WIRELESS DETECTION OF GAS LEAKAGE AND CYLINDER BOOKING USING IOT

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ABSTRACT

In our society every inventions based on human safety, In home is a major concern because there were many gas leakage accidents which lead to loss of many lives. This project proposes wireless detection of gas leakage and automatic LPG cylinders booking using IOT and simulation results of proposed wireless gas leak detecting and LPG booking using Multism Design suite for detecting frequency of sound exited by leaking from gas cylinder. The proposed system will provide an efficient solution for gas leakage accidents which is a regular problem in India which also does heavy damage to the infrastructure and lives.

KEYWORDS: Wireless sensor node design, Gas leak detection, Automatic cylinder booking.

INTRODUCTION

The gas leakage accidents are becoming common at present because of negligence and carelessness. In this project, it is mainly focused to check the gas leakage and also it books the cylinder when the gas gets over. There were many products available in themarket to check the gas leakage and alert the consumer with alarms. There is no wireless automatic regulation system to control the leakage and cylinder booking. In order to overcome the drawbacks in the existing system the conventional proposed system is employed. In the proposed system, the advanced raspberry pi is used and it is the heart of the system that controls all the sensors connected across the programmable memory which has some peripheral devices to execute the project as efficient. Many sensors like Acoustic Sensor, weight transducer are used to monitor the gas leakage with sound of air and also to monitor the weight the cylinder to book the gas at appropriate time. All the sensor output is given to the raspberry pi processor which controls the various parameters according to the required value. The automatic regulation system works on the input values from the smoke sensor. The automatic gas booking can be done by the input values form the weight transducer when the weight of the cylinder goes below the threshold value it will book the gas cylinder automatically.

LITERATURE SURVEY

[1]The paper titled as Study on Gas leakage localization method based on ultrasonic sensor area array (IEEE-2017) describes In order to realize leakage detection and leakage localization by ultrasonic waves leak generated, ultrasonic gas leak location method based on sensor array is proposed, and it achieves accurate positioning of the leak point only by time difference of arrival between leak point and sensors. Use envelopes of ultrasonic signals received by sensors to obtain whole cycle numbers of time difference of arrival, combined with remaining time difference (i.e. the part of time difference of arrival less than one signal cycle) calculated by the traditional cross-correlation algorithm, then the time difference of arrival is obtained. According to the TDOA positioning algorithm, equation group to solve the leak location is written. Finally, use combination of least square method and Newton iteration method to estimate leak location. The experimental results show that this method can accurately estimate the leak location, verifying the correctness and feasibility of the method.

[2]The paper titled as Gas leakage detection and smart alerting and prediction

using IOT(ICCT-2017) describes IoT is an expanding network of physical devices that are linked with different types of sensors and with the help of connectivity to the internet, they are able to exchange data. Through IoT, internet has now extended its roots to almost every possible thing present around us and is no more limited to our personal computers and mobile phones. Safety, the elementary concern of any project, has not been left untouched by IoT. Gas Leakages in open or closed areas can prove to be dangerous and lethal. The traditional Gas Leakage Detector Systems though have great precision, fail to acknowledge a few factors in the field of alerting the people about the leakage. Therefore we have used the IoT technology to make a Gas Leakage Detector having Smart Alerting techniques involving calling, sending text message and an e-mail to the concerned authority and an ability to predict hazardous situation so that people could be made aware in advance by performing data analytics on sensor readings.

[3]The paper titled as Wireless gas detection and localization (IEEE-2016) describes Thousands of industrial gas leaks occur every year, with many leading to injuries, deaths, equipment damage, and a disastrous environmental effect. This paper proposes a wireless gas leak detection and localization solution. The detection and localization algorithms proposed here are applied to the collected concentration data, and the methodology is evaluated. A detection rate of 91% is achieved, with seven false alarms recorded over 3 days, and an average detection delay of 108 s. The localization results show an accuracy of 5 m. Recommendations for future explosive gas sensor design are then presented.

[4]The paper titled as wireless home safety gas leakage detection system (IEEE-2011) describes wireless safety device for gas leakage detection is proposed. The device is intended for use in household safety where appliances and heaters that use natural gas and liquid petroleum gas (LPG) may be a source of risk. The system also can be used for other applications in the industry or plants that depend on LPG and natural gas in their operations. The system design consists of two main modules: the detection and transmission module, and the receiving module. The detection and transmitting module detects the change of gas concentration using a special sensing circuit built for this purpose. This module checks if a change in concentration of gas has exceeded a certain pre-determined threshold. If the sensor detects a change in gas concentration, it activates and audio visual alarm and sends a signal to the receiver module. The receiver module acts as a mobile alarm device to allow the mobility within the house premises. The system was tested using LPG and the alarm was activated as a result of change in concentration.

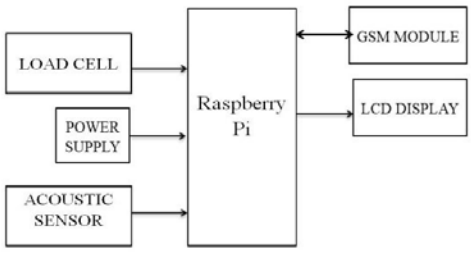
[5]The paper titled as Based on PSoC Smart sensor of gas leakage (ISSE-2009) describes This paper offers a new Smart Sensor of natural gas leak, which was realized on base of a new way of measurement, modern thin film MEMS (micro-electro-mechanical systems) structure and PSoC (programmable system on chip).The senor is a continuous operation device destined for gas leak detection and signal injection that is proportional to concentration of gas in air. If concentration is dangerous the sensor sends a message to the warning system. A gas sensitive element of the sensor is MEMS technology designed. The wireless interface is provided by a single-chip 2.4-GHz Direct Sequence Spread Spectrum (DSSS) Gaussian Frequency Shift Keying (GFSK) baseband modem that connects directly to a microcontroller PSoC via a simple serial peripheral interface. The modem supports a range of up to 50 meters. A generic aspect of the sensor is the physical principle of operation. It ensures high reliability and operating life of the device. The Sensor is made practically on one microcircuit with digital interface due to use PSoC. That has provided high accuracy and low prime cost of the device as a whole.

PROPOSED SYSTEM

In order to address the problem in the existing system, the proposed system is employed. The proposed system is to check the gas leakage, and give the values to the raspberry pi processor. The weight of the gas cylinder is also monitored. The embedded processor is used for real time monitoring of data. The parameters are constantly monitored by the processor and executes upon the instruction.

For checking the gas leakage, the acoustic sensor is used. Weight transducer is used to check the weight of the gas cylinder when it is below the threshold value it will

automatically book the cylinder. When there is a gas leakage from the cylinder after it is detected by the acoustic sensor it will automatically turn off the main power supply to the home because a small spark lead to heavy damage. It also turn off the regulator by the help of dc motor to stop the further leakage of gas. The raspberry pi processor controls all the activities through the input values from the sensors connected through the peripheral devices. In addition to that, it will send the messages to the consumers about each and every activity performed by the sensors. This will help the consumer to know the status of the gas cylinder and when it will be drained to empty.



Block diagram for proposed system

ACOUSTIC SENSOR

The escaping gas from pipeline generates heat and sound energy as gas molecules collide at orifice, heat is lost quickly due to heat transfer mechanisms but sound is transmitted at considerable distances enough for acoustic sensor to detect the changes. Sound is the mechanical disturbance of a medium (gas, liquid and solid). The sound produced by leak from gas pipeline vibrates at frequency range audible to human ear (i.e., 20Hz – 20kHz).

Acoustic sensor transmit a pulse of acoustic sound toward a target, which reflects the sound back to the sensor. The system then measures the time for the echo to return to the sensor and computes the distance to the target using the speed of sound in the medium (air), Figure 1 illustrates

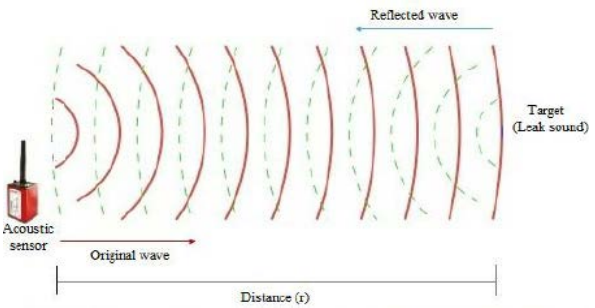


Fig 1: Acoustic sensor working principle

SPEED OF SOUND IN AIR

Time taken between the emission of the acoustic pulse and its return to the receiver is measured. The distance to the leak is then computed using the speed of sound in the transmission medium (usually air).The received signal is stronger near the leak site hence it is used to locate the leakage point. The accuracy of the leak distance measurement is directly proportional to the accuracy of the speed of sound.

$$\text{Distance}(r) = \text{speed of sound in air}(c) \times \text{time taken}(t)$$

At a normal room temperature of $\theta = 22^{o}C$, speed of sound (c) in air = 331.4 ms-1 approximate.

LOAD CELL

Load cells are used to measure weight.Load cells generally consist of a spring element on which strain gauges have been placed. The spring element is usually made of steel or aluminum. That means it is very sturdy, but also minimally elastic. As the name "spring element" suggests, the steel is slightly deformed under load, but then returns to its starting position, responding elastically to every load. These extremely small changes can be acquired with strain gauges. Then finally the deformation of the strain gauge is interpreted by analysis electronics to determine the weight.The strain gauges are firmly attached to the spring element, and therefore undergo the same movements it does. These strain gauges are arranged in what is called a bridge circuit, or more precisely a Wheatstone bridge circuit. This means that four SGs are connected "in a ring" and the measuring grid of the force being measured is aligned accordingly.

The cylinder is placed on a load cell or suspended from it, the cylinder's weight can be determined. Once the weight of cylinder reaches it minimum, load cell read that value and the measured value is noted by GSM module.

GSM MODULE

GSM (Global System for Mobile communications: originally from Group Special Mobile) is the most popular standard for mobile phones in the world. Its promoter, the GSM Association, estimates that 82% of the global

mobile market uses the standard. GSM is used by over 3 billion people across more than 212 countries and territories. GSM pioneered a low-cost (to the network carrier) alternative to voice calls, the Short message service (SMS, also called "text messaging"), which is now supported on other mobile standards as well.GSM is a cellular network, which means that mobile phones connect to it by searching for cells in the immediate vicinity. GSM networks operate in four different frequency ranges.

When the weight of the cylinder goes below the threshold value, load cell will sense it and pass the information to the GSM module. When the input value is given to GSM module by load cell, it pass message to the users and also book the gas cylinder automatically.

SIMULATION RESULTS

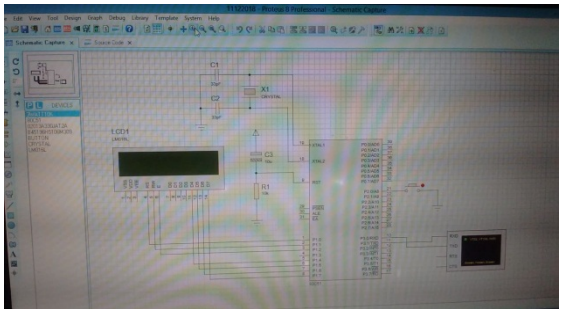


Fig 2 Simulation result of gas leakage monitoring

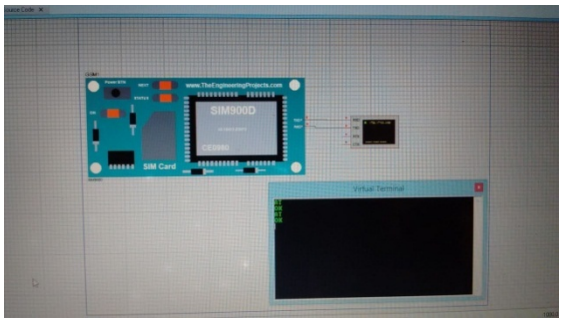


Fig 3 IOT implementation with GSM module

CONCLUSION

In this project the parameters like smoke and weight are monitored constantly with the support of raspberry pi processor. It will be also useful for automobiles and industries as they use gases in many processes, where the accidents due to gas leakage were main concern. By overcoming the drawbacks of the existing project it serve as a tool to save many lives. This will also help in booking the LPG cylinder before it gets over.

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