An IOT Based Home Automation and Chemical Detector with Real Time Data Analysis

by

Amina Kumkum
16366010

A project submitted to the Department of Computer Science and Engineering
in partial fulfillment of the requirements for the degree of
M.Engg. in Computer Science and Engineering

Department of Computer Science and Engineering
Brac University
September 2021

Declaration

It is hereby declared that

1. The report submitted is my own original work while completing degree at Brac University.
2. The report does not contain material previously published or written by a third party, except where this is appropriately cited through full and accurate referencing.
3. The report does not contain material which has been accepted, or submitted, for any other degree or diploma at a university or other institution.
4. I have acknowledged all main sources of help.

Student's Full Name & Signature:

Amina kumkum

Amina Kumkum
16366010

Approval

The project titled "An IOT Based Home Automation and Chemical Detector with Real Time Data Analysis" submitted by

Amina Kumkum (16366010)

Of Summer, 2021 has been accepted as satisfactory in partial fulfillment of the requirement for the degree of M.Engg. in Computer Science on September 26, 2021.

Examining Committee:

Supervisor:
(Member)

Amitabha Chakrabarty, PhD
Associate Professor
Department of Computer Science and Engineering
BRAC University

Head of Department:
(Chair)

Sadia Hamid Kazi
Chairperson and Associate Professor
Department of Computer Science and Engineering
Brac University

Ethics Statement

The project submitted by my own original work, which was not published elsewhere before. Along with that, the paper is not currently being considered for publication anywhere.

Abstract

IoT has become one of the most important technologies of the 21st century. We can connect everyday objects like kitchen appliances, cars, baby monitors, light, fan, water motor to the internet via embedded devices. We don't even need to move to control our home appliance. Although technologies are improving day by day, air pollution and fire incidents from gas leakage have turned out to be one of the significant issues now-a-days. For various reasons the level of methane, butane, propane, alcohol and hydrogen is increasing in the environment which is very harmful for living creatures. Gas leakage is the major issue for fire tragedies. It's a matter of great anxiety for industries, residences as well as restaurants which are run on gas power. Another important issue is the temperature and humidity level of the environment. Whether it's home, office or outdoor too much humidity with high temperature can cause our bodies overheat. Which can cause effects like heat stroke. Besides, spending time in an environment with too much humidity can actually make human sick, especially from respiratory infections. In this project I am going to make an IoT based chemical, gas and temperature-humidity detection system with home automation. This will help to use the improvement of technologies to decrease people's death and properties lose.

Keywords: IoT; Air pollution; Gas leakage; Temperature & humidity measure; Home automation

Acknowledgment

At first, all praise to the Almighty ALLAH for whom my project has been completed without any major interruption.

I am grateful to my supervisor **Dr. Amitabha Chakrabarty**, Associate Professor, Dept. of Computer Science and Engineering, BRAC University for his kind support, erudite guidance and advice in my work. He helped me whenever I needed help.

My heartiest gratitude to my parents. Without their throughout support it may not be possible to complete my degree. With their kind support and prayer I am now on the verge of my post-graduation.

Table of Contents

List of Figures

Chapter 1

Introduction

1.1 Introduction

Most of the developing countries like Bangladesh chemical management or purify law is not that strong. In Bangladesh most of the chemical related industries are forging base. Though they are maintaining some rules but due to lacking in our law they are also breaking the rules. On the other hand, rest of the native industries don't even care about environment or worker health or even the law and government.
In this modern era, technologies are upgrading but the average life expectancy of human is decreasing day by day. Human beings are suffering from various kind of diseases and accidents for which human activities are directly or indirectly responsible.

1.2 Motivation

Among various reasons of threatening human life, air pollution is most important one. It occurs when harmful chemicals enter in the environment through chemicals from industries, car emission, burning fossil fuel or many other ways. These released chemicals and particles can cause direct damage to the troposphere or other indirect damages. Environments surrounding us contain different types of chemicals in a certain level. When the percent of a substance is increased than its natural or fixed level it causes harm to humans and other living creatures. For example, if the level of methane, butane, propane, alcohol, hydrogen or smoke increases in air it may cause asthma, lung cancer, ventricular hypertrophy, Alzheimer's and Parkinson's diseases, psychological complications, autism, fetal growth, and low birth weight [15].

Recently, it is noticed that due to gas leakage, dangerous accidents are occurring. It can happen when a pipe is damaged or when gas appliance at home, office or restaurant cause a gas leak. This can happen anywhere and anytime. The natural gas which is highly flammable, increases the risk of fire and can provoke explosion like Maghbazar fire tragedy.

Another matter of concern is continuous air pollution causes global warming [25]. As a result, higher temperature and humidity is being felt everywhere. Extreme

heat waves have caused thousands of deaths around the world in recent years. Besides, humidity makes hot weather more unbearable because the higher the relative humidity, the higher the temperature actually feels.

In today's world, automation has become important in everyday life because it helps to complete a task with lesser human assistance and in a smart way. We can easily use internet to control the home appliances. This device can be used in both industrial and residential purposes.

1.3 Research Problem

As Dhaka is one of the most densely populated cities in the world [8], it has unique environmental issues. Human bodies can't always sense the harmful chemicals of environment because some chemicals don't have any color and smell. So we don't have any idea which chemicals we are inhaling outside and even inside of our house. Recently, because of gas leakage number of tragedies are increasing alarmingly.
This types of accidents can be reduced if people can sense these issues or get notified and take proper precautions at earlier stage.

Internet of Things is improving day by day and helping us in every aspect of our life. This modern technology can be used to detect harmful chemicals, gas leakage, pH level of water, home automation and many other aspects in our life to ensure safety and make life easier.

In this project, I am going to make an IoT based chemical detection with home automation system using ESP8266 Wi-Fi device. It will monitor the harmful chemicals level in the air and if any harmful chemical exceeds its natural level it will automatically turn on siren. If smoke or gas leakage is detected around this device a buzzer will buzz automatically. This device will also detect the temperature and humidity of the room. So, the user will get information of any type of uncertainty from distance places. Using nodeMCU home appliances like light, fan, water motor can also be controlled easily.

1.4 Aims and Objectives

The aim of making this device is to reduce the rate of incidents taken place by issues like polluted air by harmful chemicals, fire incidents, increasing temperature and humidity etc. Besides, this device will make human's day to day life easier by controlling home appliances like light, fan, water-motor etc.
This device will monitor the LPG, butane, alcohol, Hydrogen, smoke, CH4 and CO gas level in the air. If any of these chemical level is exceeded from its normal level it will notify user.
If smoke is detected in the air around the device, an alarm will be automatically on and will text user in user's mobile.
By detecting gas leakage, it will notify user, so unexpected occurrences may be prevented by taking fast action. All of the real time data collected by the sensors will

be stored in cloud. User can analysis past history of the data.

In our modern society, there are many single and couple residents who need to stay out of the house for a long time for work or travel reasons. Besides, there are a lot of elder persons and people who need special help. For all of them this device will be helpful to control home appliance even outside of their house and staying in one place.

1.5 Advantages of this project

- This is a compact device with many sensors including cloud which are combined using IoT.
- Major aim to build this device is to provide safety. One can take rapid actions to avoid incidents by getting alert or can avoid to go on a particular location or can take safety protections such as wearing mask.
- This device is efficient and low cost compared to other devices.
- Maintenance of this device is quite easy.
- This device provides home automation and safety features together. So, user will get most of the important services of day to day life in one device.
- Power supply can be provided by directly connecting plug to the socket. So a standby computer is not required to keep the device on.
- Data collected by the sensors can be monitored in real time on cloud platform.

1.6 Limitation

Wi-Fi connection is must to operate the device.

1.7 Organization of the Report

This report has been organized in following order:
Chapter 2 contains the paper works related to this project topics.
Chapter 3 details of hardware part of the project.
Chapter 4 describes software part of the project.
Chapter 5 shows the results.
Chapter 6 Conclusion and future work.

Chapter 2

Related Work

IoT is an ecosystem which consists of web-enabled smart devices that use processors, sensors and communication hardware to send, collect and process data. In an IoT system, all devices would collect data from living patterns in real time.
When discussing the empact of IoT, the first think comes to our mind is the safety issue. IoT can be implemented in everywhere including car, bus, motor bike, home, industry, restaurants etc.

Hundreds of papers and journals have been published related to IoT. Different types of projects are being implemented based on IoT, such as- Air pollution monitoring system, face recognition, IoT based alarm clock, smart street light, smart wheelchair, smart blind stick, smart dustbin, smart lock, smart home, monitoring chemical level of the air, detecting gas leakage and thousands of things. B.Amutha, C.Rajeshbabu, Ch.Neehar, E.Sumanth [20] proposed a device which will detect undesirable gas and temperature within the manufacturing plant. Collected data can be connected with web. Raspberry Pi and Integrated Web Server Technologies were used in their proposed model.

Water pollution is becoming one of the biggest threat for greem globalization. To ensure safe drinking water, quality monitoring of water is must. Vaishnavi V. Daigavane and Dr. M.A. Gaikwad [5] proposed a water quality monitoring system consists of sensors and wifi module. Arduino was proposed as micro-controller to build the model. IoT is a trending technology now-a-days. It helps to transfer data over network without human-to-human or human-to-computer interactions. Home automation is one of the major sides of IoT [26], which means automatic or semi-automatic control and monitor of home appliances. Authors suggested ESP8266 wifi module, relays, smartphone and android app to build their proposed model.

An Intelligent, Secure and Smart Home Automation System was studied [22], where a machine learning algorithm (Support Vector Machine) was proposed to make intelligent decisions. Authors also proposed block chain technology to ensure identification and authentication of the IoT devices. Because of increasing gas leakage, home security has become a major issue. Residential areas, vehicles, restaurants or offices which run over gas-power are at great anxiety of gas leakage. A prevention method to stop accidents associated with gas leakage was proposed [21] by the author. According to the author a gas leakage detection system can be implemented

which can detect, alert and control gas leakage.

Because of imbalance in weather parameter negative consequences may occur. An affordable, compacted size device has been studied [7], where authors have employed highly reliable DHT22 sensor and RF433 hc12 to transmit and receive data. Environmental conditions like temperature, humidity monitoring system has also been studied [12], where a micro-controller interfaced with sensors and GSM module send information wirelessly to remote server and plot the sensed data as graphical statistics.

Along with gas leakage detection has been studied a new system here [18], in which author proposed a model of automatically booking a cylinder by sending notification to gas agency. Load cell has been used to monitor the weight of LPG gas. A model of monitoring and controlling home appliances using android app based on arduino [4] has been read in which author proposed a wireless technology which will reduce the total consumed energy by the appliances. Besides, for being wireless, data transfer will be faster and minimize the rate of data loss.

Signals collected by the water sensor will be feed in real time to social network like twitter, has been found here [1].

Another study was found [9] where a gas leakage detector was proposed which send SMS to warn user about gas leakage. ESP-32 was used as a Wi-Fi module and UBIDOTS cloud to upload data. A gas leakage and fire detection technique was studied here [16], where MQ2 sensor and Raspberry Pi was proposed to implement the project. Their proposed model sends SMS to user when gas leakage and fire is detected.

Employing IoT and client server architecture a model was studied [10] which proposed to use nodeMCU. User can control home appliances through a smart phone. Home equipment can be controlled from any corner of the world by using static IP address and google assistant for voice recognition was studied [19]. To solve sundry problem in Nepal a model was proposed [2] which can control appliances even in offline. The proposed model's core system was adopted by Blynk framework.

For monitoring and controlling dams water level a model was proposed here [13]. As per the authors, developing an authorized central command center opening and closing of dam gates can be operated. Flood is a natural disaster which affects human life. By monitoring the behavior of the river can mitigate or prevent affects of flood [17]. Colima state of Mexico was chosen for data collecting and processing. Gardening is a good practise to keep health and mind fresh. Due to lack of maintenance plants become fade and even die. Using some sensors, wi-fi technology and nodeMCU a system was studied [14] which can automatically water the garden when needed based on garden soil. User can monitor the garden parameters through mobile app.

Chapter 3

Hardware Specifications

3.1 Brief Overview

This device is designed to be used in everyday life. It can be implemented in any kind of industries, offices or residences. This device will monitor some particular chemicals' level of the environment and store the data in cloud for further analysis. If any of these particular chemicals exceed it's safe level which is dangerous for human beings it will buzz an alarm and alert the user. Besides, this device is able to sense gas leakage. If the sensor of the device detects gas leakage it will automatically notify user. It can measure room temperature and humidity also. On the other hand, using this device user can control light, fan and monitor water level. Data can be stored over internet using ThingSpeak platform. Block diagram of the device is given below:

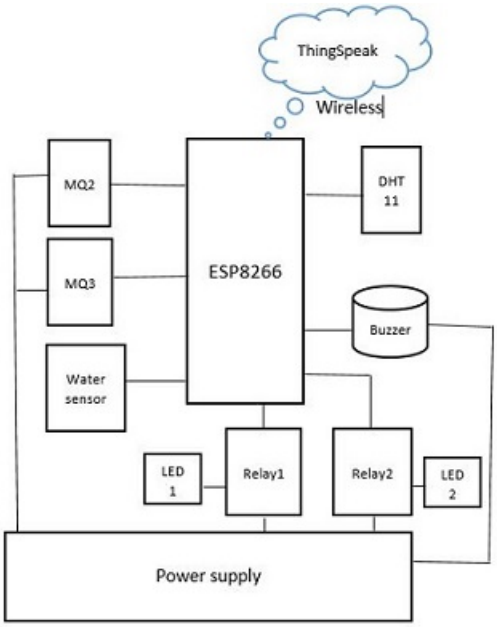

Figure 3.1: Block diagram

3.2 Chemicals of the Air

Chemicals of the air which will be monitored by this device are:

1. Hydrogen (H2): Hydrogen is the most abundant and lightest element in the universe. It is a gas at normal temperature and pressure but condenses to a liquid at -253 degree Celsius.
2. Methane (CH4): It is a colorless, odorless gas that occurs abundantly in the nature as a product of certain human activity. It is the member of paraffin series and most potent of the greenhouse gases. It is lighter than air and slightly soluble to water.
3. Carbon monoxide (CO): It is an odorless, colorless gas which is formed by incomplete burn of fuel. If human body is exposed to CO gas, its molecules will displace the oxygen and lead to poisoning. Human body cannot sense it as it has no odor and color.
4. Smoke: Smoke can be released in the air from many ways like flame, burning substances, cigarette, fireplace etc. Excessive smoke is harmful for living beings. In fire tragedies most of the people die from heavy smoke inhalation, because in heavy smoke human can't consume oxygen so oxygen level goes down and it causes death.
5. Butane: It is a colorless and highly flammable hydrocarbon which may cause explosion. Improper handle and incorrect use of this gas can be fatal.
6. LPG: Liquefied petroleum gas is colorless, odorless gas which is heavier than air. It is a mixture of butane and propane gas which is in household cylinders.
7. Humidity and Temperature: When air contains higher moisture is called humid weather in which sweat can't evaporate and makes human bodies hot and sticky. This hampers the bodies cool-down mechanism.

Air pollution causes by solid or liquid particles or by certain gases which can come to air through vehicle exhaust, factories , dust, pollen, volcanoes or wildfire. These type of chemicals are not always harmful but it the percentage increases than normal level or human beings inhale these harmful chemicals for a long time it becomes dangerous.

3.3 Hardware Components

To implement this project sensors, buzzer (alarm), LED light, micro-controller, relay, board, resistors, regulator and some other components are required.

1. MQ2 Sensor: MQ2 gas sensor is an electronic sensor used to detect the concentration of gases in the air like propane, hydrogen, methane, carbon mono-oxide anywhere from 200-10000 ppm [24]. It can also detect combustible gas and smoke. This sensor works on 5V DC and draws around 800 mW.

Figure 3.2: MQ2 Sensor

2. MQ3 Sensor: This module is used to detect alcohol vapor, CH4, Benzine, LPG and CO. This sensor is useful for gas leakage detection in both house and industries. Because of its high sensitivity and fast response time measures can be taken faster. When target gas exists, the sensor's conductivity gets higher along with the rising concentration level of the gas. Applications of MQ3 gas sensor are: alarm if gas level limit over, portable alcohol detector, sensing device as stand-alone, monitors environment [11].

Figure 3.3: MQ3 Sensor

3. DHT11 Sensor: DHT11 is a ultra low-cost digital sensor. Most probably it is the most popular and reliable temperature and humidity sensor for micro-controller based projects. It can measure humidity from 20% to 90% RH and temperature from 0 to 50 degree Celsius. It can be operated with both 3.3 and 5 Volts power. It uses a sensor and a thermistor to measure surrounding air and splits digital signal to the data pin. For both temperature and humidity resolution are 16 bit. This sensor can be used in environment monitoring, automatic climate controlling and as local weather station [23].

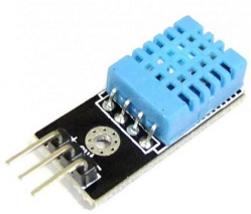

Figure 3.4: DHT-11 Sensor

4. Buzzer: Buzzer is basically a tiny speaker that can be connected directly to nodeMCU. It can convert audio signal to sound signal. It is usually powered by DC voltage. Rated voltage for buzzer is 6V and its operate voltage is 4-8V DC. Rated current is ¡30mA. It can be used in communication equipment, automobile electronics. It is a portable equipment [3].

Figure 3.5: Buzzer

5. NodeMCU Micro-controller: Node Micro-Controller Unit is an open source software and hardware development environment. It is build around a cheap System-on-a-chip called ESP8266. ESP8266 is a low-cost wi-fi microchip. It can be powered through USB port. 3.3V is enough to power the board. This controller provides multiple I/O interfaces with wi-fi and Bluetooth functionality. NodeMCU has 4 Power pins- Vin and 3.3V pins. It has GND pins to connect with ground. It has I2C pins to connect sensors and peripherals with it. NodeMCU has 17 GPIO pins to function IR remote control, LED light, button or other functionalists. It has an ADC pin for analog signals. It contains 2 UART0 and UART1 pins. UART0 is used for communication where as UART1 is to transmit data signal. This micro-controller board has many other pins which can be used for special purposes [27].

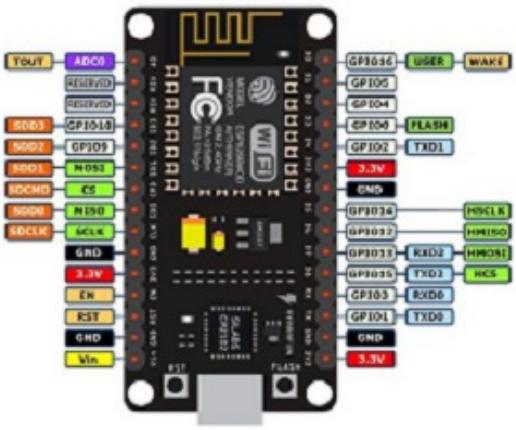

Figure 3.6: NodeMCU-ESP8266 Pinout

6. Relay: The relay module is an electrical switch which is operated electromagnetically. It decides whether to let current flow or not by turning on or off. They can be controlled with low voltage like 3.3V or 5V. Relays are commonly used in switching circuit, in home automation projects relays are used to switch AC loads. It is used to control a heavy load, used in safety circuit to disconnect the load from power supply, also used in automobile electronics for controlling gas motors [6].

3.4 Hardware Details

In this project, I have used ESP8266 as micro-controller chip. For power supply there is a transformer which will convert the power supply of 220V, we use everyday life to 12V. Transformer is connected with a diode and a capacitor to convert AC power supply to DC supply. As circuit is of 5V, need to connect a 5V voltage regulator for supplying 5V power in the device. This regulator provides two outputs-GND and +5V power. Power supply can also be provided by laptop through data cable to nodeMCU.

For connecting MQ2 sensor, GND pin is connected to the GND pin of the regulator. VCC is connected to 5V of regulator. D0 is connected to pin 0 of micro-controller.

GND of MQ3 is connected to the GND of the regulator. VCC is connected to the 5V of regulator. D0 is connected with pin2 of micro-controller.

Water sensor's GND is connected with the GND of nodeMCU. +5V is connected to 3.3V of nodeMCU. Signal pin is connected to the ADC pin of micro-controller, so that it will provide analog signal into digital form.

DHT11 sensor has three pins. GND, VCC and data. GND is connected to the GND of regulator, VCC is with 3.3V of micro-controller and data pin is connected with pin5 of nodeMCU.
Negative or GND pin of buzzer is connected with GND of regulator. Positive pin can be powered by 5V, I have connected it to pin 14 of nodeMCU with a transistor

through 1k resistor as nodeMCU provides output of 3.3V and buzzer is of 5V. Resistors are used for current limiting to transistors.

There are two relays of 5V for controlling (ON/ OFF) light and fan. I have connected two LED light with relays for verifying the output of given commands. LEDs are connected to relays through 1k resistors. Input pin of relay 1 (R1) is connected with nodeMCU in pin13, R2 is connected with pin12.

Circuit diagram of the device is given below:

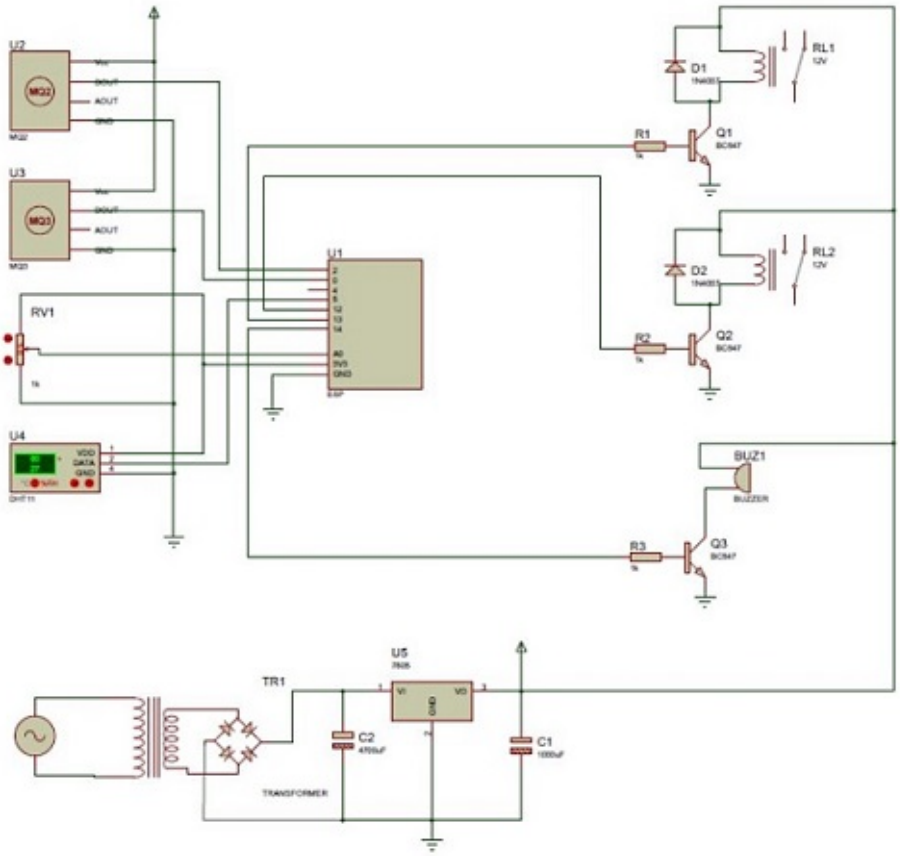

Figure 3.7: Circuit diagram

Hardware setup of the project:

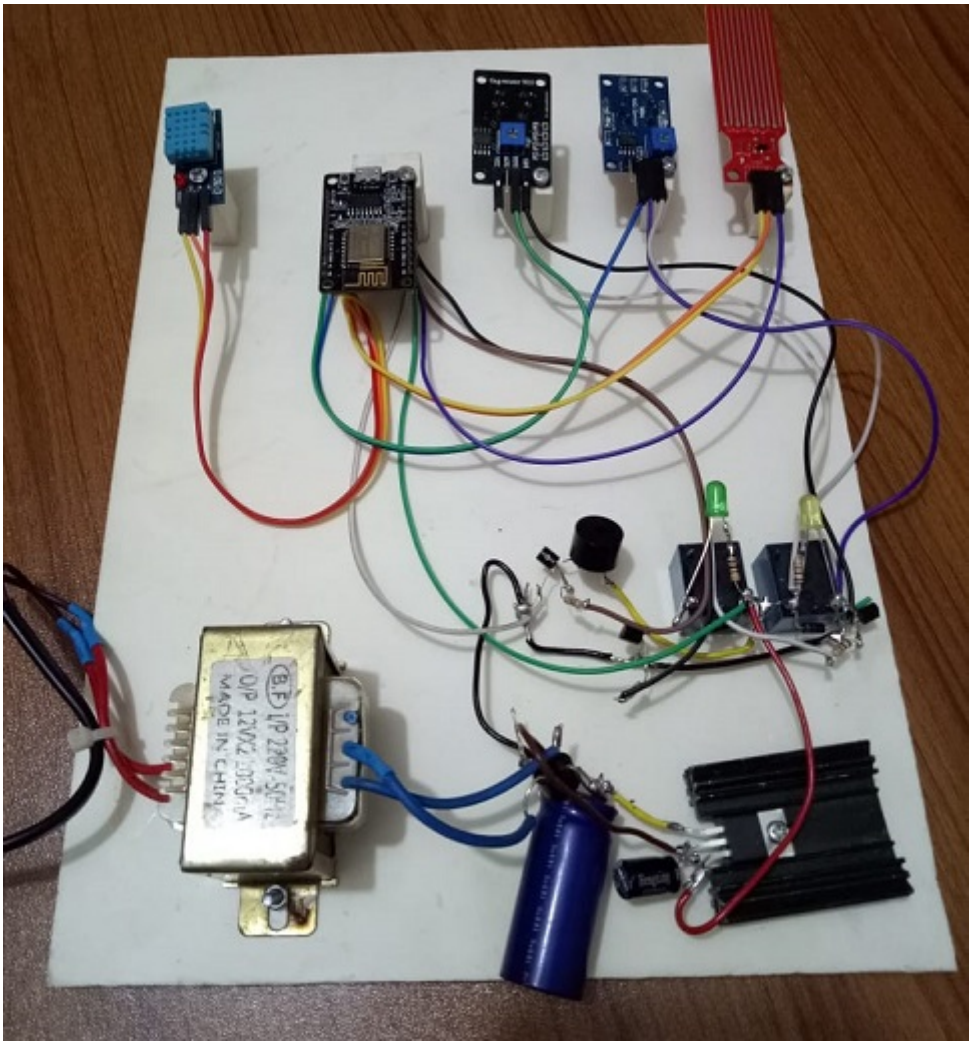

Figure 3.8: Hardware Setup

Chapter 4

Implementation

4.1 Data Processing Process

At the very beginning the process will initialize, check for input-output, serial port and wi-fi connection. The device will check for update after every 15 seconds. If 15 sec is passed and wi-fi is connected then the process will read data from sensors and post values. If posting is OK then will generate success message otherwise will generate error message.

Then the process will read data from ThingSpeak and after successful read if found any command for relays will drive it to relays. After updating time it will return to the beginning of the loop. Thus the process will keep going. The whole process is displayed in the flowchart of the next page.

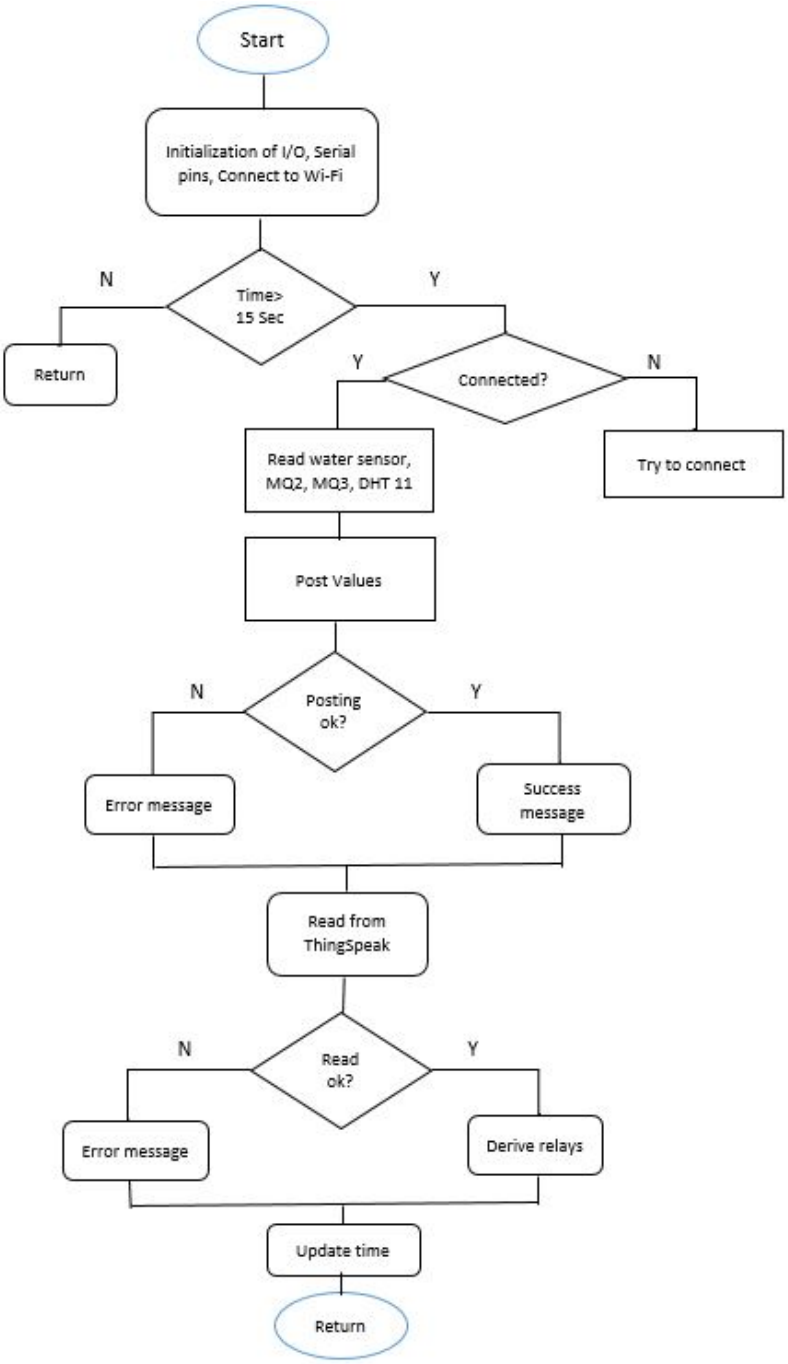

Figure 4.1: Flowchart of Data Processing

4.2 Coding Details

Firstly, all the necessary libraries are called and functions are declared. Then, the wiFi name and password need to declare with which this device will be connected. If the device is connected with Wi-Fi, then after every 15 seconds it takes data update.
Then I have declared all the variables and pins and set delay time for buzzer inside void beep() function. After that I have declared void setup() function and setup the pins mode of mq2, mq3, water pin as input and relay1, relay2, buzzer, LED as output mode. I have kept relays low at this stage. After making a beep sound it will open serial monitor.

Wi-Fi mode is declared and attempt to connect with Wi-Fi by providing ID and password begins. This process will continue until the device is connected with Wi-Fi. Delay of this process is set as 5 sec.

The main loop begins by checking timer delay. Timer starts with zero and if it is greater then 15000 mili-second then it checks if Wifi is connected or not. If not then it will enter into the loop and takes attempt to be connected. If wi-Fi is already connected then it will not enter into the loop.
For getting a new temperature reading, dht will read temperature and humidity from dht-11 sensor. Then it will read flag to check data accuracy. Humidity, temperature and flag need to compare by using OR gate. If DHT can read data successfully it will return nothing but if DHT fails to read data it will return "Failed to read from DHT sensor!"

Water sensor is connected to the ADC pin of micro-controller. So it will read analog data and MQ2, MQ3 sensors data will be read. I have declared serial command to monitor the status of sensors, relay1 & relay2. If MQ1 or MQ2 detect any harmful chemicals or gas leakage it will output beep through buzzer.

For updating data in cloud platform ThingSpeak we need to create an account. Logging in the account I have created eight channels named as-

- Channel 1: Temperature
- Channel 2: Humidity
- Channel 3: Water
- Channel 4: MQ2
- Channel 5: MQ3
- Channel 6: Fan
- Channel 7: Light
- Channel 8: Command

When an account is created in ThingSpeak it will provide a channel ID and write API key. I have written command to write the ID and key value which are integer values. If the server update is successful the server will return default value 200 and a LED will blink. So I have set the LED mood high. If the channel update is not successful it will print error message and return a value of specific http error type.

A variable f3 is declared for read operation in channel 8. After putting the read API key and channel ID if it retuns value 200 then read is successful and will post the value to serial what was read by f3.

For relay 1, if the read value of f3 is 1 then relay1 will be high and rl1 variable will be 1. If f3 returns 2 then relay1 will be low and rl1 variable will be 0. I have considered relay1 as fan. So if f3 reads command 1 then LED connected with relay1 will be on, if f3=2 then LED will turn off.

For relay 2, if value of f3 is 3 then relay2 will be high and rl2 variable will be 1. If f3 returns 4 then relay2 will be low and rl2 variable will be 0. By keeping the last time stored it will exit from the loop, return to the timer delay and check if last time is greater than timer delay or not. Thus after every 15 sec the loop continues the process.

Chapter 5

Results

The board on which the project is build need to connect with laptop/computer through a data cable to update the code to the device. The device will get power through the computer or the transformer connected with power socket. Providing power supply to the device the code need to compile and upload to the device.

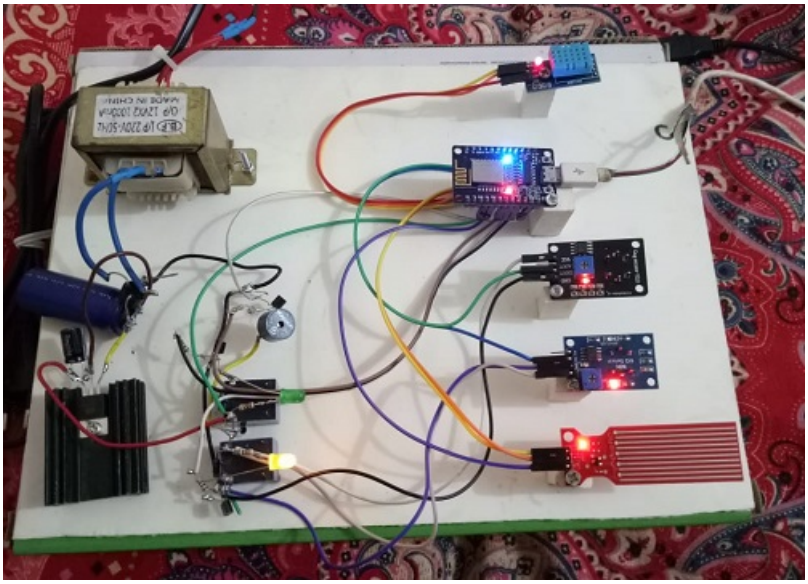

Figure 5.1: Uploading Code to the Device

After successful upload the device is ready to collect data. Now the collected data begins to store in the cloud platform named ThingSpeak. To monitor data user needs to sign-in in ThingSpeak website. User can easily monitor data in graph format on private/ public view.

Few experimental outputs which were generated in different times are added here:

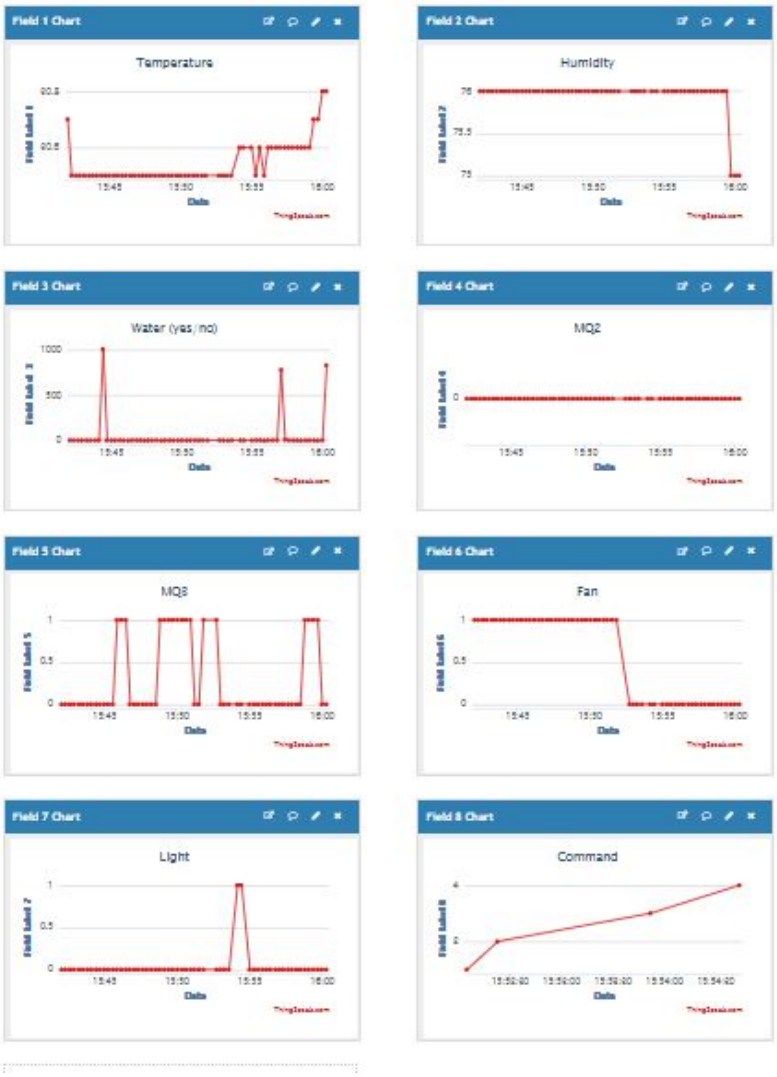

Figure 5.2: Experimental Output of Data Collection 1

In figure 5.2, we can notice that temperature and humidity is increasing and decreasing depending on the environment. MQ2 is showing flat saturation because no chemical was detected by MQ2 sensor. Gas was blown from mq3 sensor, the graph is showing the change of output and buzzer was beeped. Command was given to control fan and light, so the graph is showing to change between 0 and 1.

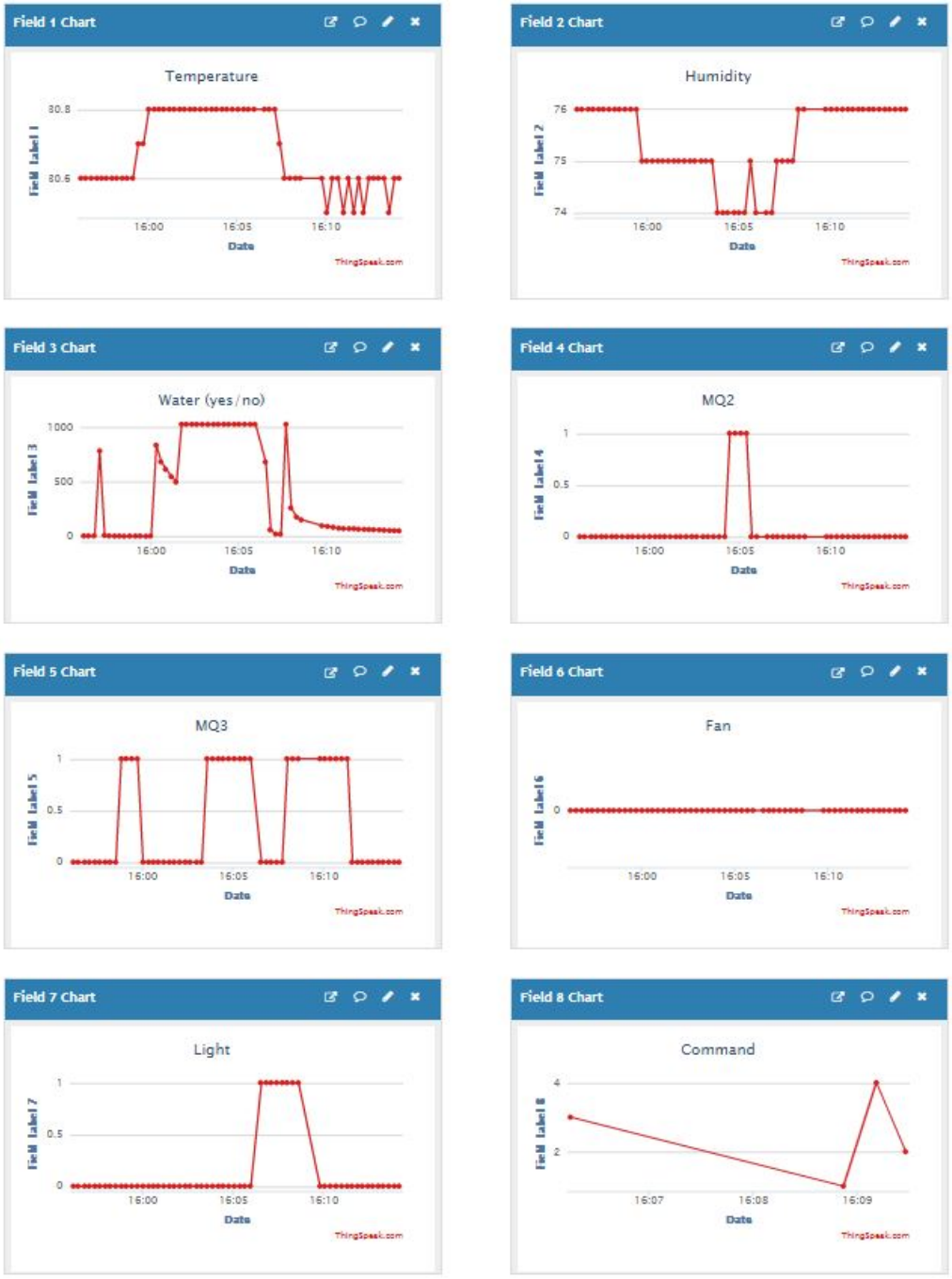

Figure 5.3: Experimental Output of Data Collection 2

Figure 5.3 shows that relay 1 which was defined as fan was given no command, so output graph is flat.

Figure 5.4: Experimental Output of Data Collection 3

In this scenario of 5.4 no gas leakage or smoke was detected by mq2 and mq3 sensors. Besides, no command was given to ON/OFF fan and light.

The command for light and fan is provided by an url which was declared by variable f3 of channel 8. This url is the write API key. Command value is changed from 1 to 4 integer value to control relays. After changing values the API key will be read and according to that the command will be followed. The URLs are added below.

Figure 5.5: URL for Giving Command ON to relay1

In Figure 5.5, command is given to relay1 to turn on the fan which is shown in this project by turning on LED connected to the relay.

Figure 5.6: URL for Giving Command OFF to relay1

In the above figure, command is given to turn off the fan/ LED connected to relay1.

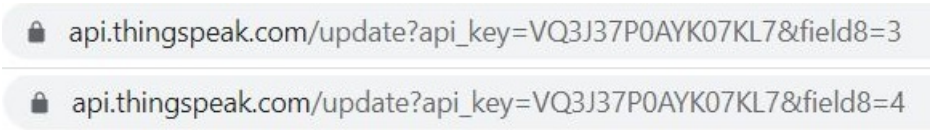

Figure 5.7: URL for Giving Command to relay2

Above figure shows the commands given to relay2, in which 1st command is for turning ON relay2 and the 2nd command is for turning OFF the relay.

Chapter 6

Conclusion and Future Work

6.1 Conclusion

This project represents the monitoring and implementation of chemical and water level detection with controlling home appliances. Though this type of work is available, chemical & gas detection is major concern now-a-days. Wi-Fi based micro-controller is used in this project. This device can be used in industries, residences, restaurants, marketing sectors anywhere. The main purpose of this project is to provide safety and avoid tragedy.

6.2 Future Work

In this age of modern science, application are limitless. Many types of sensors are available which can be implemented in this device. As extension, I will try to add android application to control the whole process. So that user will be able to control the device using his/her smart phone. Versions of micro-controllers are upgrading frequently. Instead of ESP8266 any other latest version of micro-controller can be used to update this project as future work.

Bibliography

[1] T. Perumal, M. N. Sulaiman, and C. Y. Leong, "Internet of things (iot) enabled water monitoring system," in *2015 IEEE 4th Global Conference on Consumer Electronics (GCCE)*, IEEE, 2015, pp. 86–87.

[2] B. Bohora, S. Maharjan, and B. R. Shrestha, "Iot based smart home using blynk framework," *Zerone Scholar*, vol. 1, no. 1, pp. 26–30, 2016.

[3] *Active passive buzzer*, https://components101.com/misc/buzzer-pinout-working-datasheet, 2017.

[4] R. Aravindhan, M. Ramanathan, D. SanjaiKumar, and R. Kishore, "Home automation using wi-fi interconnection," *Department of Mechatronics engineering, Chennai Institute of Technology, Anna University Chennai, Tamil Nadu, India-600069,(IRJET) e-ISSN*, pp. 2395–0056, 2017.

[5] V. V. Daigavane and M. Gaikwad, "Water quality monitoring system based on iot," *Advances in wireless and mobile communications*, vol. 10, no. 5, pp. 1107–1116, 2017.

[6] *12v relay switch*, https://components101.com/switches/12v-relay, 2018.

[7] I. A. Abdulrazzak, H. Bierk, and L. A. Aday, "Humidity and temperature monitoring," *Int. J. Eng. Technol*, vol. 7, no. 4, pp. 5174–5177, 2018.

[8] M. A. Amin, *Dhaka remains the world's most densely populated city*, https://www.dhakatribune.com/bangladesh/dhaka/2018/10/14/dhaka-remains-the-world-s-most-densely-populated-city, (accessed Oct 02, 2021), 2018.

[9] R. K. Kodali, R. Greeshma, K. P. Nimmanapalli, and Y. K. Y. Borra, "Iot based industrial plant safety gas leakage detection system," in *2018 4th International Conference on Computing Communication and Automation (ICCCA)*, IEEE, 2018, pp. 1–5.

[10] G. Madhu and C. Vyjayanthi, "Implementation of cost effective smart home controller with android application using node mcu and internet of things (iot)," in *2018 2nd International Conference on Power, Energy and Environment: Towards Smart Technology (ICEPE)*, IEEE, 2018, pp. 1–5.

[11] *Mq-3 alcohol gas sensor*, https://components101.com/sensors/mq-3-alcohol-gas-sensor, 2018.

[12] C. M. Nwe and Z. M. M. Htun, "A smart weather monitoring system using internet of things," *International Journal of Scientific Engineering and Research*, vol. 6, no. 7, pp. 26–29, 2018.

[13] S. S. Siddula, P. Babu, and P. Jain, "Water level monitoring and management of dams using iot," in *2018 3rd International Conference on Internet of Things: Smart Innovation and Usages (IoT-SIU)*, IEEE, 2018, pp. 1–5.

[14] T. Thamaraimanalan, S. Vivekk, G. Satheeshkumar, and P. Saravanan, "Smart garden monitoring system using iot," *Asian Journal of Applied Science and Technology (AJAST)*, vol. 2, no. 2, pp. 186–192, 2018.

[15] *Health consequences of air pollution on populations*, https://www.who.int/news/item/15-11-2019-what-are-health-consequences-of-air-pollution-on-populations, 2019.

[16] S. Jamadagni, P. Sankpal, S. Patil, N. Chougule, and S. Gurav, "Gas leakage and fire detection using raspberry pi," in *2019 3rd International Conference on Computing Methodologies and Communication (ICCMC)*, IEEE, 2019, pp. 495–497.

[17] C. Moreno, R. Aquino, J. Ibarreche, I. Pérez, E. Castellanos, E. Álvarez, R. Renteria, L. Anguiano, A. Edwards, P. Lepper, *et al.*, "Rivercore: Iot device for river water level monitoring over cellular communications," *Sensors*, vol. 19, no. 1, p. 127, 2019.

[18] V. Suma, R. R. Shekar, and K. A. Akshay, "Gas leakage detection based on iot," in *2019 3rd International conference on Electronics, Communication and Aerospace Technology (ICECA)*, IEEE, 2019, pp. 1312–1315.

[19] S. K. Vishwakarma, P. Upadhyaya, B. Kumari, and A. K. Mishra, "Smart energy efficient home automation system using iot," in *2019 4th international conference on internet of things: Smart innovation and usages (IoT-SIU)*, IEEE, 2019, pp. 1–4.

[20] B. Amutha, C. Rajeshbabu, C. Neehar, and E. Sumanth, "Gas and smoke detection in industries using nodemcu," *Journal of Critical Reviews*, vol. 7, no. 8, pp. 1504–1507, 2020.

[21] M. M. Khan, "Sensor-based gas leakage detector system," in *Engineering Proceedings*, Multidisciplinary Digital Publishing Institute, vol. 2, 2020, p. 28.

[22] R. Majeed, N. A. Abdullah, I. Ashraf, Y. B. Zikria, M. F. Mushtaq, and M. Umer, "An intelligent, secure, and smart home automation system," *Scientific Programming*, vol. 2020, 2020.

[23] *Dht11–temperature and humidity sensor*, https://components101.com/sensors/dht11-temperature-sensor, 2021.

[24] *How mq2 gas,smoke sensor works*, https://lastminuteengineers.com/mq2-gas-senser-arduino-tutorial/, (accessed Sep 25, 2021), 2021.

[25] *Air quality and climate change*, https://scied.ucar.edu/learning-zone/air-quality/air-quality-and-climate-change, (accessed Aug. 25, 2021).

[26] R. Bhandari, M. Patel Darshan, K. Dhimar Richi, and K. Patel, "A smart home with nodemcu using iot," *Int. J. Comput. Appl*, pp. 0975–8887,

[27] *Nodemcu esp8266 detailed review*, https://www.make-it.ca/nodemcu-arduino/nodemcu-details-specifications/, (accessed Sep 26, 2021).