IJITCE

ISSN 2347- 3657

International Journal of Information Technology & Computer Engineering

Email : ijitce.editor@gmail.com or editor@ijitce.com

International Journal of Information Technology & Computer Engineering

ISSN 2347–3657

Volume 13, Issue 2, 2025

Internet of Things (IoT) Platform for Simulating and Detecting LPG Leaks

[1]Ch. Surya Babu, [2]Dodda Lovaraju, [3] Kota Gangadhar, [4] Adapa Veerababu,
[1]Professor, Department of ECE, Rajamahendri Institute of Engineering & Technology.
[2,3,4]Student, Department of ECE, Rajamahendri Institute of Engineering & Technology.

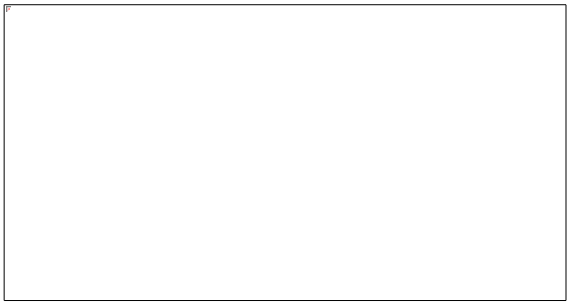
ABSTRACT:

There has to be a reliable system in place to identify and monitor leaks of Liquefied Petroleum Gas (LPG) because its usage is on the rise in both homes and businesses. To automate and monitor operations in real-time, the suggested system incorporates essential components including the NodeMCU ESP8266, a load control mechanism, a gas sensor (MQ3), and a temperature and humidity sensor (DHT11). If the MQ3 gas detector identifies a gas leak, it will immediately sound an alarm via a buzzer and a GSM-based alert system. By constantly scanning for changes in temperature that may signal potential fire dangers, the DHT11 sensor adds an extra layer of protection. A relay module controls the load mechanism by cutting electricity to avoid additional hazards. Remote monitoring and data transfer across IoT platforms are made possible by the NodeMCU ESP8266, which acts as the central controller. Enhanced safety and control, together with a cost-effective real-time solution, are offered by this integrated system to eliminate dangers associated to LPG.

EMBEDDED SYSTEMS

A computer system that is purpose-built to carry out a single or limited set of tasks, often under the restrictions of real-time computing, is known as an embedded system. As with other physical and mechanical components, it is often integrated into a whole device. A personal computer or other general-purpose computer, on the other hand, may be programmed to do a wide variety of functions. These days, many of the everyday items we use rely on embedded systems to function. Design engineers may improve the embedded system to decrease product size and cost while boosting reliability and performance since it is devoted to certain functions. Because of their mass production, certain embedded systems are able to take advantage of cost savings. From small, handheld gadgets like digital watches and MP3 players to massive, permanently installed systems like those managing nuclear power plants, traffic lights, and industrial controls are all examples of physically embedded systems. From simple systems using a single microcontroller chip to complex systems housing several modules, peripherals, and networks in a massive chassis or enclosure, complexity may range greatly. The phrase "embedded system" lacks a precise definition because the majority of systems have programmability in some form. While they share some components with embedded systems, such operating systems and microprocessors, handheld computers are not technically embedded systems as they enable the loading of multiple programs and the connection of peripherals. Computer hardware and software, either fixed in capability or programmable, particularly intended for a certain sort of application device—this is what's called an embedded system. Embedded systems may be found in a wide variety of objects, including but not limited to: vehicles, medical devices, cameras, home appliances, aircraft, vending machines, toys, and, of course, cellular phones and personal digital assistants. A programming interface is given to programmable embedded devices, and programming for embedded systems is a niche field in and of itself. Embedded Java and Windows XP Embedded are two examples of embedded-specific operating systems and language platforms. On the other hand, certain budget consumer goods include integrated application and operating system components, employ very cheap microprocessors, and have limited storage space. Instead of being loaded into RAM (random access memory), as applications on personal computers are, in this situation the program is written permanently into the system's memory.

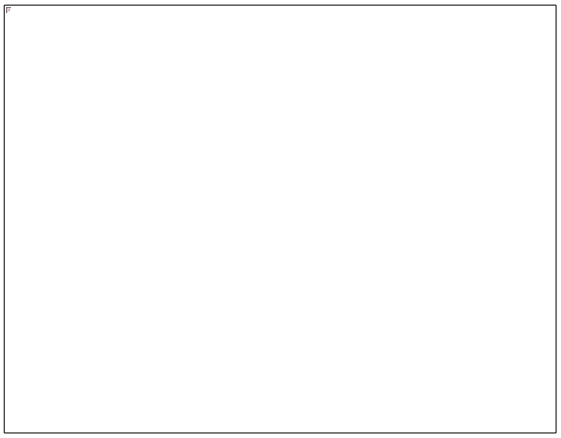
CHARACTERISTIC OF EMBEDDED SYSTEM



APPLICATIONS OF EMBEDDED SYSTEMS

International Journal of Information Technology & Computer Engineering
ISSN 2347–3657
Volume 13, Issue 2, 2025

Here, in the Embedded World, we are living. The smooth operation of the various embedded goods that surround you is crucial to your day-to-day existence. In your living room, you have a TV, radio, and CD player; in your kitchen, you have a washing machine or microwave oven; and at your office, you have card readers, access controllers, and palm devices that let you do a lot. In addition to all of this, your automobile has a plethora of built-in controls that handle functions between the bumpers, most of which you probably don't give a second thought to.



MICROCONTROLLER VERSUS MICROPROCESSOR

When comparing microprocessors and microcontrollers, what are the key differences? Any general-purpose microprocessor, such an 8086, 80286, 80386, 80486, or a Pentium from Intel, or a 680X0 from Motorola, etc., is considered a microprocessor. In addition to lacking on-chip I/O ports, these microprocessors also lack random-access memory (RAM). Because of this, they are often called general-purpose microprocessors. Designing a working system around a general-purpose CPU like the 68040 or Pentium requires the addition of extra components like as RAM, ROM, I/O ports, and timers. Though these systems are more costly and cumbersome due to the inclusion of external RAM, ROM, and I/O ports, they provide the benefit of being versatile in that the designer may choose the quantity of RAM, ROM, and I/O ports required for the work at hand. Microcontrollers are an exception to this rule. On a single chip, you'll find a microprocessor, random access memory (RAM), read/write (ROM), input/output (I/O) ports, and a timer in a microcontroller. So, since the CPU, random access memory (RAM), read/write memory (ROM), input/output (I/O) ports, and timer are all integrated into a single chip, the designer is unable to include any more memory, I/O ports, or timer into the product. Because of its set quantity of on-chip ROM, RAM, and number of I/O ports, microcontrollers are perfect for many applications where space and cost are important considerations. It is not necessary to have a 486 or even an 8086 CPU for many applications; for instance, a TV remote control. Typically, these programs will need some kind of input/output function in order to read signals and toggle bits.

INTRODUCTION

Because gas powers so many modern conveniences, including homes, businesses, and vehicles, gas leaks pose a serious risk. Several deaths and millions of dollars' worth of property damage have been associated with liquefied petroleum gas (LPG) leaks across the globe. Owusu (2014) lists the following locations as sites of tragic explosions that have occurred in Ghana in the past several years: the Valdo estate, the UDS in WA, Ashaiman, Axim, and Kwahu in the Eastern Region, as well as the Nyaniba Health Technicians Training School in Team. The importance of preventing explosions and suffocation due to careless handling of LPG stems from the fact that it is extensively utilized in Ghana. Liquid petroleum gas, or LPG, is made up of the flammable compounds propane and butane. To make the gas detectable to the sense of smell, ethyl Mercaptan is used as an odorant, as these compounds do not naturally have an aroma. The textual pieces of the trajectories are connected to the names of locations and the sorts of points they represent, including museums, restaurants, and other attractions. Semantics2, a collection of linguistic phrases describing the attributes of the trajectories, is standardized. Of course it's not going to work. In the real world, there is a lot of misspelled and ambiguous facts, and that includes the theater and the theatrics. Additionally, the concept of trajectory time alignment—in which the spatial and temporal dimensions are divided—is disregarded in reference [2]. The fact that the two dimensions are related is well-known. Two approximation similarity metrics on trajectories, MMTD and SUMTD, are proposed by us to traverse these limitations. Both measures support the edit distance's approximation of similarity and remove the problem of temporal misalignment with trajectories. Additionally, we explore the connections between textual and spatial-temporal similarities using a real-world dataset. We find weak correlations between spatial-temporal similarities and linguistic similarities. To test how well the two similarity measures—MMTD and SUMTD—work, they are applied to a classic clustering method and the outcomes are shown graphically.

LITERATURE SURVEY

International Journal of Information Technology & Computer Engineering
ISSN 2347–3657
Volume 13, Issue 2, 2025

Building a system that can identify LPG leaks and instantly turn off the supply is the main objective of this study. Another feature is that the gadget has a GSM module that would notify the proper authorities by SMS about the breach, allowing them to probe further. Among the many components that comprise the system are sensors for propane (C3H8) and butane (C4H10), an alarm, a microprocessor, a GSM module, and a gas solenoid valve. In order to conserve money and stop more damage, the system promptly turns off the fuel supply when it detects an LPG leak. Small quantities of butane and propane are among the gases that the device may detect. Our goals are: Here are the project's goals: In an enclosed space (such as a house, car, or factory), this project aims to create a system that can monitor LPG leakage, inform the user when it happens, and turn off the flow of LPG when it does.

EXISTING SYSTEM

Manual intervention, in the form of odor detection or basic alarm-based alerts, is the mainstay of traditional LPG detection and safety systems. Without the ability to be remotely monitored or automated, many older systems rely on individual gas detectors that sound alerts. On top of that, the majority of current systems miss a key component—the ability to detect changes in temperature or humidity—that might trigger an explosion or fire. The inability to automate power load regulation and real-time monitoring is another drawback of traditional installations due to the lack of smart connection. Potential catastrophes can occur in situations where no one is physically present because these systems do not respond quickly enough. Such safeguards are less effective due to a lack of Internet of Things (IoT)-enabled solutions, which restricts user awareness and remote accessibility.

PROPOSED MODEL

By utilizing the MQ3 gas sensor, the suggested smart system for detecting and controlling LPG leaks can accurately measure dangerous gas levels, allowing for prompt notifications and preventative measures. The DHT11 sensor keeps tabs on the weather in real time, picking up on changes in humidity and temperature that might signal a potential fire. There is a load control device in place to reduce the risk of ignite by cutting off power in the event of a gas leak. Processing data from sensors and sending out real-time notifications to users through an IoT platform, the NodeMCU ESP8266 is the main controller. This solution improves security by allowing for remote monitoring using push notifications on mobile devices, which guarantees quick action even when an operator is not physically there. This technology is economical and easy to use since it incorporates Wi-Fi connection, which lets users monitor gas levels and environmental conditions from anywhere.

BLOCK DIAGRAM

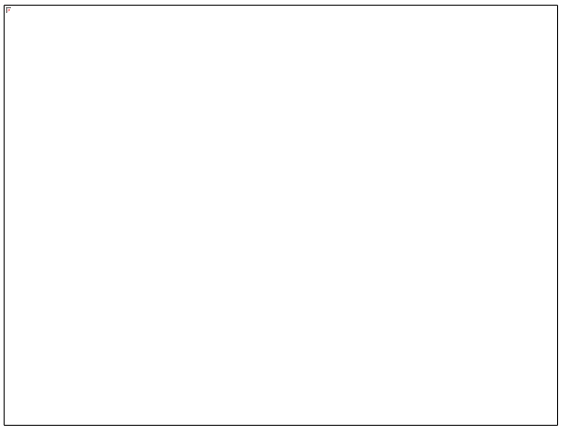


Figure 1: Block Diagram

Microcontroller:

A tiny controller, or microcontroller, as the name implies. Often used as a processing or controlling unit, they are similar to single-chip computers. For instance, microcontrollers that do decoding and other regulating operations are likely integrated into the control you are using. They find further use in vehicles, home appliances, microwaves, toys, and any other area requiring automation.

Arduino Uno Microcontroller:

One such microcontroller board is the Arduino Uno, which uses the Atmega328 (datasheet). It has a 16 MHz crystal oscillator, 6 analogue inputs, 14 digital input/output pins (6 of which may be used as PWM outputs), a power connector, an ICSP header, a reset button, and a USB connection. All you need is a USB cable, an AC-to-DC converter, or a battery to get it going; it comes with everything you need to support the microcontroller.

A key difference between the Uno and all previous boards is the absence of the FTDI USB-to-serial driver chip. Rather of that, it has an Atmega8U2 that has been configured to convert USB to serial. To celebrate the impending release of Arduino 1.0, the name "Uno"—which means "One" in Italian—has been chosen. The Uno and Arduino version 1.0 will serve as the foundational versions for future Arduino releases. For a comparison with prior generations, see the index of Arduino boards. The Uno is the newest in a series of USB Arduino

International Journal of Information Technology & Computer Engineering
ISSN 2347–3657
Volume 13, Issue 2, 2025

boards and the standard model for the Arduino platform.

ARDUINO UNO BOARD:

One board that uses the Atmega328 microprocessor is the Arduino Uno. A 16 MHz ceramic resonator, 6 analog inputs, 14 digital I/O pins (including 6 PWM outputs), 1 USB port, 1 power connector, 1 ICSP header, and 1 reset button are all part of it. All you need is a USB cable, an AC-to-DC converter, or a battery to get it going; it comes with everything you need to support the microcontroller.

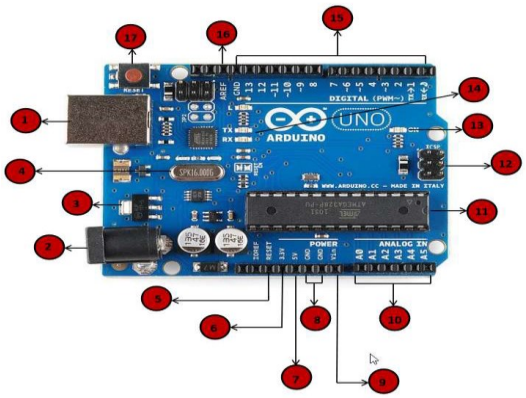


Figure 2: Arduino uno board

In contrast to all of its predecessors, the Uno does not have the FTDI USB-to-serial driver chip. As an alternative, it makes use of USB-to-serial converters coded into the Atmega16U2 (Atmega8U2 up to version R2).

HARDWARE COMPONENTS

POWER SUPPLY UNIT

The power supply for this system is shown below.

Figure 3: power supply

Diodes:

Only one path of electrical current may pass through a diode. Current may flow in either direction, as shown by the arrow in the circuit symbol. Originally termed valves, diodes are essentially an electrically enhanced version of the mechanical component.

Figure 4: Diode Symbol

One kind of electrical component that restricts current flow is the diode. A voltage loss of around 0.7V will be the sole influence on the signal when the diode is "forward-biased" in this way. No current will flow through a diode that is "reverse-biased" when the current is applied in the other direction.

Rectifier

A rectifier's job is to change the phase of an alternating current (AC) waveform so that it appears as a direct current (DC) waveform. Both "half-wave" and "full-wave" rectifiers are used for rectification. Diodes are used in both devices to convert AC current into DC current. The Half-Wave Resettable The graphic shows that the half-wave rectifier is the simplest rectifier type since it only employs one diode.

Figure 5: Half Wave Rectifier

LIQUID CRYSTAL DISPLAY

International Journal of Information Technology & Computer Engineering
ISSN 2347–3657
Volume 13, Issue 2, 2025

An array of color or monochrome pixels arranged in front of a light source or reflector makes up a liquid crystal display (LCD), a thin, flat display device. Two polarizing filters, with their polarity axes perpendicular to one other, and a column of liquid crystal molecules hanging between two transparent electrodes make up each pixel. Light would not be able to travel through them if the liquid crystals weren't interposed. To make light flow through two filters, the liquid crystal changes the polarization of the light entering the first filter.
A program's ability to communicate with the outside world depends on its input and output devices, which in turn rely on human communication. An LCD display is a typical accessory for controllers. 16X1, 16x2, and 20x2 LCDs are among the most popular types of displays that are often linked to the controllers. Which works out to sixteen characters on a single line. The first set has 16 characters on each line while the second set has 20 characters on each line. The use of "smart LCD" displays allows for the visual output of information by many microcontroller devices. Affordable, user-friendly, and capable of producing a readout utilizing the display's 5X7 dots plus cursor, LCD displays built on the LCD NT-C1611 module are a great choice. They use mathematical symbols and the usual ASCII set of characters. The display needs a +5V power and 10 I/O lines (RS, RW, D7, D6, D5, D4, D3, D2, D1, D0) for an 8-bit data bus. The only additional lines needed for a 4-bit data bus are the supply lines and six more (RS, RW, D7, D6, D5, D4). The data lines are tri-state and do not affect the microcontroller's function when the LCD display is disabled.

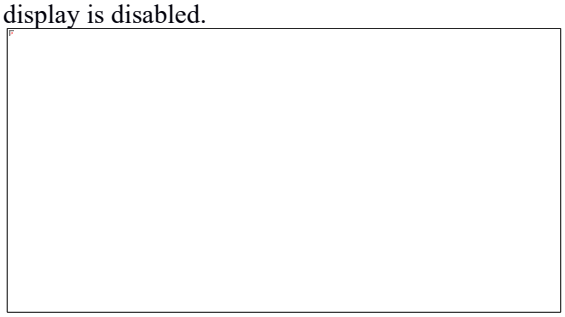
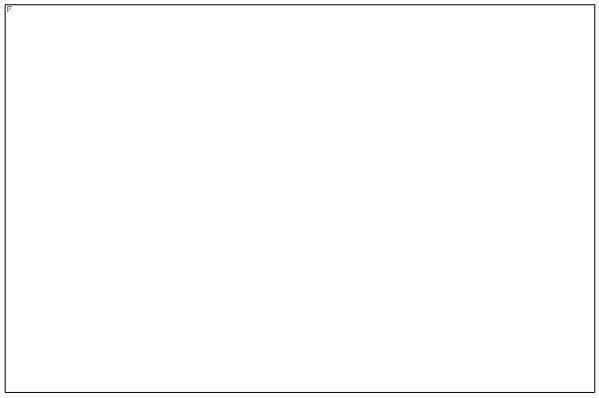


Figure 6: 2x16 LCD Display

BUZZER

In a magnetic transducer, the circuitry includes an iron core, a yoke plate, a wound coil, a permanent magnet, and a vibrating diaphragm that can be moved. The magnet's field gently draws the diaphragm up nearer the core's surface. A positive alternating current (AC) signal causes the diaphragm to move up and down, which in turn vibrates the air. This is achieved by the current passing through the excitation coil, which forms a fluctuating magnetic field. A resonator, which is composed of a cavity and one or more sound holes, may amplify vibrations in order to generate a loud sound.



ESP8266 Wi-Fi Module

This project revolves on this. Because the project relies on WIFI control of appliances, the module is a crucial part of it.
One remarkable feature of this tiny board is the integrated MCU (Micro Controller Unit), which allows for the control of I/O digital pins via a simple programming language that is almost pseudo-code like. Another benefit is that the ESP8266 Arduino compatible module is a low-cost Wi-Fi chip with full TCP/IP capability. The Chinese company Es press if Systems is situated in Shanghai and makes this gadget.
In August 2014, this chip made its debut in the ESP-01 version module manufactured by the third-party company AIThinker. The MCU can establish basic TCP/IP connections and connect to WiFi networks with the help of this little module. He was His tiny size and cheap pricing (1.7–3.5$) enticed a lot of hackers and geeks to look into it and utilize it for all sorts of projects. Because of its enormous success, Espressif now offers a wide variety of models with varying size and technological specs. Its replacement includes ESP32.

RELAYS:

Industrial controls, automotive systems, and home appliances all make extensive use of electrically controlled switches called relays.
By using a relay, two independent voltage sources may be isolated from one another; in other words, a little quantity of voltage or current on one side can manage a big amount of current or voltage on the other side, and vice versa.

International Journal of Information Technology & Computer Engineering
ISSN 2347–3657
Volume 13, Issue 2, 2025

Inductor

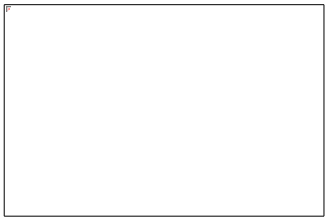


Fig7 : Circuit symbol of a relay

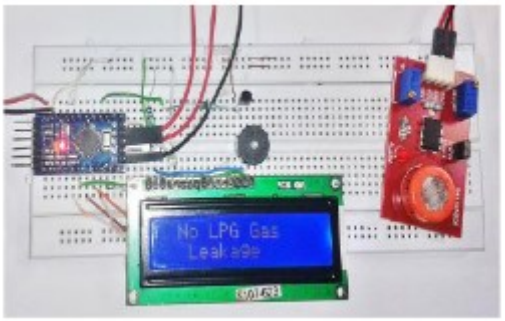
DRIVING A RELAY:

Two of the SPDT relay's five pins are used by the magnetic coil, one serves as the common terminal, and the other two are typically closed and normally connected. The coil is activated when a current passes across it. At the beginning, when the coil is deenergized, the usually closed pin and common terminal will be connected. A new connection will be formed between the common terminal and usually open pin when the coil is activated, breaking this connection. Therefore, the relay will be activated whenever the microcontroller sends an input signal to it. You may drive the loads connected between the common terminal and typically open pin while the relay is on. Consequently, the high-current loads are driven by the relay, which receives 5V from the microcontroller. This means the relay may be used as a means of isolation. The microcontroller and digital systems do not have enough current to operate the relay. In contrast to the 10 milliamps required to activate the relay's coil, the microcontroller's pin can only provide 1 or 2 milliamps. This is why the microcontroller and the relay are separated by a driver, like ULN2003, or a power transistor. By connecting ULN2003 to the relay and microcontroller, it is possible to activate many relays simultaneously.

SOFTWARES

The Arduino platform is an open-source, user-friendly hardware and software environment for prototyping. It is comprised of a programmable circuit board (also called a microcontroller) and an Integrated Development Environment (IDE) called Arduino that is pre-made for writing and uploading code to the physical board. The main characteristics are:
• Many sensors can send signals in digital or analog formats to Arduino boards, which may then be used to activate motors, control LEDs, establish connections to the cloud, and much more.
• The Arduino IDE (also called "uploading software") allows you to command your board's operations by communicating with the microcontroller on the board.
• A separate device, known as a programmer, is not required to load fresh code into an Arduino board, in contrast to most prior programmable circuit boards. The usage of a USB connection is all that is required. • The Arduino IDE employs a streamlined version of C++, which facilitates programming learning. Last but not least, Arduino offers a standardized form factor that simplifies the microcontroller's tasks.
Now that we know what the Arduino UNO board is and how it works, we can go on to setting up the Arduino IDE. As soon as we figure this out, we can upload our software to the Arduino board.

RESULTS:



CONCLUSION

Home and business safety are both greatly improved by installing an intelligent, Internet of Things (IoT)-enabled LPG leakage detection and safety system. The system guarantees real-time monitoring, automatic reactions, and remote access by combining the following components: NodeMCU ESP8266, MQ3 gas sensor, DHT11 temperature and humidity sensor, and load control mechanism. There will be fewer fires and gas leaks if people can remotely turn off electricity loads and get alerts immediately. This method is perfect for contemporary smart homes and industries since it is both cost-effective and scalable. When it comes to LPG leaks, the suggested solution offers more control and automation and is a proactive safety step that greatly decreases the hazards involved.

REFERENCES

1. Asmit a Varma, Prabhakar S, Kayalvizhi Jayavel. “Gas Leakage Det ectionand Smart Alert ing and Predict ion Using IoT." Internet of Things andApplicat ions (IOTA), International Conference on. IEEE, 2022.

2. At t ia, Hussain A., and Halah Y. Ali. "Elect ronic Design of LiquefiedPetroleum Gas Leakage Monitoring, Alarm, and Protection System Based

onDiscrete Components." International Journal of Applied EngineeringResearch, vol. 11, no. 19, pp. 9721-9726, 2020.

3. Ashish Shrivastava, Ratnesh Prabhakar, Rajeev Kumar and Rahul Verma“ Gsm Based Gas Leakage Det ect ion Syst em." Int ernational Journal OfTechnical Research AndApplicat ions EISSN: 2320-8163.

4. Babuprasanth.V. “ Cloud Connect ed Smart Gas Leakage Det ect ion AndSafetyPrecaut ion System" International Journal of MC Square Scient ificResearch Vol.6, No.1 Nov 2018.

5. Chet Sandber, Jim Holmes, Ken Mccoy, And Heinrich Koppit sch “ ThemApplicat ion of a Continuous Leak Detect ion System To Pipelines AndAssociated Equipment." Ieee Transactions OnIndustry Applications, Vol. 25,No. 5, September-October 198.Claro, M.; Santos, L.; Silva, W.; Araújo, F.;Moura, N.; Macedo, A. Automat ic glaucoma detect ion based on opt icdiscsegmentation and texture feature extraction. CLEI Elect ron. J. 2016, 19, 5.

6. Kumar Keshamoni and Sabbani Hemanth. "Smart Gas Level Monitoring,Booking& Gas Leakage Detector over IoT " International AdvanceComputing Conference IEEE, 2017.31

7. Mahalingam, A., R. T. Naayagi, and N. E. Mastorakis. "Design andimplementation of an economic gas leakage detector." Recent Researches inApplicat ions of Elect rical and Computer Engineering, pp. 20-24, 2016.

8. Mohammad Reza Akhondi, Alex Talevski, Simon Carlsen, St ingPetersen.“ Applications of Wireless Sensor Networks in t he Oil, Gas and ResourcesIndustries." International Conference on Advanced Informat ion NetworkingandApplicat ions, IEEE 2015.