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IOT based Hazardous Gas Detection System using AVR Microcontroller

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Abstract – *Health Safety is a major issue in current era and good safety systems are needed to be implemented in places which are related to work, education and living. This project that we are working on modifies the existing safety model installed in the industrial areas and this system can also be used in houses and offices. The main objective of our project is to design a AVR microcontroller based combustible and Hazardous gas detecting and alerting system. As it isqquiet often that we heard about various accidents that are being occurred due to combustible gases, i.e., LPG, LNG, propane, butane and other flammable gases. Frequently we hear, explosion in cylinder of household and vehicles, as well as accidents in industries, mines, etc. Several people have been injured and some got dead. So we are working on a project in which we are using new technology which is being used to make every existing digital system more smart, internet of things (iot). It provides real time information available on internet for faster accessing with a gas sensor that can detect various other hazardous gases. The advantage of this auto detection and alerting system over the traditionally used manual method is that it offers quickest response time possible and accurate detection of an emergency situation and in turn helps in faster diffusion of the critical situation.*

Key Words: Embedded Systems, IOT, Gas Detection, AVR Microcontroller, GSM Module, Internet Of Things.

1. INTRODUCTION

MQ-6 Semiconductor Sensor for Combustible Gas detection is a Sensitive Gas sensor. The sensitive material of this MQ-6 gas sensor is SnO2, which works with lower conductivity in clean air. When the target combustible gas exist, the sensors conductivity is higher along with the gas concentration rising. As the conductivity increases the current in the circuit of the sensor increases which results in lower sensor resistance. This change is used to correspond the output signal of gas concentration. MQ-6 gas sensor has high sensitivity to Methane, Propane and Butane and could be used to detect both Methane and Propane. The sensor could be used to detect different combustible gas especially Methane, it is with low cost and suitable for different application.

According to the value received if that is above threshold, microcontroller will turn on LED and Buzzer and message is start viewing on the 16x2 LCD display. Once few milliseconds delay, it conjointly sends the information over the internet for throwing gas out and continue send messages as "Gas Leakage Detected" to your mobile no. This information that is send over the server created on the internet and a Smartphone application can be used to notify. The data on the server is displayed at a webpage for user.

2. RELATED WORK

A number of reviews on the subject of gas leakage detection techniques were done in the past either as part of research papers/technical reports on a certain leak detection method and other gas related subjects.

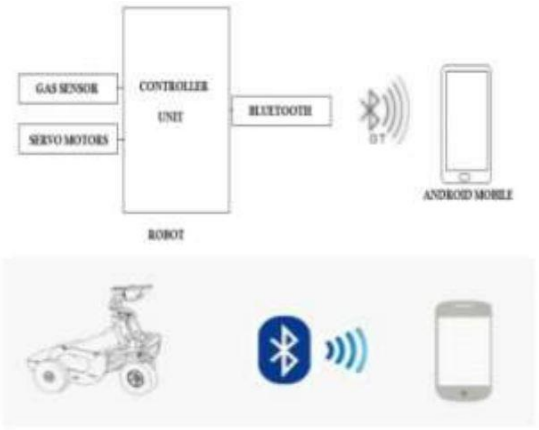
In the year of 2008, LIU zhen-ya, WANG Zhen-dong and CHEN Rong, "Intelligent Residential Security Alarm and Remote Control System Based On Single Chip Computer", the paper focuses on, Intelligent residential burglar alarm, emergency alarm, fire alarm, toxic gas leakage remote automatic sound alarm and remote control system, which is based on 89c51 single chip computer or we can say 8051 microcontroller. This device or the system that they design was used to send a message to emergency number provided and as well as call the police hotline number for emergency help. They say that it could also be a voice alarm and also give the location of the site to the local police. They further added that this intelligent security system can be used control the electrical power remotely through telephone [8].

In the year of 2006, Ioan Lita, Ion Bogdan Cioc and Daniel Alexandru Visan, "A New Approach of Automatic Localization System Using GPS and GSM/GPRS Transmission", this paper focuses on, a low cost automotive localization system using GPS and GSM-SMS services, which provides the position of the vehicle on the driver's or owner's mobile phone as a short message (SMS) on his request. This system can be integrated with the car alarm system which alerts the owner, on his mobile phone, about the events that occurs with his car when it is parked. Or sends SMS to the relatives to provide fast emergency if an accident is happened. The system is composed by a GPS receiver, a microcontroller and a GSM phone or GSM module. GPS service can be used to sends the location in case of accident. And can show details if requested by the owner of the car, this request response can contain the location and current engine status whether the vehicle is moving or not. The system can proves to be a low cost

solution for vehicle positioning as well as in car tracking system application [8].

In the year 2000, K. Galatsis, W. Woldarsla, Y.X. Li and K. Kalantar-zadeh, "A Vehicle air quality monitor using gas sensors for improved safety", this paper focuses on A vehicle cabin air quality monitor using carbon monoxide (CO) and oxygen (02) gas sensors has been designed, developed and on-road tested. As of today the use of Air Conditioner (A/C) in the cars is more often this is dangerous to outer environment causing Global Warming like problems but as well as it affects the inner environment of a car. It causes problems like decrease in the oxygen level around 15% and increase in the level of harmful gases like Carbon mono oxide. The continuous monitoring of these gases increase vehicle safety and an alert can be made to let the passengers know that the concentration of the gases has reached their threshold value and it will be dangerous to further use the exhaust or AC in car. CO concentrations of 30ppm and oxygen levels lower than 19.5% were experienced whilst driving. Later on in year 2002 they publish another paper "Investigation of gas sensors for vehicle cabin air quality monitoring". In this they proposed the use of MOS (Metal oxide Semiconductor) Gas Sensor. Commercially available gas sensors are compared with fabricated Moo3 based sensors possessed comparable gas sensing properties. The sensor has response 74% higher relative to the hest commercial sensor tested [7].

In year 2008; Ch. Manohar Raju and N. Sushma Rani, they introduce an android based automatic gas detection and indication robot. They proposed prototype depicts a mini mobile robot which is capable to detect gas leakage in hazardous places. Whenever there is an event of gas leakage in a particular place the robot immediately read and sends the data to android mobile through wireless communication like Bluetooth. In this they develop an android application for android based smart phones which can receive data from robot directly through Bluetooth. The application warns with an indication whenever there is an occurrence of gas leakage and we can also control the robot movements via Bluetooth by using text commands as well as voice commands. With the rapid developments and tremendous changes in technology where lots of new techniques are available for communication, they use one of the best feature of smart phone, i.e., the Bluetooth technology to control and monitor parameters driven by a robot.

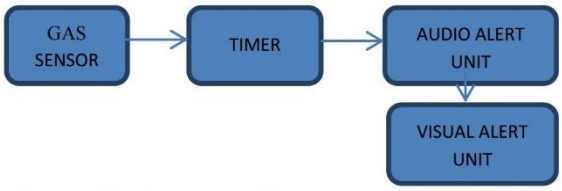


They introduce a robot and mobile application. Which made it is certain that an autonomous, mobile gas detection and leak localization robot is possible today and can significantly enhance safety [1].

S Shyamaladevi, V G Rajaramya, P Rajasekar and P Sebastin Ashok, 2014; In this research paper they told about their project ARM7 based automated high performance system for LPG refill booking and leakage detection and methodology to make their project. In this, if there is a case of leakage, the resistance of the sensor decreases which increase its conductivity. The related output pulse is fed to microcontroller and which switches on the buzzer and exhaust fan to provide quick alert to house members. Microcontroller as well as sends a message "EMERGENCY ALERT: LPG gas leakage found in your home" to required cell numbers via GSM module and the same will be displayed on LCD. The gas leakage detection system was proposed, designed and successfully implemented in this paper for home safety and industrial applications. Along with gas leakage detection, this system gives a fully automated approach towards the gas booking. Real time weight measurement of the gas and its display on LCD makes it an efficient home system and also can be used in industries and other places to detect gas leaks. This project was implemented using the ARM 7 processor and simulated using the Keil software. The cost involved in developing the system is significantly low and is much less than the cost of gas detectors commercially available in the market. That's why it turns ourt to be a good product to develop on a large scale to be available in market [4].

In year 2016,"Dangerous gas detection using an integrated circuit and MQ-9" given by Falohun A.S., Oke A.O. and Abolaji B.M. This paper was focused on combustible gas detection. In this basically, they built an embedded design which includes typical input and output devices include switches, relays, solenoids, LEDs, small or custom LCD displays, radio frequency devices, and sensors for data such as temperature, humidity, light level etc. Principle of operation proposed was the gas detector alarm system is designed with the intention to ensure that the

event of gas is intelligently detected, promptly notified and interactively managed. It is built around a timer to accept input from the gas sensor, MQ-9, and activate a buzzer and set of led that alerts in the presence of gas. The sensor used is the MQ- 9 that specializes in gas detection equipment for carbon monoxide (CO) and Methane (CH4), LPG family and any other relevant industry or car assemblage.



Block Diagram of the User Interactive Gas Leakage and Fire Alarm System is shown in the figure above. The advantage of MQ-9 gas sensor is that it has; good sensitivity to CO/Combustible gas, high sensitivity to methane, propane and CO, long life and low cost and simple drive circuit. The enveloped MQ-9 has 6 pins, 4 of which are used to fetch signals, and other 2 for providing heating current. Once powered, the output of the sensor is normally HIGH but goes LOW when gas is sensed [5].

3. THEORY OF PROJECT

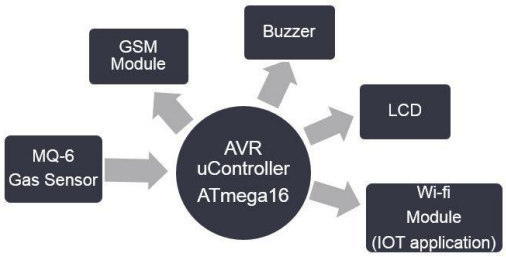
Embedded Systems is defined in many ways. Few definitions are,

"An embedded system is a microprocessor based system that is built to control a function or a range of functions."

"An embedded system is some combination of computer hardware and software, either fixed in capability or programmable, that is designed for a specific function or for specific functions within a larger system."

In the project, both the functions transmitting data over internet and sending text message to User mobile number, are done wirelessly using GSM module. MQ-6 Gas sensor is used to detect Hazardous Gases which are combustible in nature. The power supply of the project is regulated as 5V, supplied by a DC battery. The programming languages used for developing the software to the AVR Microcontroller is Embedded C as well as assembly language. The PROTEUS is used to stimulate the project on software.

Block Diagram of Proposed Model is as below:



3.1. HARDWARE & SOFTWARE

In this proposed model we want to achieve five aspects:

Design of Embedded System: In this we are using the AVR microcontroller that control all the module and other components and peripheral devices connected to it. Some of them work as input units and others as output units.

GSM Module: GSM module is used to send the message of gas leakage to the emergency number provided in the program. This module is also used to setup an internet connection and use for IOT Applications. The data fetched from the Gas Sensor is uploaded to a virtual server which can be displayed on a webpage.

Alerting System: This part includes a buzzer and a LCD Display. Buzzer is used to work as an alarm and LCD is being used to Display the Alert message and other details required to show.

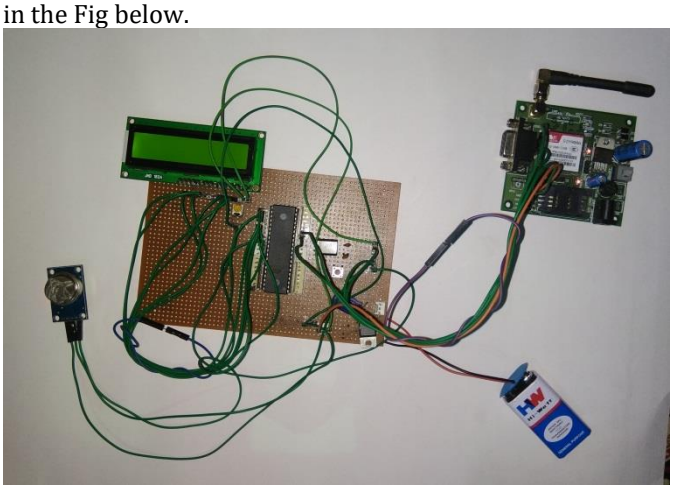
Sensor Module: This module is use to sense the gas leakage. In this module we use a gas sensor MQ 6 to perform the leakage detection operation. This is the main component of the whole system. This is a Semiconductor type Gas sensor in which the conductivity increases as the gas concentration increases. To sense the concentration of gases SnO_2 and Au layer is used. The increases conductivity results in decrease in the Sensor load resistance, this change is measured by the controller. If the concentration goes beyond threshold it sends signal to controller which starts the tasks assigned by the programmer.

Software Used: Two softwares that are used in developing this system are Atmel Studio and Proteus. Atmel Studio is used for programming. Embedded C is generally used to program microcontrollers. This studio generates a HEX code file which is required to burn in the microcontroller. On the other hand Proteus is simulation software. It is a general practice to run the program on Proteus before physically connecting the system to avoid failures.

4. IMPLIMENTATION

The hazardous gases like LPG and combustible gas were sensed by the MQ-6 gas sensor and are monitored by the AVR microcontroller and displayed in the LCD. In critical situation, that is when the LPG exceeds from normal level above 1000ppm and in the same way when the Propane exceeds the normal level of 10000ppm then an alarm is

generated and a SMS is sent to the authorized user as an alerting system, which helps in faster diffusion of the critical situation. The prototype of the proposed is shown in the Fig below.



4. SIGNIFICANCE OF THE PROJECT

4.1 Applications

- Free space exploration
- Domestic usage
- Health and life saving operation
- Industrial Application
- Also be used in remote areas using wheel Robot like mines and sewers.

4.2 Advantages

- GSM wireless module is most popular and fastest growing wireless platform in wireless communication.
- The inspection is performed without any interruption of plant operation or personnel responsibilities.
- The time required to carry out the inspection is dramatically reduced, reducing the cost.
- IOT link use makes it more preferable over other designs.
- This project is easy to use and it gives remote indication to user.

4.3 Limitations

In order for a leak to be detected, the GAS itself must either be in close proximity to the detector or within a pre-defined area. Unfortunately outdoor environmental conditions such as changing wind directions and quick dispersion of the gas cloud from a leaking outdoor installation often cause gas detection to fail simply because the gas never reaches the detector.

5. FUTURE SCOPE & CONCLUSION

5.1 Future Scope

Mobile Application: In this digital era when everyone has Smartphone. We can connect a mobile based application with the website to alert more efficiently in the Users phone by giving him proper details. This Application will be directly connected to website for more instant results.

Different Gases: Environmental air quality is also becoming increasingly important and there will be many future requirements for low-cost, air quality monitoring sensors such as MEMS-based metal oxide Semiconductor sensors which are capable of monitoring pollutants such as ozone, carbon monoxide, nitrogen dioxide and ammonia.

Infrared sensors: The demands of fail-safe operation and higher reliability have caused many users to switch to infrared gas sensing. These types of sensor generally incorporate a pulsing source of infrared radiation that is absorbed by certain gases in proportion to the gas concentration. The infrared wavelength is chosen to suit a particular gas such as methane or carbon dioxide.

Lower power and size: The power consumed by pellistor and infrared types of gas sensors has limited their use in portable instrumentation to some extent due to battery capacities. Over the last few years rechargeable technology has developed greatly with battery chemistry migrating from Nickel Cadmium (Ni-Cd) to Nickel-Metal Hydride (NiMH) and now various forms of Lithium-Ion (Li-Ion), which offer the best power to weight ratio. The mobile phone and consumer electronic markets will continue to drive the development of new battery technologies with spin-off benefits to the portable gas sensor industry.

5.2 Conclusion

The importance of gas sensing is set to grow with increasing requirements for safety and environmental protection across many industries. The current range of gas sensing technologies has served us well but the future holds many new possibilities. Power and size reductions and an improvement in ruggedness will allow a new generation of body worn devices. And our project will prove to be boom for households and industries. A wide variety of leak detecting techniques is available for gas pipelines. Some techniques have been improved since their first proposal and some new ones were designed as a result of advances in sensor manufacturing and computing power.

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