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AN APPRAISAL ON GAS LEAKAGE DETECTION AND CONTROLLING SYSTEM IN SMART HOME USING IOT

S. Sivaranjani*, D. Gowdhami, P. Karthikkannan

Dept of Computer Science and Engineering, Vivekanandha College of Engineering for Women ,Tiruchengode, Tamilnadu, INDIA

ABSTRACT

Aim: The Internet of Things (IoT) is playing a vital role in most of the fields all over the world, especially in smart home automation system. The IoT smart home system runs on conventional Wi-Fi network, Bluetooth or Internet to be implemented based on Embedded Microcontroller and sensor environment. Now a days the major crisis in residential premises is the leakage of Liquefied petroleum gas. Due to this hindrance gas sensor can be deployed into the smart home environment and after the detection of gas leakage the SMS (short message service) is sent to authorized user by GSM, then electric power supply is turned off with the help of fire sensor through relay control. After the detection of gas leakage in the smart home, window is opened by means of window sensor and the concentration of gas gets reduced slowly. Hence the survey is done here on the gas leakage detection and controlling system to overcome this trouble. *Conclusion:* Hence the occurrence of accidents due to the LPG gas leakage is controlled by using the proposed technique which is listed in the possible solution section.

*Corresponding author: Email: sivaranjinisiva16@gmail.com; **Tel.:** +91 8220356140

INTRODUCTION

The inter-connection between the physical devices like buildings, vehicles and other devices which are implanted with electronic devices, software, sensors, actuators, and network connectivity which helps and makes these objects to gather and exchange data is called as Internet of Things. When IoT is augmented with sensors and actuators, it also covers the following technologies such as smart grids, smart homes, intelligent transportation and smart cities so that the technology becomes an illustration for more general class of cyber-physical systems [1].

However, the rate of IoT adoption among home users depends on their willingness to purchase these devices, and convenience and security are identified to be the two key factors influencing their decision. As such the design and implementation of a Wi-Fi Bluetooth and or internet based IoT smart home system that uses a gateway to enable secure communication between IoT devices, and to also allow user to configure, access and control the system through user friendly interface running on mobile devices such as the ubiquitous smart phone. A smart home is also one of the applications of IoT. Even though there is a rapid growth in technologies and improvements in architecture, it comes out with many problems like how to manage and control the whole system, server side security, security in smart homes etc., Smart homes are those where household devices/home appliances could monitor and control remotely [2].

Gas sensor

A gas sensor which is made on the basis of catalytic principle is called catalytic gas sensor. The output of catalytic gas sensor is measured by a Wheatstone bridge. By monitoring the resistance change of the platinum resistance arising from increase in temperature the concentrations of gases can be detected. Following are some of the gas sensors like Carbon dioxide sensor, Carbon monoxide detector, Electro chemical gas sensor [3].

Fire sensor

The presence of a flame or fire is detected with the help of flame detector by means of sensor is designed to detect and respond accordingly. Responses to a detected flame are based on the installation, but can include sounding an alarm, switching off a fuel line (such as a propane or a natural gas line), and turning on a fire suppression system [4].

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RELATED WORK ON THE EXISTING SYSTEM

The following section describes about the review which is made on the smart home automation, different sensor's used in smart home automation.

Related Work

In [5], "**HOME AUTOMATION USING INTERNET OF THINGS**", the authors "Vinay sagar K N, Kusuma S M" described about the Wireless Home Automation system(WHAS) by IoT system in which it is sometimes called as s called a smart home. The smart home system is comprised of computers or mobile devices that are used to control basic home functions and features automatically through internet from anywhere around the world. Hence with the help of the smart home system can able to save the electric power and human energy. In this method the authors presented a home automation system (has) using Intel Galileo that employed the integration of cloud networking and wireless communication. The main advantage of this scheme is that, it provided the user with remote control of various lights, fans, and appliances within their home and storing the data in the cloud. Based on the data gathered from the sensor the system will be changed automatically and also this system was designed to be low cost and expandable allowing a variety of devices to be controlled.

In [6]**, "INTERNET OF THINGS (IOT) BASED REAL TIME GAS LEAKAGE MONITORING AND CONTROLLING**" the authors "Hina ruqsar, Chandana R, Nandini R, Dr. T P Surekha" discussed about xively which is a secured scalable platform that includes directory services, data services, a trust engine for security, and web-based management application. It also helps to provide a general ground through which any external device connected to the internet cloud actually communicates with any other device. Xively is an old fixture within the internet of things ecosystem. Gas sensor senses the gas leakage and alerts the house rescue teams which are buzzer and exhaust fan. From this the gas will be changed and replaced from the interior. A solenoid valve is an electro mechanical device that is used for controlling liquid or gas flow. When the coil is keyed up, magnetic field is created, causing a plunger inside the coil to move. The valve will return to its de-energized state, when electrical current is removed from the coil. Here using this concept one can easily know the exact date and time of the hazard.

In [7], "**EMBEDDED SYSTEM FOR HAZARDOUS GAS DETECTION AND ALERTING**", the authors "V.Ramya, B. Palaniappan" focused on how the microcontroller of designed and worked based on detecting toxic gas and then alerting the system. Here the embedded system technique was used to determine how the hazardous gases like LPG and propane were sensed and displayed each and every second in the LCD display. Then an alarm is generated immediately and also an alert message (SMS) is sent to the authorized person through the GSM when the gas exceeds its normal level. The benefit of this automated detection and alerting system over the manual method is that the response time and accurate detection of an emergency is done very quickly and in turn it also leads faster diffusion of the critical situation.

In [8], "**GSM BASED LPG LEAKAGE DETECTION AND CONTROLLING SYSTEM**" the authors "Prof.M.Amsaveni, A.Anurupa, R.S.Anu Preetha, C.Malarvizhi, M.Gunasekaran" discussed on how to detect and control the LPG gas which mainly comprised with butane and propane. In this scheme the authors used MQ6 gas sensor to detect the leakage of gas. As soon as the leakage is detected the sensor sends a signal to the microcontroller in which it sends an active signal to other devices which are connected externally. Then the alert message has been sent to the user through GSM module. The advantage of this technique is it reduces the concentration of gases. Even though this technique reduces the concentration of the gas the demerit of this system is efficiency of using the microcontroller which is used here is less and also it requires changes in program whenever multiple SMS is to be sent at a time.

In [9], "**AUTOMATION AND ENERGY MANAGEMENT OF SMART HOME USING Lab VIEW**" the authors "J.Ashley Jenifer, T.Sivachandrabanu, A.Darwin Jose Raju" discussed about how the information from the sensors has been fed into the pc. Here in this system the photo voltaic installation is made to tackle the energy. Then the Mikro C IDE was used to bind the sensors actuators and devices. Also the Lab VIEW (laboratory virtual instrumentation engineering) was done to visualize the home automation like lighting, temperature, security, gardening and energy management**.**
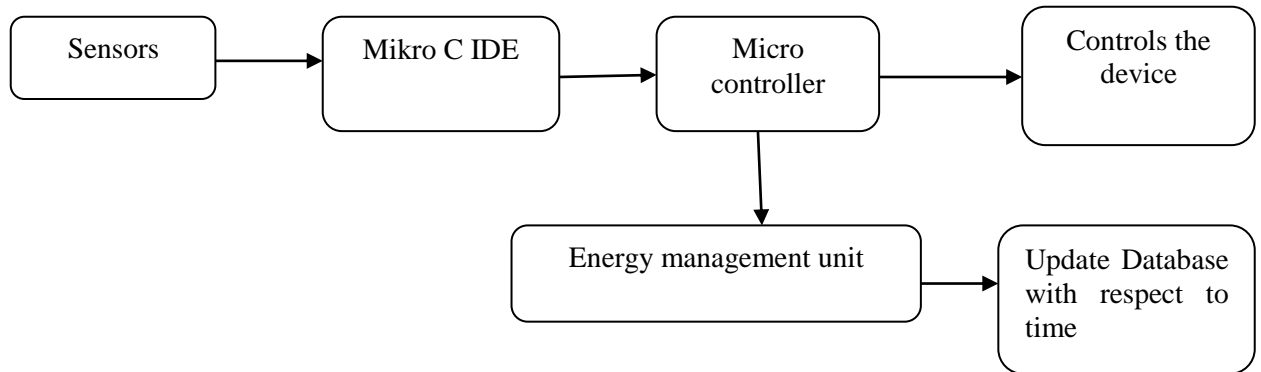
Fig. 1: Diagrammatic representation of the smart home automation using Mikro C IDE

In [10], **"SMART HOME MONITORING AND CONTROLLING SYSTEM USING ANDROID PHONE"** the authors "Gowthami.T, Dr. Adiline Macriga G" described about the home monitoring and controlling by using android phone. In this method the author used both PC and android phone to monitor and control the home for safety, security and human health care. They also used zigbee module for the Lab VIEW. The personal computer is used to monitor the various parameters in the proposed system. In this system, the various parameters are monitored and controlled with the help of android phone. Android phone has the more benefit when compared to personal computer for using at any place. Then here the information from the sensors which is from various appliances are first passed to the home monitoring server and from there the data is transferred to the local monitoring server. Hence the sensor node is responsible for collecting, processing and transmitting the data into the local monitoring server which is embedded with the web server.

In [11 &12], **"LPG GAS LEAKAGE DETECTION & CONTROL SYSTEM AND DESIGN AND DEVELOPMENT OF KITCHEN GAS LEAKAGE DETECTION AND AUTOMATIC GAS SHUT OFF SYSTEM"** the authors discussed on how they dealt on home security based on LPG gas leakage in the kitchen. In both these techniques the authors mainly concentrated on the controlling of detected LPG gas as well as on the security in home against intruders and fire accident. When the gas leakage was detected the sensor sends signal to PIC microcontroller and the system more like a first aid and a normally closed solenoid valve for the shutting off of the gas valve is used before calling for help via visual display and audible alarm to those within the environment. Since the system is an intelligent system that does not created a noise nuisance by continuously sounding alarm but the alarm stops beeping once the concentration of the gas in the atmosphere after leakage goes below the set point and opens the valve again for normal operations. The advantage of this work is it minimized injuries/losses occasioned by explosions due to gas leakages, which also improved safety of life and property while using domestic cooking gas. The following block diagram shows the gas leakage detection system which uses PIC microcontroller.

In [13], "**SMART HOME AUTOMATION BASED ON DIFFERENT SENSORS AND ARDUINO AS THE MASTER CONTROLLER**" the author "Subhankar Chattoraj" focused on how arduino, graphical user interface controls the smart home with the help of different sensors. Here the idea proposed was with a low cost solution using off the shelf components to decrease its cost and open source software to obtain around licensing requirements of software. An arduino controls sensors and actuators that monitors a defined location and take action based on specified parameters like ambient light, temperature etc. It was also focuses on sensing the temperature, gas leakage and smoke, light detection.
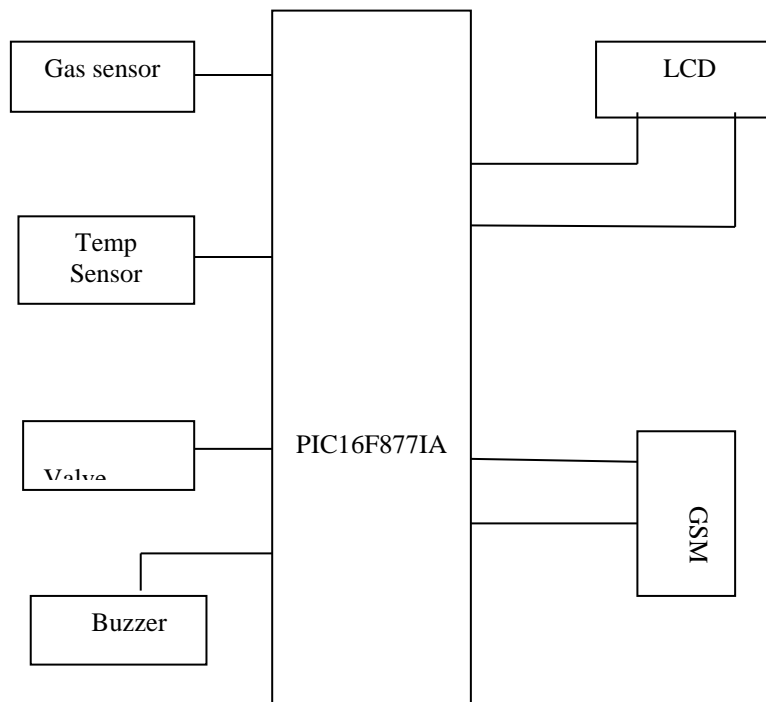
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Fig.2: Block Diagram of Gas Leakage System using PIC Microcontroller

In [14], "**SMART HOME FOR ELDERLY CARE, BASED ON WIRELESS SENSOR NETWORK**" the authors "Rasika S. Ransing, Manita Rajput" said that in a smart home, sensors are used for monitoring general parameters like temperature, humidity, LPG leakage, etc. Thus, with the development of wireless network technology, the data rate will be low, battery life will lasts for long time, complex protocols are less in number for such applications as an alternative to wasting bandwidth of high data rate protocols. Then here the authors used WI-FI, Zigbee which are the short distance communication technologies. For the system proposed in this system, Zigbee technology was employed to detect the above mentioned parameters. Zigbee is a worldwide open standard for wireless radio networks in the monitoring and control fields. The development of Zigbee technology was done by the IEEE 802.15.4 committee. So with the help of Zigbee technology information from the sensors are gathered and controlled. Hence by using Zigbee technology in the battery-powered applications the usage of data rate will be lower, cost is less, and also battery life is long. The lower data rate of the Zigbee devices allows for better sensitivity and range, but it offers less throughput only which is considered as the main disadvantage of this technology.

In [15], "**DESIGN AND IMPLEMENTATION OF A SMART FIRE ALARM SYSTEM USING GSM TECHNOLOGIES VIA SHORT MESSAGES SERVICE**" the authors discussed on how the fire has been controlled in smart home. The gas smoke sensor keep on sensing and if there occurs any fire the SMS will be sent to user through GSM with the help of (T-BoxN12R device). Then after the alarm notification has been sent, the T-BoxN12 device turn on the alarm buzzer and the door will be closed. After this the water pumping motor will be turned on. If so any fire occurred also it will be controlled by this system.

This data transfer may be done easily through two communication protocols namely, the short messaging service (SMS) and wireless application protocol (WAP). These two technologies are complementary. SMS messages have long been familiar to the mobile phone users and are affordable. The use of SMS extends the data transfer to a larger number of telephone sets. WAP is an open protocol for wireless messaging. It provides the same technology to all vendors regardless of the network system. This means that there will be WAP compliant terminals from several manufacturers.
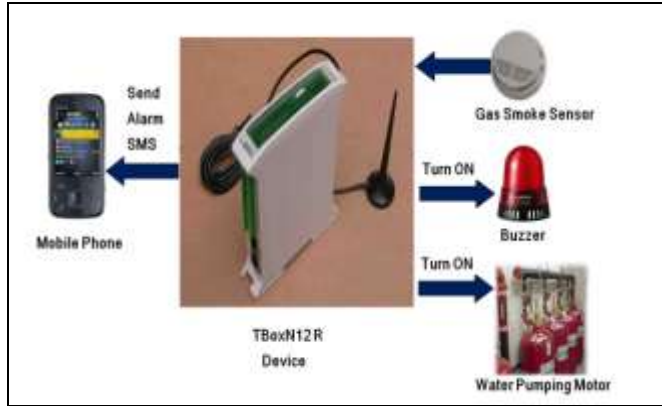
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Fig: 3. The System Block Diagram

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GRAPHICAL REPRESENTATION FOR EXISTING SYSTEM ANALYSIS
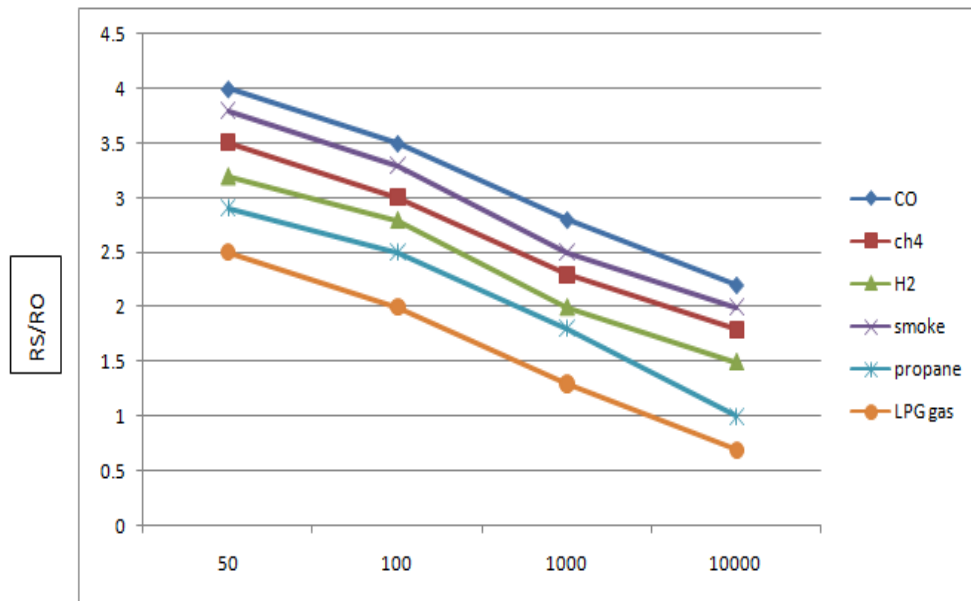
Fig. 4: Sensitivity Characteristics of MQ2 Sensor

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The above graph represents the graphical representation for the existing system analysis. This graph shows the typical sensitivity characteristics of MQ2 sensor for various gases which are used in home as well as in industries. Then MQ2 sensor is used to detect LPG gas, carbon monoxide, hydrogen, smoke, propane. Based on the response time measurements are taken as soon as possible. The graph is drawn between the resistance value and the concentration of the gas.

Where as in graph, RO represents the sensor resistance at 1000 ppm of h_2 in clean air and RS represents the sensor resistance at various concentration of gas. Then this MQ2 sensor has different resistance value in different concentration.

COMPARATIVE ANALYSIS ON EXISTING SYSTEM

In this section the analysis is done to make a view on the different sensors, controller devices and their purposes which helps to overcome the hindrance occurred during the LPG gas leakage in smart home system.

Table: 1. Purpose of Various Sensors, Controller Devices Used in Smart Home System

S.NO	Title of the Paper	Platform/ controller device	Sensor's/device used	Purpose
1	Home Automation Using Internet of Things[5]	Cloud networking, Wi-Fi network, Intel Galileo Microcontroller	Temperature sensor, Gas sensor, Motion sensor.	The parameters and threshold of the sensors are read. Those data are sent to web server and stored in the cloud which can be analyzed anywhere at any time.
2	Internet of things (IoT) based real time gas leakage Monitoring and controlling[6]	Xively	Electronic sensor	Secure, scalable platform which stores data. Stored data helps to detect the root cause of the gas leakage by electronic sensors with accurate time and date.
3	Embedded system for hazardous gas detection and alerting[7]	PIC16F877 Microcontroller	Combustible gas sensor	The hazardous gases like LPG and propane has been detected. With the sensor used, offers quick response time and accurate detection of an emergency and in turn leading faster diffusion of the critical situation by alerting the authorized user's via GSM.
4	GSM based LPG leakage detection and controlling system[8]	PIC Microcontroller (PIC16F877A)	Gas sensor MQ-6	The leakage of LPG gas is detected by the MQ6 gas sensor. Its analog output is given to the microcontroller. Then the SMS will be sent to the user through GSM and the leakage is controlled up to 0.001%.
5	Automation and Energy management of Smart home using Lab VIEW[9]	MICRO C IDE. Micro controller	Energy management sensors	The complete LABVIEW of the smart home has been done in order to display the energy management of fan, air conditioner, light.
6	Smart Home Monitoring and Controlling System Using Android Phone[10]	ZigBee	PC, android phone, home appliance sensors.	Data acquisition has been done using sensor nodes. A node contains three sensors. The sensors are used for monitoring the physical parameter measurements. In the home monitoring, the parameters such as kitchen temperature, gas and obstacle are monitored.
7	LPG Gas Leakage Detection & Control System[11,12]	RISC Microcontroller(version of PIC)	MQ 6 Gas sensor	LPG gas leakage is detected accurately with the quick and fast response time. For safety from gas leakage in heating gas fired appliances like boilers, domestic water heaters and also for cooking gas fired appliances like oven, stoves, etc.
8	Smart Home Automation based on different sensors and Arduino as the master controller[13]	Arduino board	Temperature Sensor (LM35), LPG and Smoke Sensor (MQ2), Temperature and	The temperature sensor controls the smart home. Gas sensor detects the voltage level of the smoke compared with the threshold.

			Humidity sensor (DHT11)	Humidity sensor and a thermistor to measure the surrounding air.
9	Smart Home for Elderly Care, based on Wireless Sensor Network[14]	ZigBee , Arduino MEGA 2560	Temperature sensor LM 35, Door sensor	Precise the centigrade of the temperature which in turn says about the chance of fire occurrence. LM 35 measures the temperature level from the range of -55^0 c to $+150^0$ c. Door sensor is to detect the position of the door, whether it is opened or closed.
10	Design and Implementation of a Smart Fire Alarm System Using GSM Technologies Via Short Messages Service[15]	T-BoxN12R microcontroller	Gas smoke sensor, Fire sensor	It detects the presence of smoke, the door will be turned closed and the water pumping motor is turned to put off the fire occurred.

POSSIBLE SOLUTION

By using the stepper motor which can be connected to microcontroller will slowly reduce the concentration of the LPG gas in the room of the smart home when it leaks.

With the help of the window sensor in the smart home, when the leakage of LPG gas is detected window sensor will automatically open the window as soon as the alert(SMS)message has been sent to the authorized user .then, when the window is opened the exhausting fan also turned on which leads to push out the smoke outside through opened window .when the alert (SMS)message is sent to the authorized user through GSM the fire sensor also turned through relay in order to check the occurrence of fire.

CONCLUSION

Internet of things is nothing but the interconnection of physical devices which are embedded with the electronic devices, sensors, etc. In which security is very important in the smart home system and here our work mainly concentrated on the controlling of LPG gas in smart home system. Hence with the help of the survey made, we came to know about the different sensors and their purposes used in the smart home automation. From the above analysis, we can introduce window sensor in smart home so that when the gas leakage is detected the information is given to window and the window will be opened automatically through the sensor which reduces the concentration of the LPG gas and therefore prevents the occurrences of accident.

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