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IOT-BASED MONITORING SYSTEM FOR THE DETECTION OF FIRE AND GAS LEAKS

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Abstract: *The fast rise in infrastructure and industrial facilities is causing environmental problems such as increased pollution and a changing climate, as well as malfunctioning equipment. It has significant repercussions for the need of operationally adaptive monitoring systems that are also efficient, effective, and affordable. Because of this, we came up with the concept of using this kind of technology, which we will refer to as the Internet of Things (IoT), in the form of a solution. In this paper, we suggest wireless data gathering frameworks that enable each detector node to track changes in the behavioural pattern of gases and to identify their role in the problem of gas leakage, while at the same time attempting to minimise power consumption. These frameworks can be found in the appendix of the paper. The temperature detector (DHT 11), the gas detector (MQ2, MQ7, and MQ135), and also humidity sensors are employed in the suggested device to identify the environment and the undesired gas that is present inside the manufacturing facility. The gauged details may be linked to the internet. In addition, the results of our study indicated a significant improvement in energy economy as well as high-precision data processing in comparison to more traditional ways for protective device implementation. In this scenario, the sensing devices are linked to the embedded computer system in order to monitor the deviation of parameters such as levels of air pollution from their typical values.*

Keywords: high-precision data processing, DHT 11, Internet of Things

I. INTRODUCTION

What does the acronym or short form for liquefied oil and gas mean? It is "FIRE AND GAS." It is a non-renewable source of energy, much like the rest of the fossil fuels. It is derived by

ISSN: 2057-5688

the burning of fossil fuels like oil and gas. The majority of the elements that make up fire and gas are hydrocarbons with either three or four carbon atoms in their structures. Gas (ClHa) and alkane are the traditional components of the FIRE AND GAS formula (CaHro). Depending on the origin of the FIRE AND GAS and the process by which it was produced, components other than hydrocarbons may also be present in trace amounts. These components might be present in either very small quantities or very large concentrations. Because FIRE AND GAS is highly flammable, it must be kept away from potential sources of fire and inside of a place that has enough ventilation in order to ensure that any runoff will disperse in a secure manner. Because FIRE AND GAS vapours are heavier than air, care should be taken during storage to ensure that any run won't fall to the bottom and find accumulation in an area that is low lying and difficult to disperse. In its natural condition, FIRE AND GAS consists mostly of gas and alkane and lacks any discernible odour. The odour that we are most likely to detect if there is a run is really emanating from a completely other component, which is known as the alkyl radical Mercaptan. After passing through the majority of storage terminals, this material is added to the gas that is being transported [1]. The primary objective of the paper is to provide a warning message to the people in the nearby region as well as identify gas leaks in homes, hotels, schools, and other domestic settings. These days, gas sensors are being employed all over the world in fields such as safety, health, instrumentation, and other similar areas. Using a MQ-5 gas sensor and a DHT11 temperature sensor, this article presents an implementation of the same concept. The MQ5 sensor is used on a regular basis for the purpose of detecting gas leaks for a variety of applications, and the DHTIL is utilised for the purpose of measuring the temperature and humidity of the environment in which it is located. An LCD display on the gadget also continues to provide information on the quantity of leakage, as well as humidity and temperature. The MQ6 gas sensor is capable of determining the concentration of the gas in ppm and outputting an analogous value. This value may then be converted into a digital signal by utilising the Analog to Digital Convertor that is integrated directly into the Arduino board. The user has the ability to select the low, medium, and hazardous levels for leakage based on the same digital measure that is used throughout the paper. The intensity values are compared with two different thresholds that have been specified, and depending on the results of that comparison, it categorises it into three distinct classes of leakage concentration [2].

ISSN: 2057-5688

In India, around 89 percent of households utilise fire and gas cylinders for cooking and heating. The gasoline leakage detecting system has been built to fulfil all of the criteria that were specified. An alarm system is provided by the existing buildings, and its primary purpose is to detect gas leaks in residential and commercial properties. The purpose of the proposed machine is to constantly measure the weight of the cylinder, and as soon as it exceeds the minimum threshold, it will automatically send an SMS alert to the customer as well as an Authorized FIRE AND GAS agent so that they may take the appropriate action. This apparatus was furthermore built to produce FIRE AND GAS gases like propane and butane. The maximum amount of butane that may be present is 600 ppm; anything beyond that is considered to be at an unsafe level and might be harmful. In automated cylinder booking, the weight of the cylinder at the threshold step is employed as a determining factor. In addition to facilitating safety precautions in areas where they have been a significant challenge and automated cylinder reserving except for human intervention, the primary objective of this project is to screen for leakage of liquid petroleum gasoline (FIRE AND GAS) in order to prevent primary fire accidents. The leaking of FIRE AND GAS is detected by the device with the use of a gasoline sensor, and the client is informed about the fuel leakage via the sending of SMS messages. The device makes use of a weight sensor in order to determine the weight of the cylinder and then displays the relevant weight in the FIRE AND GAS display. The suggested apparatus makes use of a GSM Modem to warn a person about a gas leak through text message and to provide automatic cylinder booking. This is done in conjunction with the reputation system. When the machine detects that the amount of fire and gas in the air has reached the predetermined level, it notifies the buyer by sending an SMS to the registered cellular Smartphone, and it also notifies the humans at home by activating the alarm that includes Buzzer concurrently. This is done so that they can take the necessary steps, such as turning on the exhaust fan or opening the windows, in order to reduce the amount of fire and gas in the air.

II. LITERATURE SURVEY

The Raspberry Pi is used in the role of base station throughout the article [1. The MQ7 and MQ135 gas sensors are used in the process of analysing the atmosphere for the presence of potentially hazardous gases. For the purpose of data visualisation, a website built using

ISSN: 2057-5688

MEAN stack was developed. This system has a number of benefits, including a low cost, mobility, simplicity of maintenance, and a rapid reaction time. In the distant future, it will be possible to improve the system by installing more sensor nodes. MQ135 was used for the identification of potentially harmful substances in the second article that we referred to. A message that is appropriate for the situation is shown on the website in response to the data that was sent by the system. The following are some of the system's advantages: People may monitor the level of pollution on their phones using the application, which promotes both modern technology and the notion of leading a healthy life. It also provides support for the healthy living concept. In the third research that was cited, MQ135 and MQ6 sensors were used in order to keep an eye on the state of the air. Some of the benefits of using this technique include: Easy Updates to Install Directly on mobile phone, pinpoint accuracy in pollution monitoring, and remote position tracking and monitoring. This prototype has the potential to be expanded in the future to include real-time simulations of metropolitan cities. In the fourth study that was alluded to, the sensors are put in various places, and the monitoring of the data may be done from any distant location. The sensors can be accessed with little effort, the graphs are plotted on the android app in a tabular style, and the location can also be presented with graphs. These are just a few of the system's many benefits. The issues that need to be solved include properly transmitting data, effectively maintaining the equipment in all kinds of weather, and maintaining the device itself. In the fifth article, MQ2, DHT11, and SDS021 sensors are used in order to analyse the quality of the air and the relative humidity. The benefits of using this approach are as follows: The sensors are readily accessible, and a tabular representation of the graphs may be seen on both the android app and on the website Thing Speak. In the future, the System may be enhanced by the addition of additional sensors, such as those for detecting fires and so on. In the sixth article that we discussed, MQ135 and MQ2 sensors are used in order to determine the quality of the surrounding air. The positives are that sensors are readily accessible, and people may use an application on their smartphones to monitor the level of pollution in their surroundings. In the future, the System may be enhanced by the addition of more sensors, such as those that detect fire, as well as more powerful sensors, which provide more accurate output.

III. PROPOSED METHODOLOGY

ISSN: 2057-5688

The processing, monitoring, and administration of the data by Node MCU is the primary focus of this approach that has been suggested. The inbuilt Node MCU (ESP8266Wifi) module is what is used for communication with the other systems, web servers, and personal computers. The master side and the slave side are the two different ways of communicating, and they are frequently referred to by those names. This system is very adaptable and simple to monitor, in addition, there is no need for any kind of human labour in order to accomplish this goal.

The purpose of the gas sensors that are installed in this location is to determine the presence of various types of active gases in the surrounding environment, which is a less significant aspect of a support programme. This form of gear is used to detect gas leaks or other pollutants that are responsible for these incidents. It is also able to connect with the control unit so that the operation may be shut down quickly if necessary. The gas sensor sends a warning to the employees in the location where the leak occurs, giving them the opportunity to take the appropriate steps, and that sort of system is crucial not only for the flora and fauna in this region but also for the people who live there. The approach that uses sensors to detect potentially hazardous gas leaks is known as the process of identifying gas leakage. This method was developed. In situations when a leakage of hazardous gas has been identified, these detectors would normally transmit an audible signal or a message via wireless networks to alert the appropriate authorities and persons in the area.

ISSN: 2057-5688

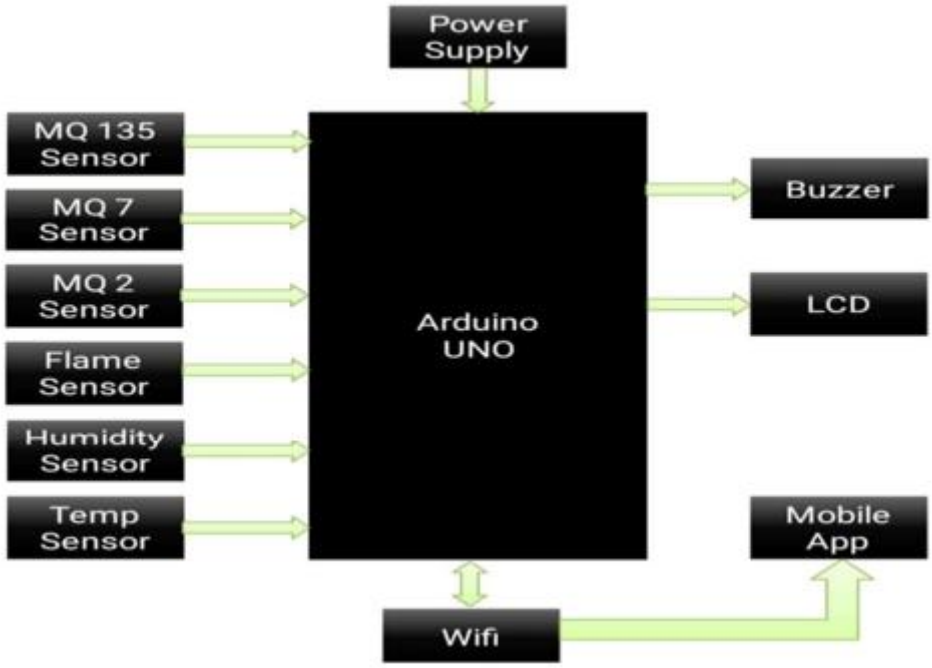

Figure 1: Proposed model architecture

Figure 2: MQ7 Gas Sensor for Carbon Monoxide & MQ2 Grove Gas Sensor

Figure 3: Air quality sensor (MQ135) for detecting a wide range of gases, including NH3, NOx, alcohol, benzene, smoke and CO2

An open-source firmware and development board based on the programming language Lua, NodeMCU is designed with the Internet of Things (IoT) in mind. Hardware that is based on the ESP-12 module is used, and it comes with software that is designed to operate on

ISSN: 2057-5688

Espressif System's ESP8266 Wi-Fi System-on-a-Chip (SoC). This individual's CPU is RTOS compatible and has a configurable clock frequency ranging from 80MHz to 160MHz. The NodeMCU can store both data and applications in its 128 KB of RAM and its 4 MB of Flash memory. Because of its high processing power, built-in Wi-Fi and Bluetooth connectivity, and Deep Sleep Operating capabilities, it is suitable for Internet of Things applications. The Micro USB connector and the VIN pin may both be used to power the NodeMCU (External Supply Pin). The UART, SPI, and I2C interfaces are all supported by it.

Figure 4: NODE MCU with its pin configuration

The DHT11 is a popular kind of sensor that measures both temperature and humidity. The sensor consists of a specialised NTC for measuring temperature and an 8-bit microcontroller for outputting the values of temperature and humidity as serial data. Additionally, the sensor is compatible with a wide range of applications. Additionally, the sensor is factory calibrated, making it simple to link with several different types of microcontrollers. With an accuracy of 1 degree Celsius and 1 percent, the sensor is able to monitor temperatures ranging from 0 degrees Celsius to fifty degrees Celsius and humidity levels ranging from twenty percent to ninety percent. Therefore, if you are interested in measuring inside this range, then this sensor may be the most appropriate option for you.

ISSN: 2057-5688

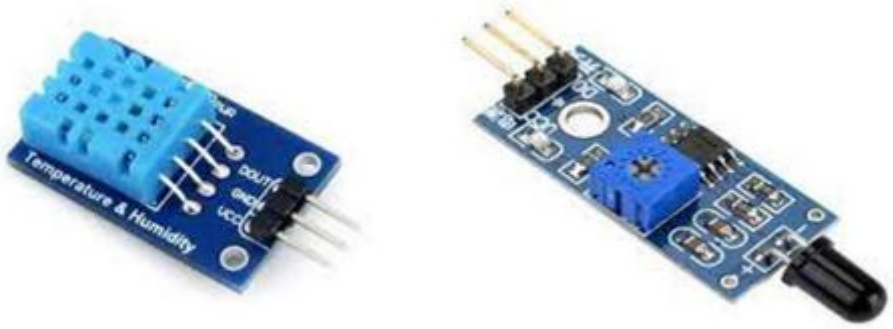

Figure 5: DHT 11 Sensor & IR Sensor

Figure 6: Arduino Atmega controller

The Flame Detection Sensor Module is very sensitive to flames, yet it also has the ability to detect normal light. In most cases, it is utilised as an alarm for a fire. Finds a flame or a light source with a wavelength that falls anywhere between 760 and 1100 nanometres. Detection sites at around 60 degrees, which are very sensitive to the flame spectrum. Performance that is both customizable and consistent is referred to as sensitivity. Infrared flame sensors are designed to function inside the infrared portion of the electromagnetic spectrum. An explosion causes certain heated gases to generate patterns in the infrared area. These patterns may then be analysed using a specialised thermal imaging camera since the gases emit the patterns in the same region. The infrared flame sensor can detect the presence of fire as well as other sources of infrared radiation (Flame or a light source of a wavelength in the range of 760 nm to 1100 nm can be detected). Arduino is a microcontroller that may be used in a variety of robots, including those that seek for heat.

Atmel ATmega328 that has already had the boot loader installed onto it. Atmel ATmega328 microcontroller that comes in a DIL-28 packaging and is already loaded with the bootloader

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for the Arduino UNO 16MHz. In a bespoke embedded project, the usage of Arduino code may be enabled via the use of this device rather than through the utilisation of an actual Arduino board.

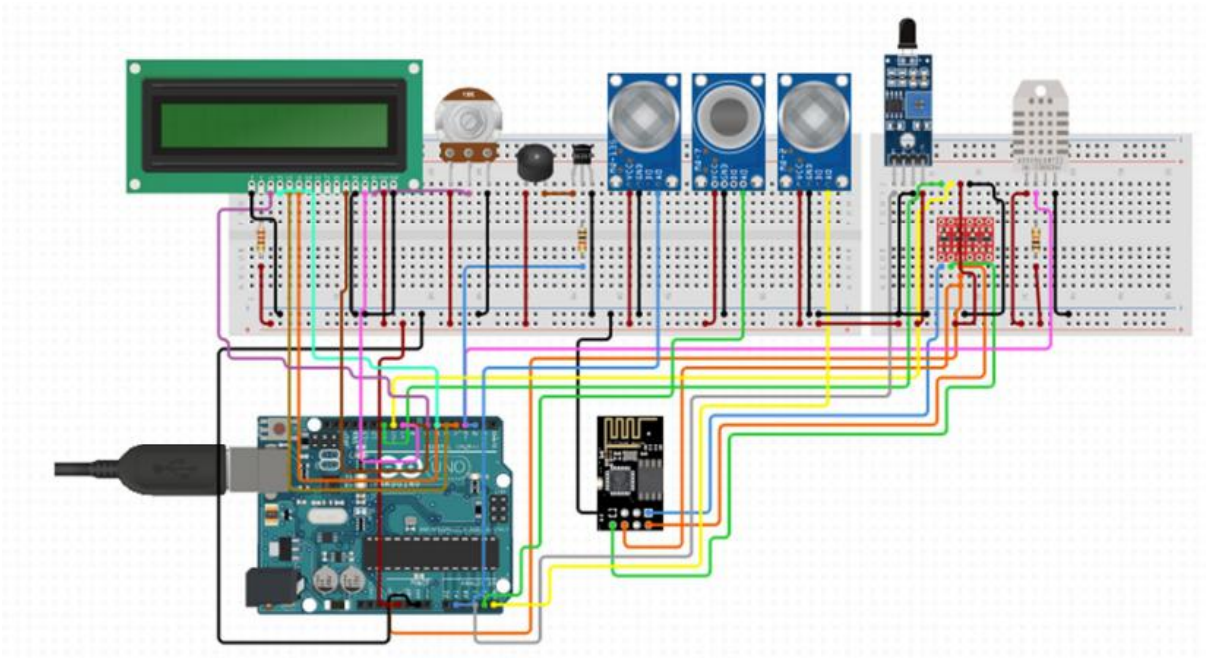

Figure 7: Circuit diagram of our system

In this particular setup, the MQ2, MQ7, and MQ135 sensors, in addition to the IR flame sensor, are responsible for concurrently and methodically gathering data from the surrounding environment. This information is then sent to the Arduino board in the form of analogue inputs. The Arduino board then determines if the values that have been sent in by the sensors are lower or higher than the value that is being maintained in the memory component of the board. The Arduino will take the appropriate action depending on whether the value is more than or less than the threshold value. The red light will illuminate and the buzzer will sound if there is smoke or dangerous gas present in the area. The green led will illuminate whenever there is no sign of an ignitable gas nearby. The red light will illuminate and the buzzer will sound if there is a flame in the vicinity. There will be no beeping from the buzzer or flashing of the lights if there is not a flame in the immediate area.

IV. APPLICATIONS AND DISCUSSIONS

ISSN: 2057-5688

In order to protect people and property from the hazards of fire, the implementation of a system that can automatically recognise fires is an absolute need. However, the contention is that these traditional fire extinguishing frameworks are not adequate to make a brief move during a fire and save lives. Numerous plants and structures in India have legitimate establishment and fire security arrangement, such as alarm, fire quenchers, water supply framework, and so on. There is no assurance that every minute of every day will be checked for fire with a manual structure. Aside from that, the present fire framework does not provide information on the force in a building or the production lines, nor does it reveal the area of gas leakage. The use of continuous control over the Internet or a remote organisation increases the viewing and controlling of fire safety systems that are located outside of the building. Through the use of the internet or a remote organisation, the status of the fire security framework and any other structure frameworks may be inspected anytime and from any location at any time. One central office will be responsible for controlling the fire safety systems that are located in a number of different buildings.

This will increase the efficacy of constructing the board activities while simultaneously lowering costs, more effectively separating fire risks from other types of risks, and increasing the amount of time that can be devoted to ensuring the safety of both property and people. However, GSM-based monitoring and management of fire safety administration frameworks would need to have security insurance to prevent false fire data from being sent to building owners and fire unit personnel.

V. CONCLUSION

This article is all about the internet of things and its application for building fire and gas detection systems that can be installed in residential complexes, offices, and warehouses in order to prevent these kinds of disasters from occurring in the near future. The purpose of this application is to prevent these kinds of disasters from occurring. Smoke detectors, temperature and humidity sensors, and other types of sensors are often included in fire alarm systems. An Arduino controller is attached to the data that is received from the sensor. In addition, the LCD display, Buzzer, and Node-MCU module are all linked to Arduino in order to provide output. The fire alarm is signalled by a buzzer, and the LCD indicates the current condition of the fire detection. Certain users may be alerted by Nodemcu modules in order to

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know or avoid anything happening in their home, workplace, or building. This approach is applicable in a variety of settings, including homes, workplaces, and hotels. The provision of safety is ensured by this method. The device is able to carry out a variety of parameter measurements for the purpose of fire detection in buildings at an earlier stage. According to the findings of our research, we believe that there need to be at least one of these systems in place for the same functions.

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ISSN: 2057-5688

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