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Water Sprinkler with LPG Detection, Notification, and Control System and GSM Module

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Abstract

This system intends to show an automatic design that can detect, alert, and regulate gas leakage by employing an exhaust fan to remove gas from the area when there is a leak and a sprinkler to put out a fire in the event of a fire break-out. An alarm is triggered, an exhaust fan moves the gas outside, and a liquid crystal display (LCD) indicates how the system is functioning despite any distortions in the event of a gas leak. The Arduino UNO serves as the system's primary controller, and the buzzer serves as a notification device. In the case of a gas leak, notifications are sent via the GSM module to the registered cellphone number. The installation of a monitoring system for gas leaks in vulnerable areas is one of the steps done to stop accidents caused by this gas leak. The system uses a gas sensor (MQ) to find liquefied petroleum gas (LPG) leaks and a buzzer to notify nearby businesses, organizations, or individuals of the problem. The appliance is designed to be used in homes where running heaters and other natural gas or LPG-powered equipment can be challenging. For businesses or sectors that rely on natural gas or LPG for their operations, the system can also be used for other things.

Keywords— LED, LCD, Water Sprinkler, GSM Module, Arduino Uno, Buzzer, Exhaust Fan, MQ Sensor, LPG

I. INTRODUCTION

When people are developed out of a variety of issues that need to be fixed in order to be guarded and protected, there is a sense of anxiety that arises that leads to the creation of a security system [1]. When there is unpleasant information present, people yell and make noise [2]. Then, with cheers and assistance, he explained to the crowd the benefits of traffic lights, particularly in the early days of African society when there were many fires, kidnappings, and invasions. Nigeria is where I was born and raised [3]. Although each of these alerting or warning systems is helpful, it is also inconsistent and unreliable [4]. The system created by Moses Farmer and Dr. William in 1851 serves as the basis for the fire alarm security system. The two fire alarm boxes in this system both feature handles and telegraph locks [5]. Researchers have looked into fire detection in the past. While Rashkovetsky et al. [6] looked into the application of deep semantic segmentation to identify wildfires in multi-sensor satellite pictures, Xie et al. [7] identified successful video fire identification utilizing motion-based dynamic and static functions. Ajith and Martnez Ramón investigated unsupervised fire and smoke segmentation from infrared footage [8]. Zhang et al. conducted study into the organization of a data collection mission for an unmanned fixed-wing aircraft to monitor forest fires [9].Graff et al. looked into the use of

Poisson regression to predict daily fire activity [10]. Xu et al. looked on the adversarial adaptation of synthesis to reality in quick smoke detectors [11]. Nguyen et al. created a multi-stage real-time fire detection method utilizing short-term memory networks and convolutional neural networks [12]. Chaoxia et al. [13] examined information-guided fire detection based on Faster RCNN. Liu et al. looked at a framework for high-resolution video smoke detection employing combined spatial and frequency domain functions [14]. Zhang et al. investigated ATT Squeeze UUNet, a simple network for the detection and identification of forest fires [15]. Shi et al. looked into the best locations for wildfire surveillance cameras and sophisticated smoke detection systems [16]. Contextual and multitemporal active fire detection algorithms based on FengYun2GSVISSR data have been presented in a paper by Lin et al. [17]. A repetitive tendency prediction neural network for multi-sensor fire detection was investigated by Nakip, et al. [18]. Huang and Du [19] looked at the optimization of fire detection based on virtual reality video imagery. Cao et al. [20] examined Attention Enhanced Two-Way LSTMs for early detection of forest fire smoke. Someone needs to grab for one of these boxes, pull the handle, and transmit a fire or explosion notice to the closest alarm station in the event that an outbreak or explosion is discovered in a business, industry, house, or office. There, the station operator will receive a message, inform the fire department of the fire's occurrence, and enable the delivery of aid. Nearly 40 years later, in 1890, Francis Robins Upton created the first electronic fire alarm system. Francis recalled that most individuals wouldn't have enough time to stand up and grab the box's handle in the case of a fire or explosion. He therefore designed an electrical system to do away with this stage. The creation of the fire safety system was not well received at first, especially when it was first made available to the general public, but over time, awareness of the need for a fire warning system that was more advanced than the one he built grew. Li, et al. [21] conducted research on the creation and field use of a dual CO2 and CO2 mid-infrared gas sensor system for fire early detection. Sucuoglu et al. [22] developed a mobile robot that is outfitted with a fusion fire detector. The attention-based CNN version for fireplace localization and identification in actual global images was then examined [23]. Muhammad advised utilizing convolutional neural networks to detect fires before they spread while keeping an eye on efficient disaster management [24]. Solórzano et al. [25] looked into early fire detection based on gas sensor arrays, multivariate calibration, and validation. Lin, et al. [26] investigated an active fire detection technique based on the multi-temporal Feng Yun-3C VIRR data. With modified sea urchin-like ZnO, Li et al[27] .'s research looked into the vapor detection of overheated PVC cables for fire warning purposes. Yuan et al. [28] explored early fire detection for an underground diesel fuel storage area. Krebs et al. [29] looked on the production and detection of hydrogen fluoride gas during a firefighting scenario. Nemalidinne and Gupta [30] investigated an unsubsampled visible and infrared domain image fusion framework for fire detection utilizing pulse-coupled neural networks and spatial fuzzy clustering. Since then, especially with regard to the newest technical advancements, there have been numerous improvements made to fire alarm systems. The usage of gas always raises the potential of property damage and life-threatening leaks; thus, all businesses and homeowners today are required to evacuate the area in the event of a fire. As a result, creating a low-cost gas leak detection system can reduce danger over time. Liquefied petroleum gas (LPG) and methane leaks have recently been the cause of multiple accidents in both industry and the household. A fire or explosion caused by this gas leak caused the loss of numerous lives as well as significant property. To provide people enough time to flee potentially dangerous areas, early warning signals must be sent using cutting-edge technology. Shen et al. [31] looked into the harmonic waveform recognition-based near-infrared laser detection of methane under non-cooperative target settings. For visible light enhanced methane detection at ambient temperature, Wang looked into a new p-type sensor material [32]. Keyes et al. [33] looked at a better way to identify cellular methane leaks in the metropolis. A fiber optic multipoint methane remote sensor system based on pseudo-differential detection was studied by Wang et al. [34]. Li et al. [35] looked at a photoacoustic tiny single-fiber sensor for finding methane leaks. Xia et al. [36] investigated a sensitive methane sensor with ppt detection employing a long lane multipath cell and a mid-infrared band laser cascade. Wang et al. [37] conducted a study in which). Sampaolo et al. [38] looked into the detection of methane, ethane, and propane using a small quartz-enhanced photoacoustic sensor and a single band-to-band cascade laser. With variations in ambient factors and mass composition (N2, O2, H2O) taken into consideration, the properties of a compact photoacoustic mid-infrared sensor sensitive to methane, ethane, and acetylene detection were examined. [39]. Johnson et al. looked into a blind evaluation of the detection of aerial methane sources by Bridger Photonics LiDAR. [40]. Li et al. [41] examined high-sensitivity methane detection based on quartz-assisted photoacoustic spectroscopy using high-power diode lasers and wavelet filtering. Zhang et al. looked into an IHQCL-based gas sensor for the simultaneous detection of methane and acetylene [42]. Sepman et al. looked into the laser-based detection of methane and soot during the gasification of surrounding biomass [43]. Zhao et al. [44] examined the selective detection of methane using a PdIn2O3 sensor with a catalytic filter screen. Yang et al. [45] investigated a potential difference sensor for methane detection based on the SmMn2O5 sensor electrode. Sandoval-Rojas et al. [46] studied its behavior in the electrochemical production and detection of dopamine of a novel poly (3,4 ethylene dioxythiophene) doped with bis (pyrazolyl) methane sulfonate. Tian et al. [47] looked at a near-infrared methane sensor using neural network filtering. Methane detection in the ppb range was examined by Gong et al. [48] using a T-type optimized photoacoustic cell and an NIR diode laser. Giglio et al. [49] looked into the broadband detection of methane and nitrous oxide utilizing a quartz [1]-assisted photoacoustic sensor and a quantum cascade laser circuit with distributed quantum feedback. Ch'ien et al. [50] looked into a wavelet filter approach for improved methane gas sensor detection using non-dispersive infrared technology. The goal of this study is to build gas warning systems that can identify the presence of gases in our environment, industry, schools, and hospitals, including liquefied petroleum gas (LPG) and methane. The MQ5 sensor utilized in the circuit design will automatically identify the presence of the gas. A red LED that emits light, a buzzer that sounds an alarm when gas seeps into the environment, and an exhaust fan that removes the gas from the air make up the system. Other places where the system can be used include kitchens, gas storage facilities, and oil and gas pipelines.

II. RELATED WORKS

This article describes how to set up a fuel line leak detector. This technology makes it possible to find gases in our environment, industry, educational institutions, and hospitals, including liquefied petroleum gas (LPG) and methane. The circuit layout MQ5 sensor will routinely find any ACORS fuel line leak that poses a hazard to or endangers the local population or society, and the circuit layout GSM modem will alert the leak. It is delivered either to the tracking device that manages the structure, business, or display units, or to the consumer whose number is registered on the device. This device has a buzzer that, in the event of a fuel line leak, sounds an alarm. The device can be used in a variety of settings, including kitchens, fuel line garage facilities, and oil and gasoline pipes. The goal of this study is to create a gasoline line warning device that consistently finds and alerts drivers to fuel line leaks. This device is intended for use in residential safety areas where heating appliances, appliances powered by fuel lines made of plant material, and appliances powered by fuel lines made of liquid petroleum pose a risk. This fuel line warning device can also be used for various aspects of businesses and plants that rely on LPG and natural fuel line operations. The fuel line leak detection device notifies the registered mobile phone via text message. The aggregate intelligence of all studies is what allows the Arduino microcontroller to function. The ADAFRUIT net software is used to control and monitor this fuel line alert device. Following notification, the buzzer activates. Customers can control how the fans and water pumps are turned on with the use of this internet software device. The adoption of this resourceful online warning device has been suggested for several hospitals. The gasoline line sensor employed inside the layout provides a signal to the Arduino in the event of an unanticipated fuel line leak. The Arduino then notifies other devices involved in the arrangement, including medical facilities. Until the required response is reached, alarms are sent out once more. The device was intended for placement on walls and ceilings. The detecting device will send a brief message (SMS) to alert the home's owner of a fuel line leak if it is simply placed or wall-mounted and activated. A solenoid valve for establishing and maintaining the fuel line supply, an Arduino microcontroller, a MQ5 fuel line sensor with an ATmega328 microcontroller, a buzzer for alarms, a SIM900A GSM/GPRS module for message composition, a relay, and other components make up the detecting device. It has modules and utilizes virtual indicators that are delivered using Arduino [51–52]. This system intends to demonstrate a design that can automatically detect, alert, and control gas leakage by sucking the gas outside of the area where the leak is occurring. LEDs are used in this system to determine the type of gas (red and green). When a gas leak is discovered, the alarm sounds, the exhaust fan pulls the gas outside, and a liquid crystal display (LCD) shows the system's functioning under all distorting conditions. The system's primary controller is an Arduino UNO, and the buzzer serves as a notification mechanism. Installing a gas leakage monitoring system in vulnerable locations is one of the preventative measures to stop accidents caused by this gas leakage. The system uses a gas sensor to find liquefied petroleum gas (LPG) leaks and a buzzer to notify nearby businesses, organizations, or individuals of the leaks. Additionally, the system has two indicators (LEDs). The red LED will show that a gas leak has been detected, and the green LED will indicate that there has been no gas detection, or that there is no gas leakage in the environment. The gadget is designed for use in homes where heaters and appliances that run on natural gas or LPG could pose a concern. In sectors or establishments that depend on LPG and natural gas, the system can also be used for other purposes [53].

III. METHODS AND MATERIALS

3.1. Materials

Table 1: Below are the materials used in this research

S/N	Names of components	Number used
1	Exhaust Fan	1
2	Sprinkler	1

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3	GSM Module	1
4	Arduino	1
5	Buzzer	1
6	Liquid Crystal Display	1
7	Switch Button	1
8	Light Emitting Diode	1
9	Battery	3
10	Connections	23

3.2 Methods

The entire system is operating without a hitch. The Arduino's pins 8, 9, 10, 11, and 12 are linked to the LCD's pins 4, 6, 11, 12, and 14. A 10k ohm resistor connects the Arduino's pin 5 to the transistor Q4, which manages the exhaust fan. The transistor Q3, which is used to control the water sprinkler, is linked to pin 5 of the Arduino with a 10k ohm resistor as well. The RXD of the GSM module is linked to pin A4 on the Arduino Uno, and the TXD is connected to pin A5 on the same board. It is essential that all connections be made correctly for a functional operating system. The system was discovered to be error-free and functioning properly.

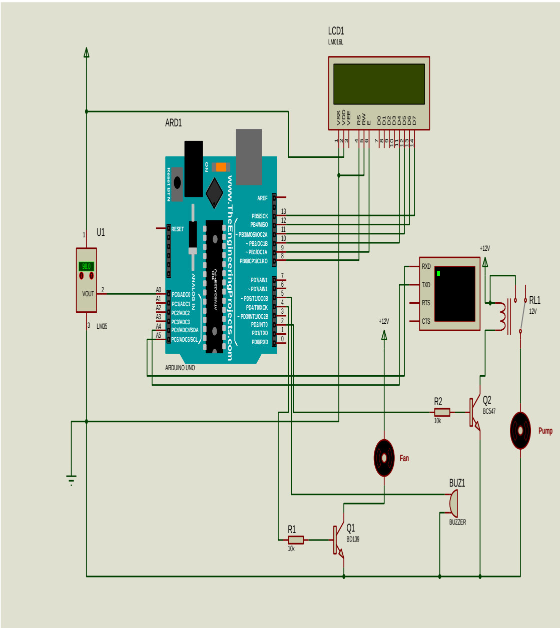

Fig. 1(a): A circuit diagram shows all the connections between the components

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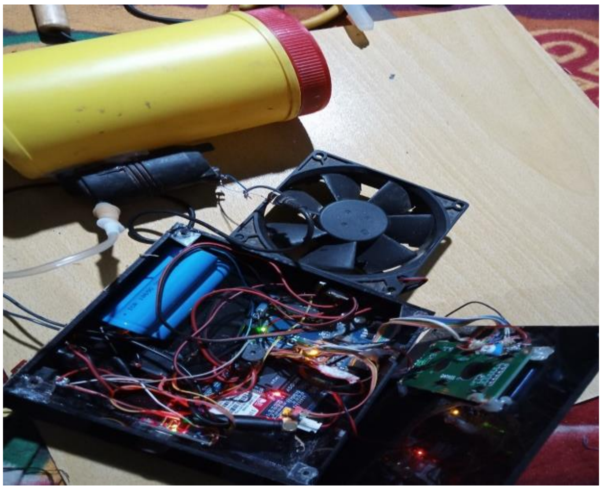

Fig. 1(b): Circuit construction shows all the connections between the components

Fig. 1(c): Circuit implementation

IV. RESULTS

The outcomes of the systems that were put into place are displayed in the photos below.

Fig. 2: LPG detection system implementation result

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Fig. 3: Waiting as a result of implementation

Fig. 4: Gas leakage was not detected as a result of the implementation

Fig. 5: The implementation result shows there is LPG present in the environment

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Fig. 6: The system sends an SMS to the registered mobile number

Fig. 7: Messages are delivered to the registered mobile number

Fig. 8: The bowl of the sprinkler contains water in it

Fig. 9: The sprinkler if there is no LPG detection

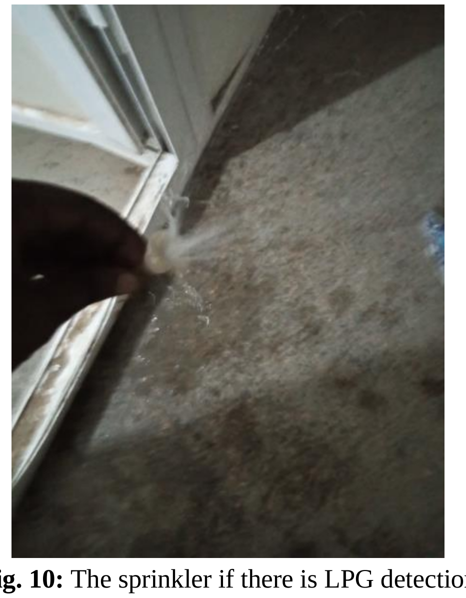

Fig. 10: The sprinkler if there is LPG detection

CONCLUSION

The system is determined to be working well; the LPG sensor, GSM module, exhaust fan, and sprinkler are all found to be in good working order. The system is both affordable and effective. It won't cost more than $100 to put it into action. Due to the sudden fire outbreaks and explosions caused by LPG leakage around the world, these systems can be placed in order to prevent such catastrophes in our schools, colleges, hospitals, industries, and homes.

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