists of Arduino board, voice kit module, speaker and Zigbee S2C module. Zigbee is bidirectional and transceiver, which communicates with sensor and relay unit system in home automation zone. In this remote unit system, the user can control home light by turning it ON by pressing button 'D1'on the remote unit keypad and again pressing button 'D1'to switch off the home light. The user can control fan by turning it ON by pressing button 'D2' on the remote unit keypad and again pressing button 'D2'
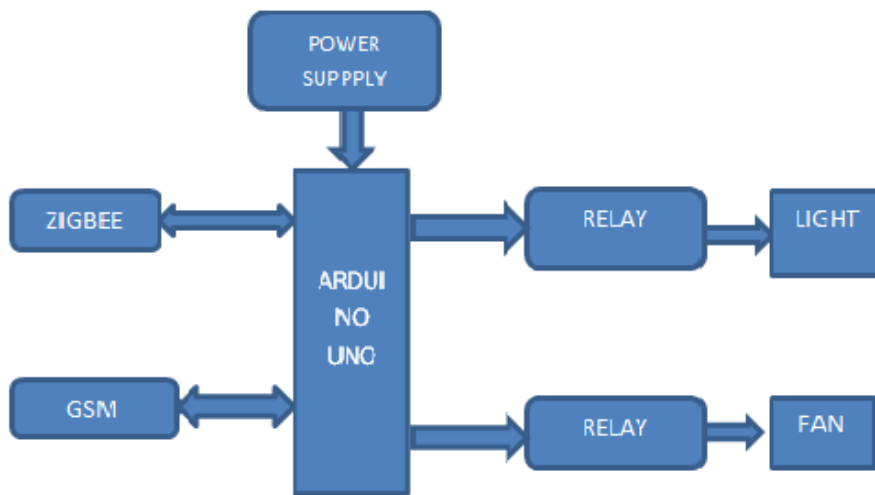
3.3 Relay unit system

Figure 3.3: Remote unit system

In the system automatic receive the call and mobile wireless communication system if press '*1' in the mobile keypad then first Light is ON in the relay unit system and if press '#1' in mobile keypad then first Light is OFF. If the button '*2' in the mobile keypad then fan is ON in the relay unit system and if press '#2' in mobile keypad then fan is OFF.

4. Flowchart of LPG Gas Detection System

A gas sensor is a device which detects the presence of various gases within an area, usually as part of a safety system. This type of equipment is used to detect a gas leak and interface with a control system so a process can be automatically shut down. Here MQ6 gas sensor is used for detection. It does not detect cooking fumes and is efficient in detecting propane and butane gases.
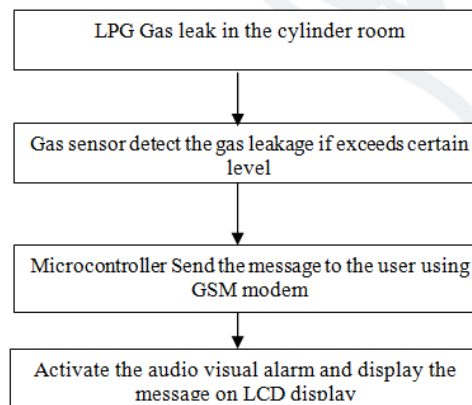

Figure: 4.1 Flowchart of LPG Gas Detection System

Microcontroller ATmega8A provides control to PIR sensor and MQ6 gas sensor. If PIR Sensor detects Human Body in room then it sends signal to Arduino UNO result of glow light of Room. If MQ6 gas sensor detects the LPG gas (LPG GAS Leakage) it will send signal to Microcontroller and Drive the alarming system connected with Buzzer. Bearing in mind user accessibility and convenience, the system made to produce alarm while buzzers represent audible alarm meant to draw immediate attention of user also it send a warning message to user on mobile phone.

5. RESULTS AND DISCUSSION

5.1 Interfacing Result on LCD

Arduino IDE software is used to run the program to interface the sensors and the Microcontroller ATMEGA8A. Analog to Digital Converter (ADC) is used to convert the voltage from the sensors to the digital systems so that the result will be displayed on the LCD screen in digital form.

Figure 4.3 The Motion Detected recorded on LCD display

If any person continuous to enter the home then will get detected by PIR sensor speaker is ON and SMS send to user by using GSM.

Figure 4.4 The Concentration of gas recorded on LCD display

. If the LPG gas concentration is greater than 30ppm, then pulse is fed to microcontroller and simultaneously switches on the buzzer. Also logic high pulse given as an interrupt to microcontroller, microcontroller sends message "LPG Detected" to required cell number via GSM module and the same will be displayed on LCD.

6. CONCLUSION

The system based on Zigbee based home automation proposed solutions for limitations of earlier technologies. System has better features in terms of high speed, high data rate and frequency of operation as well as low power consumption. The comparatively study between Zigbee and existing wireless technologies shows that these features along with some other benefits that make it suitable to replace the existing wireless technologies. Existing smart home monitoring and control systems do not accommodate special needy users to manage their home appliances. A wireless sensor network based system for smart home automation has designed, built and tested to address such missing functionality. The implemented system's major contribution is that it is customized to provide the special need residents with tools and services to monitor and operate home appliances remotely. The implemented system provides home residents with disabilities to take advantage of the advancement in technology. It enables them to perform their daily activities by remotely monitoring and controlling their home appliances without having to depend on others. The system is programmed so that it can be configured to adjust to the customer's disability providing them with better and convenient lifestyle. It can be extended to include more and different services and tools. The system is portable, compact, affordable and easy to use.

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7. FUTURE SCOPE

This system is designed for homes to enable people with different types of disabilities the control of appliances and device within their home environment. In the forthcoming years Zigbee would give reforming statistics which would absolutely change the wireless world. In this system we analyzed today's security issues. This system helps to overcome the problem of complexity and provides easiest way to secure the homes and offices. The leakage detection of gases has gained more interest in recent years especially in fields of safety, industry, environment, and emission control. Gas leakage detectors built with microcontrollers to detect and send information through GSM module. Interactive motion detection security system can be enhanced in future by adding additional infrared emitting system at home. Features such as addressing, acknowledgements and retries help ensure safe delivery of data to the intended node also control the all the electrical appliance in smart homes through GSM by using android phone from any location.

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