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IoT Based Gas Leakage Detection and Alarming System using Blynk platforms

Noor Kareem Jumaa*, Younus Mohammed Abdulkhaleq, Muntadher Asaad Nadhim, Tariq Aziz Abbas
Al-Mansour University College, Computer Technology Eng. Dept., Baghdad, Iraq

Correspondence
*Noor Kareem Jumaa
Al-Mansour University College,
Computer Technology Eng. Dept., Baghdad, Iraq
Email: noor.jumaa@muc.edu.iq

Abstract
Gas or liquefied petroleum gas (LPG) is a chemical substance resultant from petroleum and could be dangerous in industrial places or those that deal with this substance. Gas leakage causes many health issues. So, to prevent such catastrophes and in order to maintain a clean air environment, the workspace atmosphere should be frequently monitored and controlled. The proposed monitoring gas leakage detector system is based on Internet of Things (IoT) technology. NodeMCU ESP8266 Wi-Fi is used to be the microcontroller for the whole system. The combustible gas sensor (MQ2) is used in order to detect the presence of methane (CH4) and carbon monoxide gas (CO). MQ2 sensor will detect the concentration of the gas according to the voltage output of the sensor and the ESP8266 will send the data reading from the gas sensor to Blynk IoT platform over an IOS phone; data visualization is done using Thingspeak IoT Platform. Besides, a fan will immediately work upon the leakage occurs along with an alarming buzzer.

KEYWORDS: IoT, Gas leakage, Blynk platform, Thingspeak, LPG, Alarm system.

I. INTRODUCTION

One of the very important things in human life is safety. Safety refers to the awareness of risks and potential dangers in and around human locations, which may cause bodily harm or even death. There are several kinds of risks and potential dangers which threaten the safety of many houses and lives. One of the risks and potential dangers is the gas leak that may affect serious damage in the place where the person is. [1]

Liquefied Petroleum Gas (LPG) was first discovered in 1910 by the scientist Dr. Walter Snelling which is a mixture of commercial gases such as propane and butane with saturated and unsaturated hydrocarbons Due to the usefulness of LPG, it is widely employed for many purposes such as industrial and domestic fuel, auto gas, heating, lighting, etc. The wide demand for LPG leakage is growing day by day. However, when LPG is leaked, it may cause serious fire accidents. Also, the number of casualties due to such incidents is also on the rise in recent years. Therefore, there is the purpose for a system to find and also prevent the leakage of LPG. Before the invention of electronic gas detectors for households in the 1980s, they were detected by a chemical dipped paper that changed its color in the presence of those gases. But then, many inventions were discovered to find, monitor, and alert the spillage of dangerous gases [2].

LPG consists of a mixture of propane and butane which is a highly flammable chemical. It is an odorless gas due to which Ethanethoil is added as a powerful odorant, so that leakage can be easily detected. LPG Gas leaks have increased from 0.72% to 10.74% of all kitchen accidents. The small LPG cylinder of weight 5kg in which the burner is located immediately over the cylinder without using a rubber tube is seen to be safer than the one which uses a rubber pipe as this subway has the hazards of getting cracked which in turn can make way to leakage [3].

In this research, a computer program running online was created to detect leakage locations and act as an automatic supervisor in remote areas; simple gas leak detector is a simple device that is used to detect the leakage of gas and if the gas leak occurs, an equivalent message is conveyed by the means of a buzzer and powered by Wi-Fi, it is capable to broadcast messages to the stakeholders about the LPG leak through the Blynk application which is based on the IoT technology; where -IoT is defined as a system that permits the devices for communicating with each other directly without human intervention [4]-. The proposed system will continuously monitor the environment for any leakage. Just in case of any leakage detection, it'll alert the user via a buzzer and by using the ESP2866 wifi microcontroller and an IOS IoT application; it'll alert the user about the environmental conditions to the gas level of that location of

installation using Blynk (as mentioned previously) notification. Thingspeak IoT platform is used for data visualization to illustrate the gas level variety which performs the gas sensor readings.

II. Literature Survey

In [1], a gas leakage detection system was developed to warn the human from the gas toxic; the warning is a Short Message Service (SMS) goes to the corresponding person's cellphone using Arduino UNO and SIM900 GSM/GPRS gateway.

In [2], the researcher designed a gas detection leakage they proposed that if any leakage is sensed through the gas sensor, a SMS will be sent automatically to the corresponding persons or family member using GSM. Their system has an added function to measure the weight of the LPG cylinder and displayed on the LCD display. If the quantity of the gas cylinder is less or equal to10kg, it will automatically book the LPG cylinder by sending an SMS to the dealer. Also when the weight of the LPG cylinder comes down to 0.5 Kg, it alerts the persons in the house by SMS to change the cylinder.

In [5], the author had developed a system capable of measuring the amount of gases in ppm and percentage to save the human body from the various toxic gases and hazardous elements or chemicals or compound consisting in the atmosphere. In his proposed system, he used Arduino Uno R3, nRF24L01Plus Wireless Transceiver Module, and the MQ2 gas sensor and the results was monitoring at the receiver side using Arduino IDE serial monitoring.

In [6], the author proposed an IoT based gas detection prototype using Proteus design suite. He depends the Blink IoT platform for data visualization. He concludes the system said that the proposed technique wirelessly transfers alert notification to the user and therefore the user can easily connect the devices through a Smartphone from any location.

III. Gas Leakage Detection Techniques [7, 8]

There are several different techniques to design a gas leakage detector, the most popular techniques are as follows:

a) **Robots-based gas leakage detector**: it is an automatic gas detection and indication robot. The prototype depicts a mini mobile robot that is capable to detect gas leakage in hazardous places. Whenever a gas leakage occurs in a particular place, the robot directly reads the data and sends it to the android mobile via a wireless connection such as Bluetooth. An android application for Android-based smartphones could be used, which can receive data from robots directly through Bluetooth. The application warns with an indication whenever there is an occurrence of gas leakage. Fig. (1) illustrates this prototype.

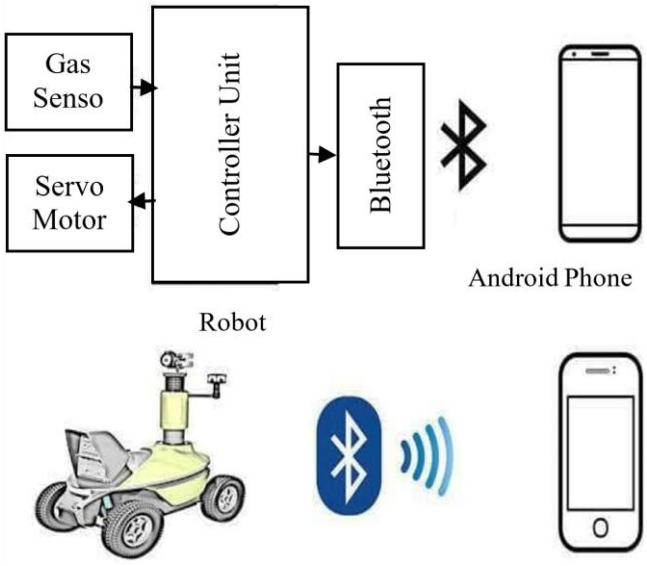

Fig. 1: Robot-based gas leakage detector.

b) **GSM-based gas leakage detector:** an LPG gas sensor is used for sensing the leakage and produce the result in Short Message Service (SMS) with help of Arduino Uno to alert humans. The sensor has excellent sensitivity combined with a quick requital time and also sense iso-butane, propane, Fig. (2) shows the prototype of GSM based gas leaks detector.

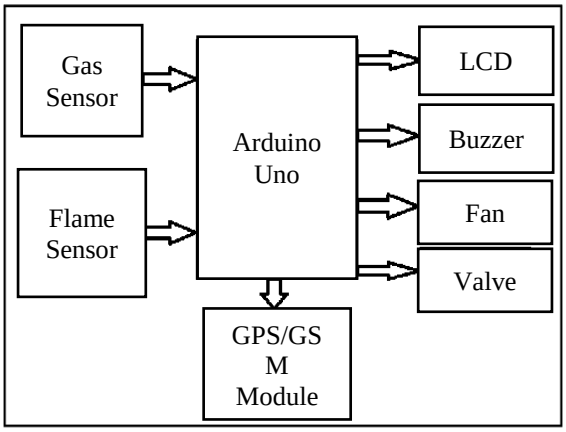

Fig. 2: Robot-based gas leakage detector.

c) **IoT-based gas leakage detector:** in this type of gas leak detection, ESP2866 nodeMCU is usually used as a microcontroller and a wifi module.
This system records the value of the LPG leak level on an IoT platform –which could be a cloud platform of application platform- and the awareness message is sent to the smartphone through the wifi on an IoT application such as Blynk IoT application. Fig. (3) illustrates this prototype.

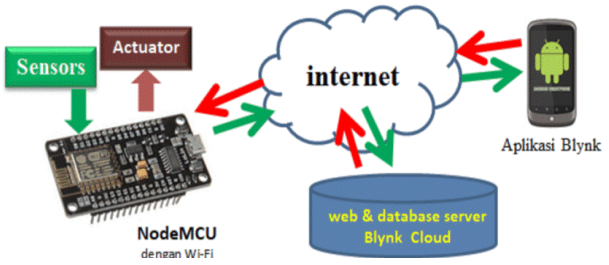

Fig. 3: IoT-based gas leakage detector.

IV. Proposed System Components

In this research, the hardware components (Gas Sensor MQ-2, Wi-Fi Node MCU ESP8266, Fan, Power Supply 9V, Buzzer, Relay, Buttery 3.3v to 5v, red LED and green LED, Transistor B514, Breadboard, 200 ohms resistors) were used along with Blynk Application.

The following subsections describe the details of the proposed system. Table (1) below review the components, their quantity, and price in IQD.

TABLE 1
List of required hardware opponents, quantity and price in IQD.

Component	Quantity	Price
ESP8266 nodemcu	1	13000
MQ2 gas sensor	1	5000
T09D060-2D1 power supply	1	8000
92*92*25mm fan	1	3000
Buzzer	1	1000
Normally-open relay	1	2000
9 volts battery	1	3000
Bread board	1	3000
LEDs	2	1000
Transistor	1	2000
Resistor	1	250
Wires	16	3000

V. Methodology

When a gas leak occurs, which is detected by a gas sensor MQ-2, it will send data to the controller (ESP8266) via the controller analog port (A0) as illustrated in Fig. (4). Then the controller (ESP8266) will send a warning text message alerting the occurrence of a gas leak via (Wi-Fi) technology in conjunction with Blynk Application which works on Android and IOS operating systems, the proposed system used IOS Blynk App. At the same time, the buzzer will be on for an alarming, by connecting it to the microcontroller digital port (D5), and the fan will be working to change the air of the place and get rid of leaking gas. A transistor works in the form of a switch that turning on and off low loads, when the circuit is closed -while the red LED is on- the relay is turning on and off the high loads, where the high load performs the fan. The flowchart of the proposed system is shown in Fig. (5).

VI. Working Principles

Following subsections describe the working principles of the proposed system's parts.

a) Blynk Platform

The Internet of Things (IoT) connects devices and tools to the internet network to be controlled remotely through websites and smartphone applications, as well as to control tools and instruments by means of codes and algorithms structures for artificial intelligence issues. IoT is used for smart home controlling to operate lamps or other home-use devices, it can also be used as a security system or as an industrial-use system. For example, to open or close the main building gate, to operate a fully automatic industrial machine, or even to control internet and communication ports. More ideas can be done using IoT technology. Huge industrial facilities or governmental institutions have many lamps. Employees sometimes forget to turn them off at the end of the day. Energy could be saved by letting the security control lighting of the building with IoT clouds or applications.

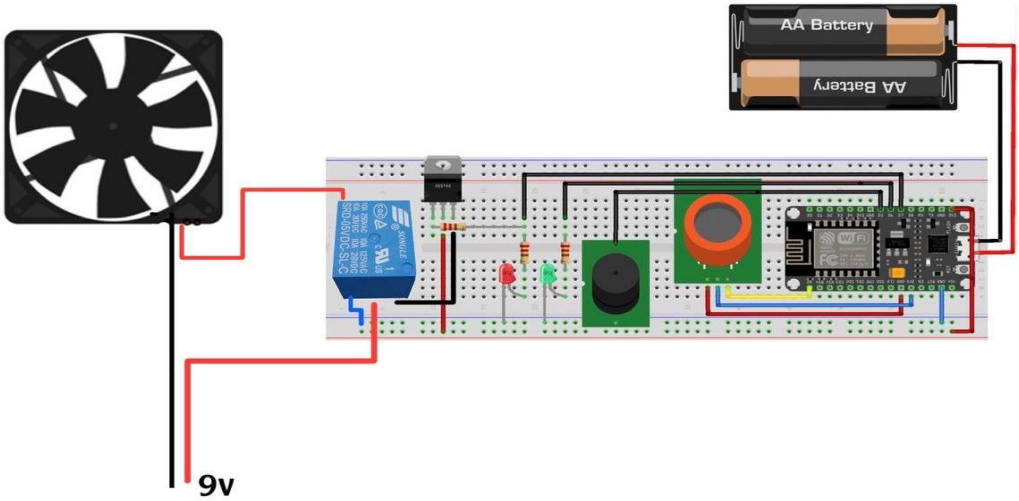

Fig. 4: Circuit Diagram of the Proposed System.

Blynk is an IoT platform that supports both IOS and Android while being compatible with a plethora of microcontrollers such as Node MCU (ESP), STM32, Arduino and Raspberry Pi over the Internet. The architecture of Blynk consists of three major components: [9]

1) The Blynk application, which controls an embedded system and displays sensing data on widgets.

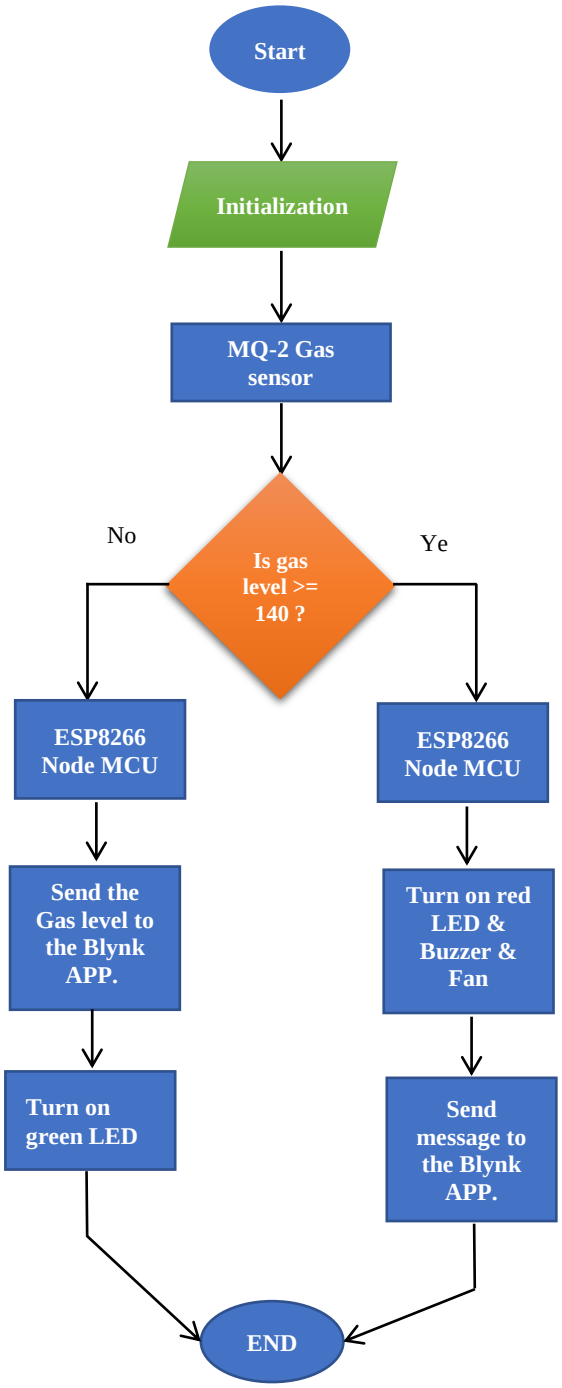

Fig. 5: The Flowchart of the Proposed System.

2) The Blynk server, which allows all cloud-based communications between smartphones and embedded systems.

3) The Blynk libraries, which consist of various widgets to perform different control, display, and time management operations.

b) Proposed System Operations

This system contains two power sources. The first source is a power Supply T09D060-2D1, which is a transformer that converts high voltage 220v to low voltage 9v and feeds the fan. The second source is a battery rechargeable (3.3v-5v) that feeds the controller (Wi-Fi Node MCU ESP8266) as well as the rest of the circuit elements.

The controller ports must be connected to the sensor as follows:

(Vcc → 3.3v , GND → GND , A0 → A0) also (D5 → +buzzer , D6 → + green LED , D7 → +red LED)

The relay is also connected to the transistor and the fan, as shown in Fig. (6) below:

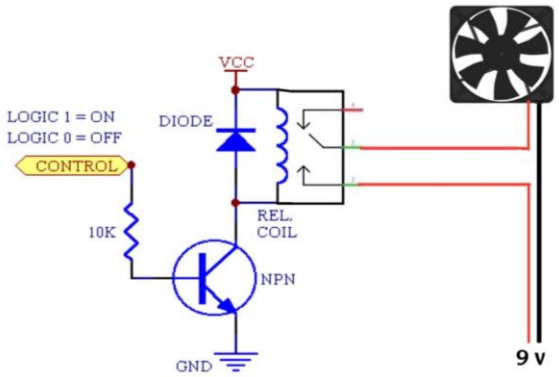

Fig. 6: Relay Connections.

VII. Real Time Prototype

As mentioned in previous sections, this system is built based on the controller (ESP8266) with the gas sensor (MQ-2), as shown in the real pictures illustrated in Fig. (7). In the event of gas leakage, the sensor will send a signal to the controller, through Wi-Fi technology, the controller will send a warning text message of the presence of gas leakage using the Blynk application available on the mobile phone system. In this system, an IoS mobile phone is used. The fan and the red light will also work.

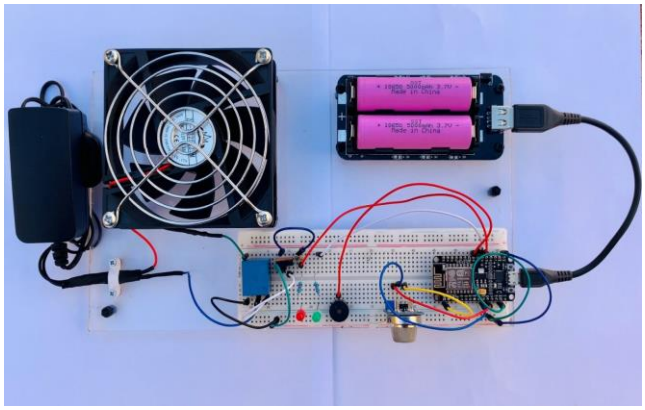

Fig. 7: Real-Time Prototype of the Proposed System.

VIII. BLYNK'S IOT PLATFORM RESULTS

When a gas leak occurs, a message warning of the presence of leaked gas will be sent to the mobile phone interface as shown in Fig. (8) below which clarifies the Blynk app. notification.

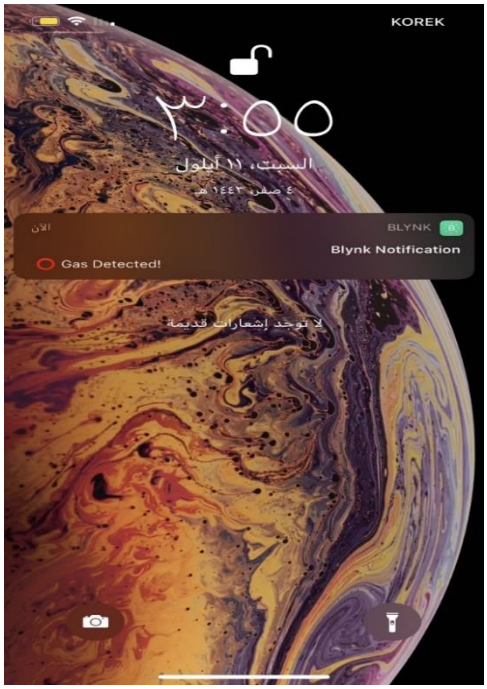

Fig. 8: Blynk app notification.

Fig. (9) illustrates a Blynk warning message of gas leakage case, the amount of gas which is the gas sensor reading can be seen. For example, the gas level was (192), which exceeded the threshold limit (140). While Fig. (10) illustrates the value of the data sensor reading (75) which does not exceed the threshold limit (140), so it represents the normal condition of the system in terms of no gas leakage.

It should be mentioned that the system status is based on the following table.

TABLE 2
Threshold of Gas Detection.

MQ2 Sensor Reading	Status
< 140	No gas leakage
≥ 140	Gas leakage detected

IoT Thingspeak platform is used to record the readings of the MQ2 gas sensor. Fig. (11) views the readings that performs the LPG intensity in the gas leakage location.

Fig. (12) shows the details of 'Field1' from 8 fields available in the Thingspeak's channel. The starting of the leakage is also illustrated in the figure.

From Fig. (12), starting of the gas leakage is clear in the details of the Thingspeak's field1 where the gas sensor reading was 141 which presents the gas intensity in the atmosphere with 14.1%.

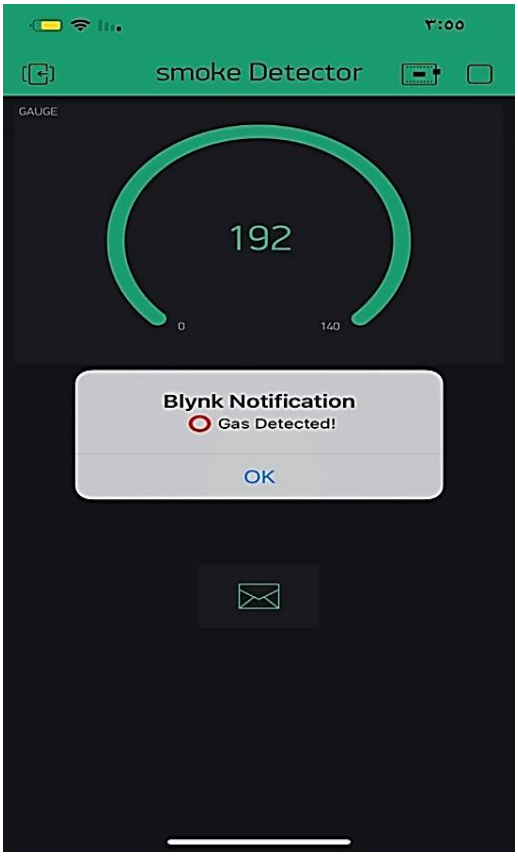

Fig. 9: Blynk app notification for gas leakage case.

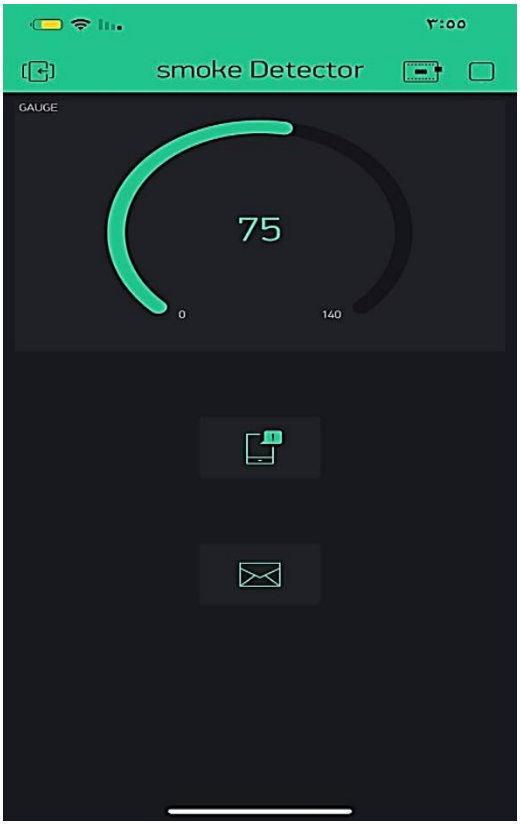

Fig. 10: Blynk app notification for no gas leakage case.

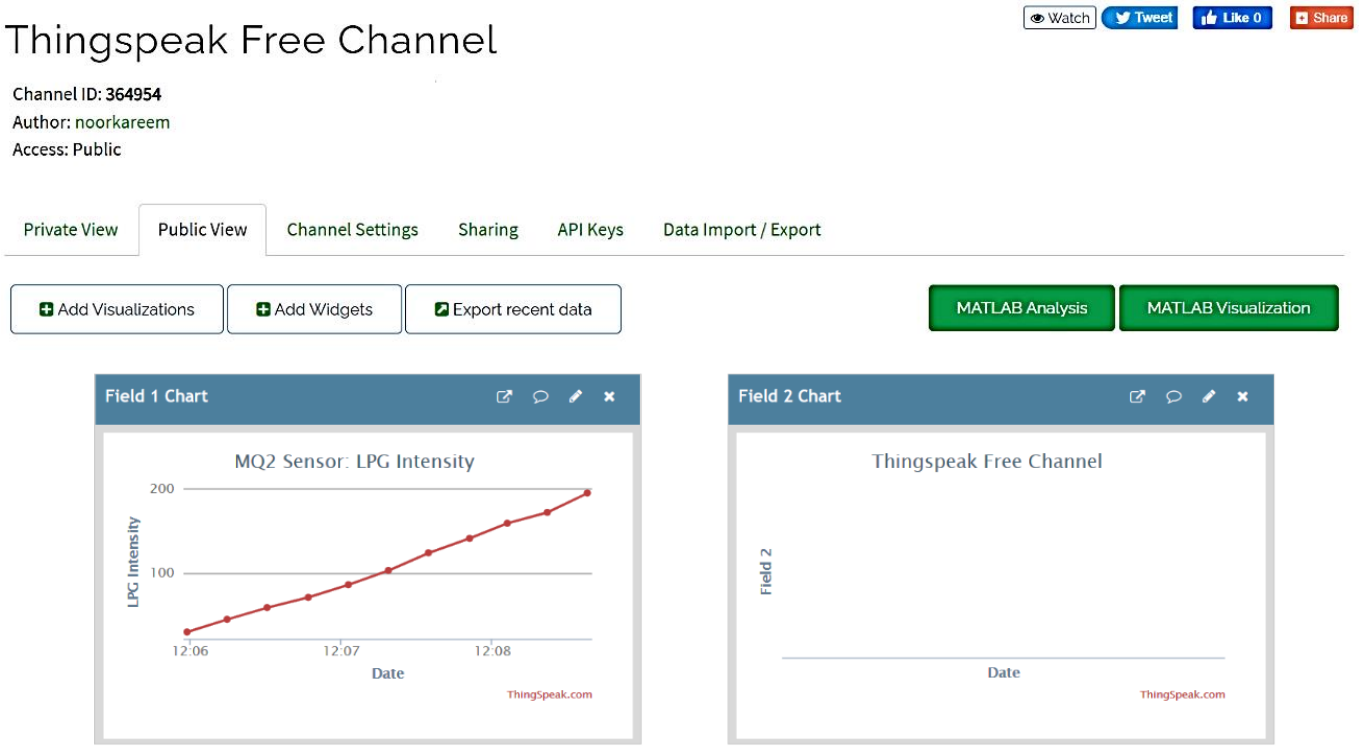

Fig. 11: Thingspeak IoT platform visualization for gas sensor readings.

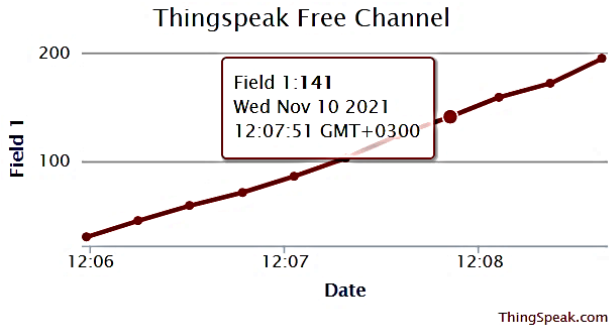

Fig. 12: Thingspeak's channel1/field1 visualization for gas sensor readings.

IX. Conclusions

In this research, an IoT approach for gas leakage detection system at a low concentration is described. The leakage is detected using the MQ-2 gas sensor. The sensor sends a signal to ESP2866 NodeMCU microcontroller. In the next step, microcontroller sends an active signal to other externally connected device which performs a cellphone.

The efficiency of the NodeMCU is proven through sending multiple messages to the Blynk application that could be a message per second, which is faster than other IoT platforms, for example, the Thingspeak IoT platform sends message each 15 seconds which is used for recording the readings of the gas sensor. The number of warning messages sent could be set by changing the programming of the NodeMCU. This easy control over the devices like exhaust fan makes the environment less accident- prone. Using the NodeMCU microcontroller also makes the system cheaper. Quick access and control makes the system very useful.

In addition, this paper presents a gas leakage detection system using two IoT platforms; Blynk IoT application to alarm the regarding person and the Thingspeak IoT cloud for data recording and visualization.

Conflict of Interest

The authors have no conflict of relevant interest to this article.

References

[1] Marchel Thimoty Tombeng, "Prototype of Gas Leak Detector System Using Microcontroller and SMS Gateway", *Cogito Smart Journal*, Vol. 3, No. 1, 2017.

[2] T. Alex Stanley Raja, R. Senthil Kumar, A. Nandhakumar, and K. V. Santhosh Kumar, "LPG Leakage Detection and Autorefilling Using Arduino", *International Journal of Engineering and Advanced Technology*, Vol. 8, Issue 2S, 2018.

[3] Vasudev Yadav, Akhilesh Shukla, Sofiya Bandra, Vipin Kumar, Ubais Ansari, and Suraj Khanna, "A Review on Microcontroller based LPG Gas Leakage Detector", *Journal of VLSI Design and Signal Processing*, Vol. 2, Issue 3, 2016.

[4] Noor Kareem Jumaa, "Survey: Internet of Thing Using FPGA", *Iraqi Journal for Electrical and Electronic Engineering*, Vol. 13, Issue 1, 2017.

[5] Mobasshir Mahbub, "Toxic and hazardous gas detection, measurement and monitoring system for safety assurance in home and industrial application of wireless

sensor node", *Engineering and Technology Research*, Vol. 1, No. 3, 2019.

[6] Guru rama gayathri and Yoga ananth, "IoT BASED GAS MONITORING SYSTEM USING ARDUINO", *International Research Journal of Engineering and Technology*, Vol. 7, Issue 4, 2020.

[7] Prof. Parag Naik, Pranay Dhopte, Rajat Wanode, Roheet Kantode, and Saurabh Nagre, "Gas Sensor Using Arduino UNO & MQ2 Sensor", *International Journal of Advanced Research in Computer and Communication Engineering*, Vol. 7, Issue 3, 2018.

[8] Syeda Bushra Shahewaz and Ch. Rajendra Prasad, "Gas leakage detection and alerting system using Arduino Uno", *Global Journal of Engineering and Technology Advances*, Vol. 05, No. 03, 2020.

[9] http://www.blynk.cc/