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IOT BASED INTELLIGENT GAS LEAKAGE DETECTION SYSTEM

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Abstract - *Safety has always been an important criterion while designing home, buildings, industries as well as cities. The increased concentration of certain gases in the atmosphere can prove to be extremely dangerous. These gases might be flammable at certain temperature and humidity conditions, toxic after exceeding the specified concentrations limits or even a contributing factor in the air pollution of an area leading to problems such as smog and reduced visibility which can in turn cause severe accidents and also have adverse effect on the health of people. Many accidents occur in day to day life like explosion because of LPG (Liquid Petroleum Gas) leakage. Major harm is caused, if gas leakage is not detected early. But now the system can detect the gas leakage using gas sensor (MQ5). In this LPG gas leakage detector, device will get connected to WIFI, the minimum and maximum parameter can be set accordingly. Such IoT as well as Arduino based gas leakage detector systems can be installed in homes, hotels LPG gas storage areas.*

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***Key Words*: LPG, MQ5, IoT, Arduino**

1. INTRODUCTION

Liquefied Petroleum Gas is an odorless gas which is highly flammable in nature and thus detection of gas leakage becomes very important to prevent mishaps. The LPG accidents may occur by leakage, leakage and explosion, leakage and fire, Poisoning and asphyxiation. Leakage is a case in which LPG leaked, but it did not catch fire and cause human damages such as poisoning and asphyxiation. However, in this report, leakage of a very little amount of LPG from joints as little as soap bubbles formed when those of threaded parts or rubber tubes are soaked by soap water is excluded. Leakage and explosion cases in which LPG leaked, and it resulted in an explosion or a fire caused by the explosion when the explosion resulted from leaked gas only as well as when a fire broke out following explosion caused by leaked gas [6]. A case in which a fire that is not limited to that recognized as a fire by the fire department resulted from leakage of LPG excluding those covered by above. Here, a fire without leakage, which is caused by the overheating or the failure of LPG appliances including their accessories or by spreading of flames from a cooking oven, grill, etc., is not classified as a LPG accident. Poisoning and asphyxiation is a case in which human damages of CO poisoning and asphyxiation are caused due to incomplete combustion, leakage of LPG, or leakage of exhaust gas from exhaust pipes, etc., at LPG consumption facilities. To overcome such mishaps, gas leakage detection system is made with the help of IOT. Internet of Things is extension of Internet to provide connection with physical objects. The regular objects can be made smart by addition of sensors and communication interfaces and can be accessible via Internet. Projections for the impact of IoT on the Internet and economy are impressive, with some anticipating as many as 100 billion connected IoT devices and a global economic impact of more than $11 trillion by 2025.

Gas leakage leads to various accidents resulting in both material loss and human injuries. The risk of explosion, firing, suffocation is based on their physical properties such toxicity, flammability, etc. The number of deaths due to explosion of gas cylinders has been increasing in recent years. The reason for such explosion is due to substandard cylinders, old valves, worn out regulators and lack of awareness in handling gas cylinders. The LPG or propane is a flammable mixture of hydrocarbon gases used as fuel in many applications like 6 homes, hostels, industries, automobiles, vehicles because of its desirable properties which include high calorific value, less smoke, less soot, and meagre harm to the environment. Natural gas is another widely used fuel in homes. Both gases burn to produce clean energy, however there is a serious problem of their leakage. Being heavier than air, these gases do not disperse easily. It may lead to suffocation when inhaled and may lead to explosion.

Due to the explosion of LPG, the number of deaths has been increased in recent years. To avoid this problem there is a need for a system to detect the leakage of LPG. Gas leak detection is the process of identifying potentially hazardous gas leaks by means of various sensors. This LPG leakage detection and alert system to avoid fire accidents and to provide house and commercial safety. Now a days people are having very busy schedule and hence sometimes they forget or don't get enough time for booking the gas from the gas agency. So it would be much easier and helpful if there was a provision to book the gas automatically [7] – [9]. A major amount of gas is being wasted due to carelessness. Sometimes they forget to turn off the burner which may also could lead to damages. The smart gas system detects the leakage of the LPG and alerts the consumer about the leak by a notification through by using android app through IoT and consumer can turn off the gas valve. The additional advantage of the system is that it continuously monitors the level of the LPG present in the cylinder using load sensor and if the gas level reaches below the threshold limit of gas so that the user can replace the old cylinder with new in time and books the cylinder by automatically send a notification to the gas agency. An added feature is that if the users accidently forget to turn off the gas burner, the system will

inform by activating an alarm. so the problem of wastage of the energy is solved.

2. LITERATURE SURVEY

This system [1] presented how to detect the leakage using a gas sensor and book a new cylinder automatically by sending a message to agency. But there was no steps taken to prevent accident in case of leakage. In this system the amount of gas is continuously monitored by displaying the same on the LCD. Load cell (weight sensor)is used to measure the weight of cylinder and is sent to MCU which will be displayed on LCD. There are two threshold values, in which load cell output reaches the threshold value1 a message is to user as "LPG level is low" and to distributor as "book a new cylinder" along with username and id and same message is displayed on LCD.

LPG Gas Detector using GSM Module [2] was proposed which detects gas leakage and alerts through alarm and status display besides turning off the gas supply valve. A device that can detect such leakages and shuts off the gas supply to the burner from the cylinder was designed and developed. This device can be deployed anywhere cooking place or in kitchen. This system will ensure that explosions resulting from leakages of cooking gas from the cylinders are averted.

Design and implementation of an economic gas leakage detector was proposed [3]. A system, detecting low and high gas leakage levels and alerts the users by issuing appropriate audio-visual warning signals. A controlling and monitoring system for LPG [4] was proposed. In this system the stove knob is automatically controlled using relay dc motor. Additionally the system proposed the automatic rebooking of cylinder when the level of gas goes below the normal weight of cylinder. But there was no provision for detection of gas and prevention of fire accident due to gas leakage. Wireless gas leakage & level detection with auto renewal system [5] was proposed. A system in which gas level is detected and auto booking is done with the gas station also giving the information to the consumer. But it did not deal with the detection and prevention issue. 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.

2. PROPOSED SYSTEM

LPG gas detector system senses the LPG gas using MQ5 gas sensor. This device will continuously monitor the level of LPG gas present in the air. While monitoring, if the value of LPG gas in air is within the set limit then the RGB LED on the circuit will glow green giving a safe sign. Whenever the gas exceeds above the predefined threshold limit specified, then the RGB LED will glow red and simultaneously solenoid value will turn off and update it over IoT. The device will perceive gas outflow like Methane leak, Butane leak, and LPG leak, Methane outflow or any such petroleum centered on gaseous substance that can be discovered using MQ5 sensors and set up an SMS centered Alert method send SMS alert to given mobile number enter inside the Arduino program. The device will fabricate a sound alarm during gas outflow and rest the alarm once gas outflow is regulated show status in web and mobile interface and to rest the gas supply using Solenoid controller.

The proposed framework is produced utilizing the ESP8266. ESP8266 may be a digital computer which might create and adjust completely different ways it permits us to run different programs and moreover bolster distinctive peripherals that are to be utilized in our framework. MQ Sensors are introduced on the point of the LPG Supply to acknowledge the spillage of gas. Once the button edge is achieved it will send an alarm message to power versatile. The message is send to Email and the given phone number. LED is cautioned while gas spillage takes places and furthermore. The sound sign is associated with the framework. This data is kept in webpage utilizing it. The whole working on the framework can be accomplished by executing c program code and by introducing the required sensor libraries.

IoT Based Intelligent Gas Leakage Detection System is done using ESP8266-12E Wifi inbuilt microcontroller with MQ-5 gas sensor which detects gas presence in atmosphere and is set to alert by activating buzzer and simultaneously activates DC Fan or Air Exhaust Fan connected to the system as shown in Fig 5.1. The gas level data is frequently updated to the cloud server and whenever it crosses the threshold level or alert signal sent to the server, it sends an alert to the user by mail and mobile notification.

2.1. Advantages of Proposed System

- Uses NodeMCU which has an in-built Wi-Fi connecting method.
- SMS are sent to the user when the gas leakage is identified.
- Low cost and cheap method.
- Easy to implement.
- Communication channel availability is maximized.
- Safety system integrity is improved.

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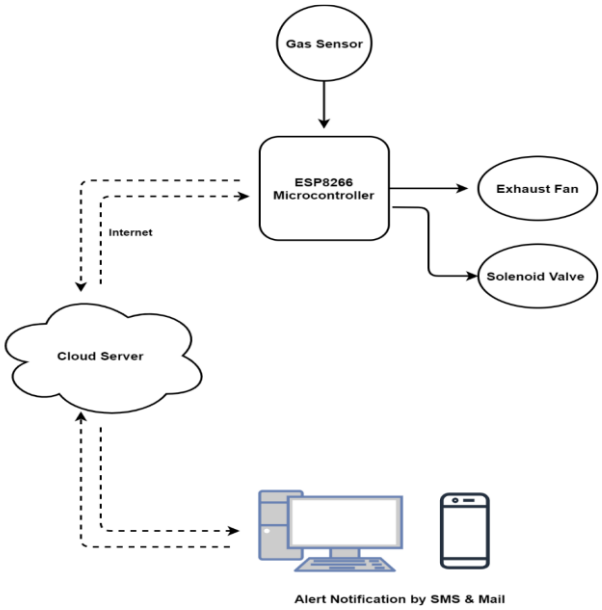

Fig -1: Architecture of the proposed system

2.1. Microcontrollers and Sensors

2.1.1. NodeMCU

NodeMCU is an open source Lua based firmware for the ESP8266 Wi-Fi SOC from Espressif and uses an on-module flash-based SPIFFS file system. NodeMCU is implemented in C and is layered on the Espressif NON-OS SDK. The term "NodeMCU" by default refers to the firmware rather than the dev kits. NodeMCU firmware was developed so that AT commands can be replaced with Lua scripting making the life of developers easier. So, it would be redundant to use AT commands again in NodeMCU. As shown in Fig 5.2, It is developed as a companion project to the popular ESP8266-based NodeMCU development modules, but the project is now community-supported, and the firmware can now be run on any ESP module.

2.1.2. MQ5 Gas Sensor

The Grove - Gas Sensor(MQ5) module is useful for gas leakage detection (in home and industry). It is suitable for detecting H2, LPG, CH4, CO, Alcohol. Due to its high sensitivity and fast response time, measurements can be taken as soon as possible. The sensitivity of the sensor can be adjusted by using the potentiometer. This is an Analog output sensor. This needs to be connected to any one Analog socket in Grove Base Shield. Connect this module to the A0 port of Base Shield. The output voltage from the Gas sensor increases when the concentration of gas increases. Sensitivity can be adjusted by varying the potentiometer.

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. 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.

2.1.3. Buzzer

A buzzer is a small yet efficient component to add sound features to our project/system. A shown in Fig 5.4, it is a very small and compact 2-pin structure hence can be easily used on breadboard, Perf Board and even on PCBs which makes this a widely used component in most electronic applications. There are two types of buzzers that are commonly available. The one shown here is a simple buzzer which when powered will make a Continuous Beeeeeep.... sound, the other type is called a readymade buzzer which will look bulkier than this and will produce a Beep. Beep. Beep. Sound due to the internal oscillating circuit present inside it. But, the one shown here is most widely used because it can be customised with help of other circuits to fit easily in our application. This buzzer can be used by simply powering it using a DC power supply ranging from 4V to 9V. A simple 9V battery can also be used, but it is recommended to use a regulated +5V or +6V DC supply. The buzzer is normally associated with a switching circuit to turn ON or turn OFF the buzzer at required time and require interval.

2.2. Cloud Servers

2.2.1. ThingSpeak Cloud Server

ThingSpeak is an IoT analytics platform service that allows you to aggregate, visualize, and analyze live data streams in the cloud. The data can be sent to ThingSpeak from the devices, create instant visualization of live data, and send alerts. ThinkSpeak stores all the information sent to it in one central location in the cloud, so that the data can be easily accessed for online or offline analysis as shown in Fig 5.5. ThingSpeak automatically charts the data that is sent to it, so that the devices or equipment can be remotely monitored from anywhere. View the data from any web browser or mobile device.

2.2.2. IFTTT Notification System

If This Then That, also known as IFTTT is a freeware web-based service that creates chains of simple conditional statements, called applets. As in Fig 5.6, an applet is triggered by changes that occur within other web services such as Gmail, Facebook, Telegram, Instagram, or Pinterest. n addition to the web-based application, the service runs on iOS and Android. IFTTT employs the following concepts:

• Services (formerly known as channels) are the basic building blocks of IFTTT. They mainly describe a series of data from a certain web service such as YouTube or eBay. Services can also describe actions controlled with certain APIs, like SMS. Sometimes, they can represent information in terms of weather or stocks. Each service has a particular set of triggers and actions.

• Triggers are the "this" part of an applet. They are the items that trigger the action. For example, from an RSS feed, you can receive a notification based on a keyword or phrase.

• Actions are the "that" part of an applet. They are the output that results from the input of the trigger.

• Applets (formerly known as recipes) are the predicates made from Triggers and Actions. For example, if you like a picture on Instagram (trigger), an IFTTT app can send the photo to your Dropbox account (action).

3. RESULTS AND DISCUSSION

This part describes the whole system implementation from the plotting of schematic to print PCB and deployment. Fig-2 is the scematic diagram of the system, which is integrated with MQ-5 Gas sensor for sensing gas content in atmosphere, ESP8266-12E Microcontroller which comes with inbuilt WiFi does the whole control and process of the system, Buzzer to alert detection and DC fan which is used as air exhaust in case of a gas leakage. Along with the Buzzer, the user will be notified through SMS or email whichever he prefers. The system is implemented in such a way that in case of a leakage is detected, the user will be very well notified, and some measures will be taken to avoid a gas leakage accident.

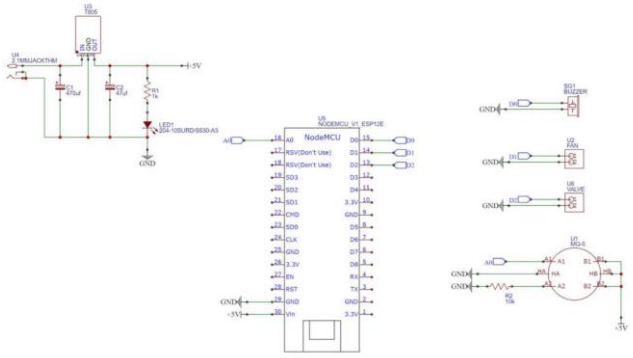

Fig -2: Schematic Diagram

3.1. Connecting to the Wi-Fi module

A connection between the PCB and the Wi-Fi module is required in order to enable the android to control the PCB. First, we need to connect the VCC pin of the Wi-Fi module to the VCC port in the PCB. Second, we need to connect the GND pin of the Wi-Fi module to the GND port in the PCB. Lastly, we need to connect the receiver of the Wi-Fi module to the transmitter of the PCB and the transmitter of the Wi-Fi module to the receiver of the Arduino-Uno board.

3.2. Testing the connection

After installing the app on the phone and connecting the PCB with the Wi-Fi module a test to make sure that the phone is interacting with PCB and Relay via the Wi-Fi module is needed.

• Open the web in the android device.

• Search for Wi-Fi devices via the web app.

• Connect to the Wi-Fi module.

• If the light in the Wi-Fi module stopped blinking then everything is fine otherwise the wiring needs to be checked.

3.3. Programming the ESP-12E Wi-Fi Module

In order for the ESP-12E to be able to interact with the application used in this project, a certain program (code) needs to be uploaded to the module through Arduino IDE as shown in Fig-3.

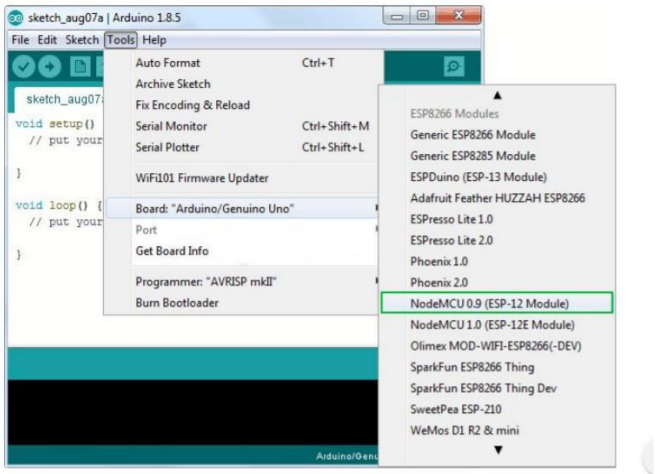

Fig -3: Programming to ESP-12E

MQ Sensors monitors the gas presence in atmosphere as well as the storage level. This system identifies gas outflow like Methane leak, Butane leak, and LPG leak, Methane outflow or any such petroleum centered on gaseous substance that can be discovered using MQ5 sensor and to set up SMS centered alert method in which the device send SMS alert to given mobile number and E-mail alert to the given E-mail address enter inside the program. The device will also fabricate a sound alarm during gas outflow and rest the alarm once gas outflow is regulated. The program helps to show status in web and mobile interface and to reset the gas supply using Solenoid controller.

4. CONCLUSION

Face Recognition systems are vulnerable to spoofing It can be concluded that the LPG Gas Leakage Detector on IoT with NodeMCU and Gas Sensor is a success. This paper contains Node MCU, gas sensor and an electric solenoid valve. Overall the system is user friendly and low cost. The system is implemented in such a way that in case of a leakage is detected, the user will be very well notified, and some measures will be taken to avoid a gas leakage accident. Also, it can be concluded that the objectives of the paper have been successfully met and they are as follows. Constructed a system which detects the leakage of LPG gas or natural gas. The system alerts the user on the phone and

via email. The system provides Buzzer to alert the user about the leakage.

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