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Automated Gas Leakage Detection and Shutoff in Hospitals

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Abstract-

A gas leaks lead to personal life and financial damage. Much effort has been dedicated to preventing such leaks and developing reliable techniques for leak detection and leakage localization using variable gases and variable sensors in hospital.

When they sense the presence of harmful gases at unsafe levels, they activate an alarm system. This project describes a system for detecting a variable gas leakage from cylinders which notifies the user via the IOT network. The system consists of an Oxygen, Nitrogen, Nitrous Oxide gas leakage detector which sends a warning signal to Arduino UNO Micro controller. The same is shown on the LCD, which is attached to the controller's output port. A threshold value is set in the controller. Once the threshold level is reached, the voltage value is given to the micro controller, which alerts the user and cut off(close) gas cylinder using Solenoid Valve. Gas leakage sensors are used in our project to detect gas leaks. The same is shown on the LCD, which is attached to the controller's output port

***Index Terms*—Micro controller, Solenoid valve, Buzzer, LCD display, Gas sensors, IOT module.**

I. INTRODUCTION

Gas usage for medical purposes is frequently essential. Since, the gas cylinder warehouse is regarded as an essential component of any hospital. Hospitals usually have even an extensive gas supply network that deliver a number of different types of gases to various locations inside the hospital such as patient and operating rooms. Hospitals are required to have a smart gas leak detection system for security purposes. This system becomes even more useful and effective when it is linked to Internet of Thing (IOT). that way, the system will be capable of sending a warning message to the hospital´s safety personals in case the system detects any gas leakage . Hospitals, clinics, and community health facilities will all have quite diverse work environments. Nursing systems are intricate, with a number of components that need to be understood, including different hospital systems, patient care, insurance, nursing suppliers, and legal issues. Every country in the world has some form of decent healthcare system, and there have been healthcare systems for many years in addition to numerous histories. Essentially, each nation should design and structure its health systems in accordance with its needs and available resources. This is because the common elements of nearly all health frameworks are healthcare and health-related issues Health system innovation is distributed among market players in a number of nations. Governments, nonprofit organizations, labor unions, houses of worship, and other organized bodies frequently work together to fund planned healthcare services targeted at the populations they serve. Instead of being revolutionary, healthcare has instead been portrayed as a standard biological process.

The Recent trend is to bring the technology into our Hospital and office. By making the place smart, the day-today activities are becoming more and easier. The development of Hospital automation has become mandatory in Hospitals as people are moving towards to the smart Hospital concepts. This is where 'Internet of things (IOT)' comes into picture. As the regular works has become smart, the things used are still the same like Gas cylinder in Hospitals. Sometimes it may result on an accident. Consequently, technology must be used to reduce the risk of accidents. IOT is a rapidly expanding technology in the automotive and industry. The primary objective of the project is to detect the gas leakage of LPG cylinders, which are commonly used in Indian Hospitals, and an alert to the user and the surrounding neighborhood using IOT.

II. LITERATURE SURVEY

- IOT Based Industrial Plant Safety Gas Leakage Detection System. The majority of industrial fires occur as a result of gas leakage. These seriously harm the machinery, people, resulting in accidents and fatalities, and the environment. Existing leak detection devices alert nearby individuals using on-site alarms. Accordingly, this idea suggests a leak detector that alerts those in question via SMS. Hazardous gases, including LPG, methane, and benzene, are detected by this detector. Explosions can occur from the easy ignition of LPG and methane gasses. When inhaled in higher doses, benzene is a carcinogen that can affect an employee's health. Hence, detection of these gases is essential.

- Pipeline Gas Leakage Detection And Location Identification System.Every diminutive task in this planetary is machine-controlled by cyberspace of belongings which makes our life easier. Now internet of things is used for safety purpose also. Nowadays outflow of gas in pipeline is the major difficulty. The chief mental object of this project is to detect the leakage of gases in the pipeline. Pipeline will be monitored with in an regular intervals using gas detection sensors. If there is any leakage in the pipeline then it will be detected and information such as name of the gas, pressure rate of the gas and its location where there is leakage of gases will be passed to the mobile phone, laptops, etc using IOT. The accurate location for the gas leakage will be detected using the GPS.
- Development of Smart Cooking Stove: Harvesting Energy from the Heat, Gas Leakage Detection and IOT Based Notification System. The design and implementation of smart cooking stove with safety features has been discussed in this paper. To increase the efficiency of the conventional cooking stove, an energy harvest system from cooking heat has also been proposed in this research work. Heat absorbing body and Thermoelectric Cooler (TEC) module are used for this purpose. Heat is absorbed to generate power by using see beck effect through TEC module. Generated power can be stored in a battery which can be delivered to the load. Sensor based safety feature has been implemented which can detect the leakage of gas and notify the user through mobile message using an IOT server.
- Gas detectors have been available in the market for an extensive period and have been widely utilized across various industries. They serve a broad spectrum of applications and can be found in industrial plants, refineries, pharmaceutical manufacturing facilities, paper pulp mills, aircraft and ship-building facilities, wastewater treatment plants, vehicles, indoor air quality testing, and hospitals.. There are a lot of ways in which the Gas Detectors could be characterized. Gas detectors are differentiated according to the gas they detect, the sensor technology employed, and occasionally by the components affecting their operational mechanism (like semiconductors, oxidation, catalytic, photo ionization, infrared, etc.). They are also commonly categorized as either fixed or portable detectors. Booking systems are present today. A. IVRS. B. SMS. C. ONLINE BOOKING. IVRS was introduced to complaint and book the cylinder by the user by calling to the landline number of the subscriber. Because there is no response to users' calls or the phone lines are constantly busy, and navigating through IVRS instructions according to their format can be confusing, users experience inconvenience. ONLINE BOOKING are always bit time consuming process And it required some knowledge about the messaging and internet. These entire processes are difficult to the non-literature peoples and it is time consuming for busy schedule peoples. Most of the users are not able get to know the level of LPG gas in cylinder. So the booking was not completed within the specified time frame, resulting in the user having to wait for a new cylinder, causing inconvenience.. For SMS required method particular format code is needed and distribute mobile no. SMS < IOC > to the same mobile number where booking is made .So IVRS, ONLINE BOOKING, SMS are time consuming and bit difficult method for gas booking.
- Leakage of gas is one of the main problems in industries, Hospitals and gas driven vehicles like buses, cars and autos. Detecting and preventing gas leakages is crucial, and one significant method employed for this purpose is the gas leakage detection kit. The primary objective of this paper is to automatically detect and prevent gas leaks. The significance of this paper lies in its ability to automatically detect and prevent gas leaks. For this we use gas sensor which sense the propane gas and butane gas. The gas leakage detection system incorporates a GSM module, which is responsible for sending alerts to the users' mobile phones to notify them of any detected gas leaks. But the previous method which uses to detect the gas leakage.

III. EXISTING SYSTEM

• Compressed Natural Gas (CNG) and Liquid Petroleum Gas (LPG) are commonly used gases in hospitals and automobiles.

• While they are user-friendly and produce fewer pollutants, they can be hazardous in the event of a leak caused by accidents.

• Currently, measurements are taken manually, with no means of transmitting the data.

Presently, data transmission between locations will be facilitated through wireless radio communication signals. But Radio signal will affect the human health like Cardiac Stress, Impact in Fertility, Derails Brain Function, and Affects Cell Growth. Voice and data transmission have been previously accomplished through various technologies, including wireless communication protocols such as infrared, Bluetooth, and Wi-Fi. Also the voice and data transmission is done by LDR and Laser torch. The most commonly used method for voice and data transmission is through wireless LAN (Local Area Network).The Hospital/office automation is done using the web server's core that manages, controls, and monitors users' Hospital. Also the Hospital/office automation is done using GSM and Bluetooth.

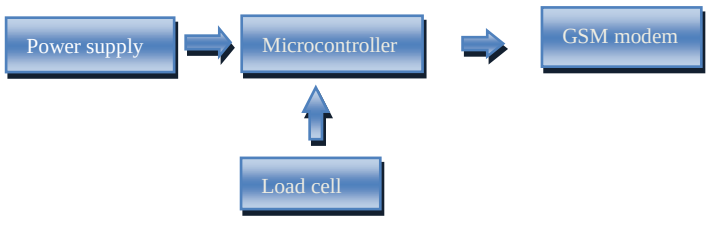

Fig: 3.1 Existing block diagram

IV. PROPOSED SYSTEM

The smart system is designed to be utilized in hospitals. In hospital mostly Oxygen, Nitrogen, Nitrous Oxide gases are using. When a sudden leakage happens in any of these gases, the gas sensor sends a signal to the micro controller. The controller processes a signal and send notification to other external devices attached such as LCD, buzzer and an Gas shutoff solenoids which previously connected with gas cylinder. A smart system will include the required sensors to detect gas leaks, scanning for any leakage and displaying the results on the LCD. When the sensors find any gas leakage in a room or where the devices are installed, it immediately sends a notification by IOT network, there will be an automatic messaging generating operation. The gas sensors keep on scanning for gas, it detects the leak depending on the predefine threshold. The system functions independently when humans enter, and it also operates reliably when activated by the human operator or responsible personnel pressing the push button switch in case of a gas leak.

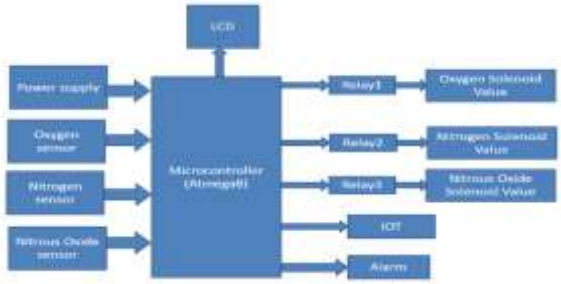

Fig: 4.1 Proposed block diagram

V. HARDWARE REQUIREMENTS

The proposed system consists of seven core modules responsible for data processing and interfacing with other applications, ensuring user-friendliness. Here are a few examples.

1. Micro controller
2. Power Supply
3. Gas sensor
4. Relay
5. Solenoid Valve
6. LCD
7. IOT Module
8. Buzzer

5.1 MICROCONTROLLER

Fig: 5.1Pin Configuration of Microcontroller

The ATmega8A microcontroller, manufactured by Atmel (now part of Microchip), is a versatile 8-bit microcontroller widely used in embedded systems and DIY projects. It features 8KB of flash memory for program storage, 1KB of SRAM for data storage, and 512 bytes of EEPROM for non-volatile storage. With a variety of peripherals including timers, ADC, SPI, USART, and GPIO pins, the ATmega8A offers flexibility for a range of applications. Its low power consumption and robust performance make it suitable for battery-powered devices as well. Programmed using C or assembly language, the ATmega8A is a popular choice for hobbyists, students, and professionals alike, seeking a reliable and cost-effective microcontroller solution for their projects.

5.2 RELAY

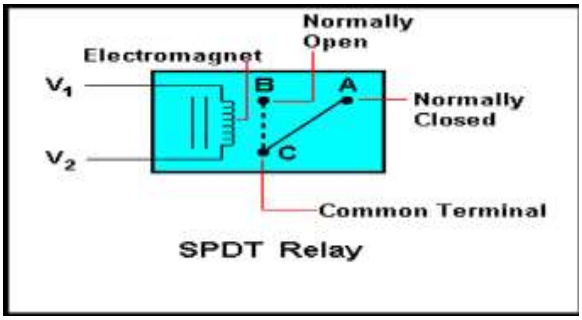

Fig: 5.2 Circuit Diagram of Relay

A relay is an electrically operated switch. Many relays use an electromagnet to operate a switching mechanism mechanically, but other operating principles are also used. Relays are used where it is necessary to control a circuit by a low-power signal (with complete electrical isolation between control and controlled circuits), or where several circuits must be controlled by one signal. The first relays were used in long distance telegraph circuits, repeating the signal coming in from one circuit and re-transmitting it to another.

5.3 LCD DISPLAY

Fig: 5.3 LCD Display with 16x2 Alphanumeric Lines

The LCD Module is used to show interactive messaging. We investigate an intelligent LCD with two lines and 16 characters per line that is linked to the controllers. The LCD, or Liquid Crystal Display, is extremely useful for providing user interface as well as troubleshooting. The HITACHI 44780 is the most popular kind of LCD controller, and it offers a simple interface between the controller and an LCD. These LCD's are both easy to connect with the controller and inexpensive. The display module is designed to offer a user interface through which system users may interact with the system either via the LCD or through various apps for the user and system.

5.4 SOLENOID VALVE

Fig: 5.4 Solenoid Valve

The purpose of a solenoid valve is to open or close an aperture in a valve body, allowing or preventing flow through the valve , By energizing the coil, a plunger opens or shuts the aperture by raising or lowering it inside a sleeve tube. Solenoid valves are made up of a coil, a plunger, and a sleeve assembly.

5.5 BUZZER

Fig:5.5 Piezoelectric buzzer

A buzzer is an electrical device that produces a buzzing or humming sound, typically used as a signal or alert in various electronic systems, alarms, games, or appliances. It usually consists of a vibrating mechanism, such as an electromagnet, that causes a metal diaphragm or other material to vibrate and create sound when an electric current passes through it.

5.6 GAS SENSOR

Gas sensors are available in wide specifications depending on the sensitivity levels, type of gas to be sensed, physical dimensions and numerous other factors. This Insight covers a methane gas sensor that can sense gases such as ammonia which might get produced from methane. When a gas interacts with this sensor, it is first ionized into its constituents and is then adsorbed by the sensing element. This adsorption creates a potential difference on the element which is conveyed to the processor unit through output pins in form of current. What is this sensing element? Is it kept in some chamber or is kept exposed? How does it get current and how it is taken out? Let's find out in this Insight!!!

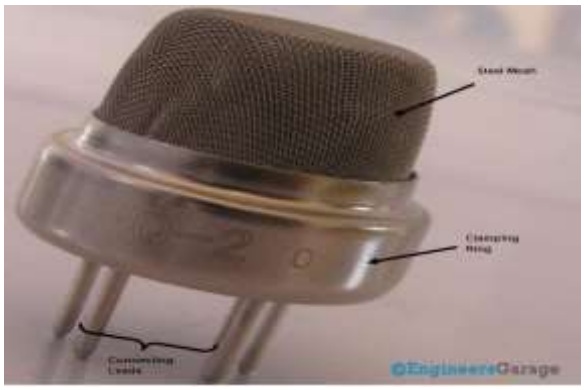

Fig: 5.6 MQ 2 Gas Sensor

The gas sensor module consists of a steel exoskeleton under which a sensing element is housed. This sensing element is subjected to current through connecting leads. This current is known as heating current through it, the gases coming close to the sensing element get ionized and are absorbed by the sensing element. This changes the resistance of the sensing element which alters the value of the current going out of it.

Common Gas Detector Applications

Although detectors are an essential application for Hospital and commercial safety, they are also employed in numerous industrial industries. Gas detectors are used in welding shops to detect combustibles and toxics and in nuclear plants, to detect combustibles. They are also commonly used to detect hazardous vapors in wastewater treatment plants.

Gas detectors are very efficient in confined spaces where there is no continuous employee occupancy. Such spaces include tanks, pits, vessels and storage bins. Detectors may also be placed at a site to detect toxins prior to occupant entry

VI. SOFTWARE REQURIMENTS

Fig: 6.1 Atmel ATmega8 in 28-pin narrow DIP

The AVR is a modified Harvard architecture8-bitRISC single chip microcontroller which was developed by Atmel in 1996. The AVR was one of the first microcontroller families to use on-chip flash memory for program storage, as opposed to one-time programmable ROM, EPROM, or EEPROM used by other microcontrollers at the time.

6.1 DEVICE OVERVIEW

The AVR is a modified Harvard architecture machine where program and data are stored in separate physical memory systems that appear in different address spaces, but having the ability to read data items from program memory using special instructions.

6.2 DEVICE ARCHITECTURE

Flash, EEPROM, and SRAM are all integrated onto a single chip, removing the need for external memory in most applications. Some devices have a parallel external bus option to allow adding additional data memory or memory-mapped devices. Almost all devices (except the smallest Tiny AVR chips) have serial interfaces, which can be used to connect larger serial EEPROMs or flash chips.

6.3 PROGRAM MEMORY

Program instructions are stored in non-volatile flash memory. Although the MCUs are 8-bit, each instruction takes one or two 16-bit words.The size of the program memory is usually indicated in the naming of the device itself (e.g., the ATmega64x line has 64 kB of flash while the ATmega32x line has 32 kB).There is no provision for off-chip program memory; all code executed by the AVR core must reside in the on-chip flash. However, this limitation does not apply to the AT94 FPSLIC AVR/FPGA chips.

6.4 INTERNAL DATA MEMORY

The data address space consists of the register file, I/O registers, and SRAM.

6.5 INTERNAL REGISTERS

Fig:6.5 Atmel ATxmega128A1 in 100-pin TQFP package

The AVRs have 32 single-byte registers and are classified as 8-bit RISC devices.

In most variants of the AVR architecture, the working registers are mapped in as the first 32 memory addresses (000016–001F16) followed by the 64 I/O registers (002016–005F16).

Actual SRAM starts after these register sections (address 006016). (Note that the I/O register space may be larger on some more extensive devices, in which case the memory mapped I/O registers will occupy a portion of the SRAM address space.)

VII. MERITS AND DEMERITS

Merits:

- This paper deal with the concept of monitoring a gas cylinder.
- Here the consumption level is continuously monitored.
- Gas Cylinder Shut off whenever gas leakage is detected.

Disadvantages:

- Not suitable for remote monitoring.
- Manual work is needed..

VIII. RESULTS &CONCLUSION

Gas leaks cause serious mishaps that result in material losses and human injuries. Gas leakage is caused mostly by poor equipment maintenance and a lack of public knowledge. Generally, the gas warehouses is one of important parts in a hospital. To ensure safe operation, design and implementation of a smart system to detect and inform safety personals about any gas leakage with in the minimum possible time. This Smart gas detection system is used on Arduino micro controller board, all sensors are connected to the micro controller board. The gathered signals are processed to generate an alert message through the IOT network. The system can monitor, detect, control solenoid value, and access the network automatically in response to any type of signals which comes from related sensors. The smart system is design to be a simple, flexible and cost effective.

Fig:8.1 Gas Detection Status in Display

Fig:8.2 Notification of Detection System on Serial Monitor

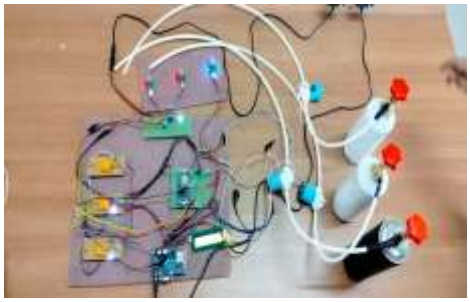

Fig:8.3 Gas Leakage Detection System

IX. FUTURE WORK

The proposed system can be updated in following ways for better reliability and performance. The number of sensors can be increased to improve safety level. Further integration in advanced technologies could enhance predictive capabilities, allowing for proactive measures

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