DEVELOPMENT OF GAS DETECTION AND DATABASE SYSTEMS ON CUPPING PRACTICE (CIRCUIT AND HARDWARE)

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DEVELOPMENT OF GAS DETECTION ON CUPPING PRACTICE

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ABSTRAK

Projek ini menerangkan reka bentuk pengesanan gas amalan bekam dengan pangkalan data. Bekam kering dan basah adalah dua jenis terapi bekam yang paling popular. Bekam basah mencederakan kulit, membolehkan darah disedut ke dalam cawan. Matlamat perubatan moden adalah untuk mengesan dan memahami kesan Terapi Bekam. Pernyataan masalah bagi projek ini ialah gas yang dihasilkan di dalam cawan semasa bekam boleh memberi isyarat kesihatan pesakit dan berbahaya kepada pengamalnya. Juga, kesihatan pesakit bekam (gas yang dikeluarkan semasa bekam) tidak diketahui. Matlamatnya adalah untuk membina tatasusunan sensor untuk pengesanan gas. Matlamat kedua ialah untuk mencipta GUI (Antaramuka Pengguna Grafik). Matlamat ketiga ialah mengamalkan bekam kering dan basah. Kami memulakan bekam kering dan basah selepas membina perkakasan untuk peranti bekam. Penderia akan mengesan gas sebaik sahaja ditanam pada tubuh manusia. Bacaan penderia akan ditunjukkan pada apl. Data sensor kemudiannya akan dihantar ke aplikasi Blynk. Data kemudiannya akan dimasukkan secara manual ke dalam GUI. Akhir sekali, perisian PhPMyAdmin akan menyimpan data setiap pesakit dalam pangkalan data.

ABSTRACT

This paper describes the design of a cupping practice gas detection with database. Dry and wet cupping are the two most popular types of cupping therapy. Wet cupping lacerates the skin, allowing blood to be sucked into the cup. The goal of modern medicine is to detect and understand the effects of Cupping Therapy. The problem statement for this project is that the gas produced inside the cup during cupping can both signal the patient's health and be dangerous to the practitioner. Also, the cupping patient's health (gases expelled during cupping) is unknown. The goal is to construct a sensor array for gas detection. The second goal is to create a GUI (Graphical User Interface). The third goal is to practice dry and wet cupping. We begin dry and wet cupping after constructing the hardware for the cupping device. The sensors will detect gases once implanted on the human body. The sensor reading will be shown on the app. The sensor data will then be sent to the Blynk application. The data will then be manually entered into the GUI. Finally, the PhPMyAdmin software will store each patient's data in a database.

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LIST OF SYMBOLS

DCT	Dry Cupping Therapy
WC	Wet Cupping Therapy
T	Causative Pathogenic
CPS	Substances
BPP	Blood Bourne
NO	Pathogen Nitric Oxide
$N2$	Nitrogen
$O2$	Oxygen
$NH2$	Ammonia
$H2O$	Water
EDRF	Endothelium Derived Relaxing Factor
CO	Carbon Monoxides
V	Volt
USB	Universal Serial Bus
LPG	Liquid petroleum Gas
IOT	Internet of Things
WIFI	Wireless Fidelity
DBMS	The database management system

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CHAPTER 1

INTRODUCTION

1.1 Background

This chapter focuses on three main topics. The first topic of this project is cupping practice. Next, the topic to be addressed is on gas detection of Nitric Oxide gas that forms inside the cup during the cupping process. Finally, the last topic to discuss here is database systems for the cupping practice. Currently, there is currently no systems available for detecting gas and databases system for cupping practice. The study and investigation of gas contained in the cupping process, the design of a sensor to measure the gas detected, the analysis of gas containing when doing wet and dry cupping and developing its database systems are the three main objectives(Lee et al., 2019).

1.2 Project Overview

Cupping is a technique that involves scarification and the use of a cupping glass to drain blood from the body. Cupping therapy is regarded as one of the most widely utilized traditional treatment procedures In Asian and Middle Eastern countries. According to some reports, cupping has been practiced in various nations for over 2000 years, including Egypt and China (Mehta & Dhapte, 2015). Cupping is also known in China as Baguan, where Ba refers to lifting up and guan refers to the cups used. The cupping procedure entails the use of a cup and a suction device to remove air from the cup, resulting in negative pressure inside the cup that draws the skin and subcutaneous tissues in. Dry and wet cupping are the two main types of cupping.

Figure 1.1;Dry Cupping.

Source: (*Active Care Physiotherapy Nd Sports Injury Center* , 2021)

Figure 1.2 Wet Cupping.

Source: (*Active Care Physiotherapy Nd Sports Injury Center* , 2021)

Different types of cupping are selected based on the treatment goals of the acupuncturist. There are also different types of cups. Most commonly, cups are made out of glass. However, a thousand years ago, cups were made of bamboo, clay, or animal horns. Cupping therapy can be divided into four different categories using four different approaches. The first classification scheme is based on "technical categories," which include dry, wet, massage, and flash cupping therapy. The second classification is based on "suction-related strength," which includes light, medium, and heavy cupping therapy. The third classification is for "suction-related methods," which includes fire, manual suction, and electrical suction cupping therapy. Herbal goods, water, oxygen, moxa, needle, and magnetic cupping therapy are among the fourth categorization's "materials inside cups."

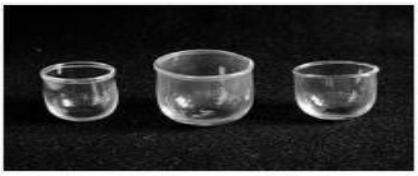

Figure 1.3: Glass Cups.
Source: (Is & Cupping, 2017)

Figure 1.4: Plastic Cups.
Source: (Offers, n.d.)

Figure 1.5: Bamboo Cups.

Figure 1.6:Horn/Chopper Cups.
Source: (Images, n.d.)

Figure 1.7: Bronze Cups.
Source:(Commons, n.d.)

1.2.1 Gas Sensor

During the cupping process, a gas can be visually seen from outside of the cup, the gas is known to be Nitric Oxide (NO) gas. Nitric Oxide (NO) is a signalling gas molecule that effects blood flow and volume by mediating vasodilation. NO regulates blood pressure, aids immunological responses, regulates neurotransmission, aids cell differentiation, and performs a variety of other physiological tasks. Cupping therapy may promote the release of NO from endothelial cells, resulting in the induction of some favourable physiologic effects. The "Release of Nitric Oxide and Increased Blood Circulation Theory" explains this method. The expression of NO synthase (s), enzymes that produce NO from L-largening, was shown to be greater at epidermal acupuncture points in rats in an investigation. Endothelium-Derived Relaxing Factor (EDRF), the active molecule recovered from perfusates following stimulus application, has been identified pharmacologically and chemically as NO. Endothelium-dependent vasodilators are mediated by EDRF, an unstable humoral molecule produced form arteries and veins. Furthermore, the effects of NO on vascular smooth muscle are quite similar to those of EDRF.

The method of detection for this gas is by using Gas sensors. A device that detects the presence or concentration of gases in the atmosphere is known as a gas sensor. The sensor produces a corresponding potential difference based on the gas concentration by changing the resistance of the material inside the sensor, which may be detected as output voltage. The kind and concentration of the gas can be calculated using this voltage value. In later chapters, the chosen type of sensors will be discussed and why such sensors are chosen.

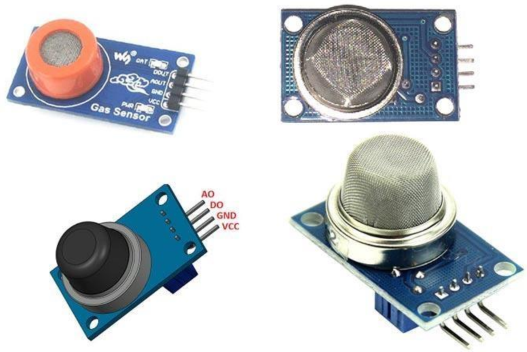

Figure 1.8: Gas Sensors.
Source: (Sensors, 2020).

1.2.2 Database System

For this project, database systems are used for the keeping of record patients during cupping therapy. A database is a logically organized collection of structured data kept electronically in a computer system. A database management system is usually in charge of a database (DBMS). The data, the DBMS, and the applications that go with them are referred to as a database system, which is commonly abbreviated to just database.

To make processing and data querying efficient, data in the most common types of databases in use today is often described in rows and columns in a sequence of tables.

Data may then be accessed, managed, updated, regulated, and organised with ease. For writing and querying data, most databases employ structured query language (SQL).

1.3 Problem Statement

During the cupping process, the cups that is attached to the patient's body would act as a vacuum that will suck up the oxygen in the cup. In the course of the suction process, a type of gas would be produced inside the cup. However, the gas produced inside the cup has the potential to be harmful for the practitioner preforming during the therapy session.

Moreover, the monitoring of gas released in the cup can be used to indicate the level of healthiness of the patient. No recorded status of the healthiness based on the gas released of the patient during the cupping process.

1.4 Objective

The main objectives of this project are:

- To develop gas detection mechanism.
- To design the gas sensor using array for sensors which are MQ5 (CO_2), MQ7 (CO_2), MQ135 (NH_3) and MQ131 (NO).
- To test of the system for dry and wet cupping system

1.5 Project Scope

- The main goal of this project is to design a hardware mechanism in accordance to the cupping system. To achieve the first objective, select the suitable sensor for gas detection. Design the gas sensor using array for sensors which are MQ5 (Carbon Dioxide sensor), MQ7 (Carbon Monoxide Sensor), MQ135 (Ammonia Oxide Sensor) and MQ131 (Nitric Oxide sensor)

- At the same time, the scope of work also involves the developing GUI (Graphical User Interface) that will be programmed using BLYNK. The BlYNK app would then display the data of the sensor.

- Lastly, to design the hardware mechanism which can be implemented during the dry and wet cupping process for all cup sizes.

CHAPTER 2

LITERATURE REVIEW

2.1 Introduction

This chapter will provide the review from previous research that is related to this project. For the history of cupping, the cupping therapy is exist since the ancient Egyptians around 1500 B.C. From the Egyptians, cupping was introduced to the ancient Greeks, where Hippocrates and Galen was also the great advocates of Hijamah(Micunovic, 2014). Then, from the ancient Greeks and Romans, through the Alexandrians and Byzantines, cupping therapy was passed on to the Muslim Arabs and Persians. Prophet Mohammed sanctioned the use of cupping. There are two types of cupping which is dry cupping, involve suction only and wet cupping involves combination of suction and controlled medicinal bleeding. There many different methods to vacuum or sucking the blood from the body including sucking with the mouth directly over a cut and wound, using leech to draw blood, the use of instruments such as animals horn, or the more modern methods of using bamboo, glass or plastic cups. Besides that, based on the review, the nitric oxides gas will appeared inside the cup when apply cupping. This nitric oxides gas produces by the pathogen that come out with the interstitial fluid and lymph. Pathogen is a microorganism that cause diseases. For the hardware, there are many gas sensor that can be used which is electrochemical sensor, general gas sensor, catalytic sensor and sensor array. In this project used general gas sensor. For the microcontroller, ESP32 is used.

2.2 History of Cupping

The earliest recorded references to Cupping Therapy use are found in the Ebers Papyrus, written by Ancient Egyptians in Hieroglyphics, about 1550 B.C(Qureshi et al., 2017).Ge Hong (281–341 A.D.), a well-known Taoist alchemist and herbalist from China is also known to have written on Cupping Therapy. Cupping Therapy use in Egypt dates to 3500 B.C. and its practice is documented in hieroglyphic writing(Pictures, 2021).In ancient Greece, Hippocrates advocated Cupping Therapy for many ailments(Shixi & Yu, 2006). In the early 1900s, Sir Arthur Keith (1866–1955 B.C.) mentioned that Cupping Therapy was performed with successful outcomes(Ry, 2020). In China, Cupping Therapy forms one of the cornerstones of traditional Chinese medicine (TCM). Cupping Therapy is very popular in Chinese public hospitals employing Traditional Chinese Medicine, and extensive research on Cupping Therapy has been carried out in China(Cao et al., 2010).[8] The evidence-based value of Cupping Therapy has been documented through hundreds of years of research, clinical experience of practitioners and subjective experience of users worldwide. In ancient Macedonia (3300 B.C.), Cupping Therapy was to treat diseases and health disorders(Qureshi et al., 2017). In modern medical sciences, Cupping Therapy is used in a variety of human diseases(Al-Bedah et al., 2019a).

Figure 2.1:Cupping Instrument used by Aincent Egyptians.
Source: (Were, 2022)

Other than that, from the ancient Greeks and Romans, through the Alexandrians and Byzantines (Qureshi et al., 2017) cupping therapy was passed on to the Muslim Arabs and Persians. The Prophet Mohammed sanctioned the use of cupping. Figure 2.0: The cupping instruments during ancient Egyptians7 There are some hadeeth on hijamah. Example Jabir bin Abdullah (RA) relates that he heard Rasulullah (SAW) saying: “If there is any good in your treatments it is in the blade of the Hajjam, a drink of honey or branding by fire whichever suits the ailment, and I do not like to be cauterized” (Bukhari and Muslim) (Prophet, n.d.).

Cupping is now an important and popular therapeutic modality of Unani Medicine. The cupping technique soon spread through the medicine world, throughout Asian and European civilizations. Each country is having their own name for cupping therapy and having their own methods of cupping. As example as in figures below.

Figure 2.2: Horn Cupping in Indonesia.
Source: (Shows et al., n.d.)

Figure 2.3: 19th Century Cupping.
Source: (Therapy, 1862)

2.3 Cupping Therapy

Cupping is a simple application of quick, vigorous, rhythmical strokes to stimulate muscles and is particularly helpful in the treatment of aches and pains associated with various diseases. Thus, cupping carries the potential to enhance the quality of life.(Al-Bedah et al., 2019a) Each cupping session takes about 20 min and could be conducted in five steps. The first step includes primary suction. In this phase, the therapist allocates specific points or areas for cupping and disinfects the area. A cup with a suitable size is placed on the selected site and the therapist suck the air inside the cup by flame, electrical or manual suction. Then the cup is applied to the skin and left for a period of three to 5 min. When doing the dry cupping treatment, after placing the cup towards the skin within this time, the cup is then release to expose its gasses. If it is Wet Cupping, the process will proceed to the second step.

The second step is about scarification or puncturing. Superficial incisions are made on the skin using Surgical Scalpel Blade No. 15 to 21, or puncturing with a needle, auto-lancing device or a plum-blossom needle. The third step is about suction and bloodletting. The cup is placed back on the skin using the similar procedure described above for three to 5 min. The fourth step includes the removal of the cup, followed by the fifth step, which includes dressing the area after cleaning, and disinfecting with FDA approved skin disinfectant. Furthermore, suitable sizes of adhesive strips are then applied to the scarified area, which remain there for 48 h. (Al-Bedah et al., 2019b)It is wise to know that the suction and scarification are the two main techniques of wet cupping therapy. Each technique of cupping might be responsible for certain changes at the level of body cells, tissues or organs. Specific interventions could enhance or suppress body hormones, or it might stimulate or modulate immunity, or it may get rid of harmful substances from the body, and eventually it might ease the pain.

Figure 2.4: Dry Cupping.

Source: (*Active Care Physiotherapy Nd Sports Injury Center* , 2021)

Figure 2.5: Wet Cupping.
Source: (*Active Care Physiotherapy Nd Sports Injury Center*, 2021)

There is a variety of methods for sucking or vacuuming blood from the body, including sucking directly with the mouth over a cut or wound (as in the case of poisonous wounds). Drawing blood with a leech, or using instruments like an animal's horn, or the more sophisticated. Using bamboo, glass, or plastic cups with a fire or pump mechanism is a modern method.

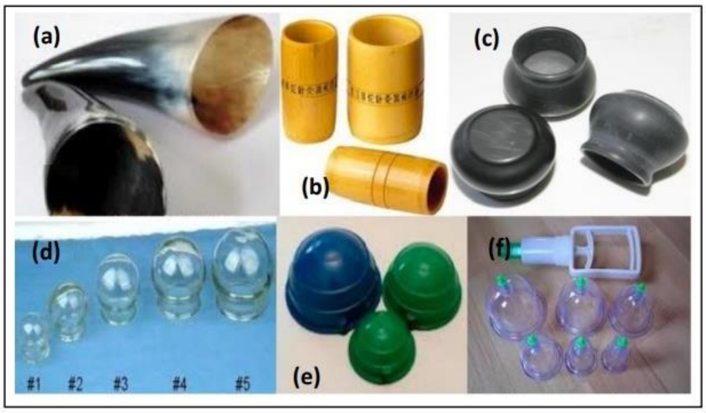

Figure 2.6: Types of cups, a) Animal Horns b) Bamboo Cups C) Metal Cups d) Glass cups, e) Pottery, f) Plastic Cups.

Traditional cupping, with use of heated cups, also has some similarity to moxibustion therapy (Mehta & Dhapte, 2015) .Heating of the cups was the method used to obtain suction: the hot air in the cups has a low density and, as the cups cool with the opening sealed by the skin, the pressure within the cups declines, sucking the skin into it. In this case, the cups are hot and have a stimulating effect something like that of burning wool as shown in figure below.

Figure 2.7: Heating of Cup.
Source: (In, 2019)

Figure 2.8: Moxibustion Method.
Source: (Facts, n.d.)

2.4 Gas Released During Cupping Therapy

When the negative pressure is applied to the skin surface the first time a cup is applied, the skin surfaces lifted up into the cup due to its viscoelastic nature. The local pressure around the capillaries present insides this pocket lifted into the cup increased capillary filtration and thereby collection of filter fluids which include causative pathogenic substances (CPS), old and damaged red blood cells, in addition to lymph and interstitial fluid in the interstitial space of this pocket (Mehta & Dhapte, 2015)as shown in figure below.

Figure 2.9: Fluid mixtures during cupping therapy showing blood clots.
Source: (Mehta & Dhapte, 2015)

Only a suction stimulation is done on the disturbed point and thereafter the red blood cells from the vascular system are brought out to the surrounding tissue areas without injuring capillary vessels

This cupping practice also caused the production of endogenous nitric oxides, which contained inside the causative pathological substances. Figure 18 show the causative pathological substance present in the blood and the interstitial fluids.

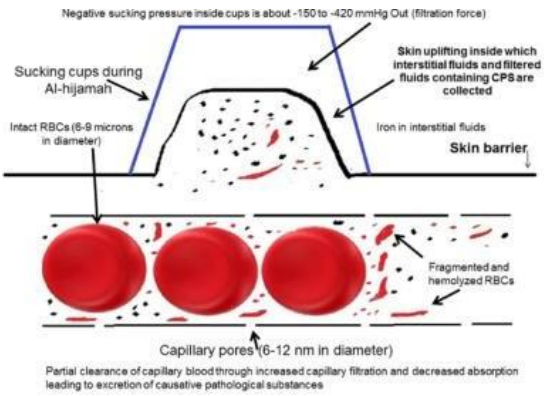

Figure 2.10: Causative pathological substances in the blood Vessels.
Source: (Mehta & Dhapte, 2015)

From the Taiba theory (Mehta & Dhapte, 2015) hijamah is minor surgical excretory procedure and its effect is similar to the mechanism of excretory function via glomerular filtration of the kidney, as well as abscess drainage, by which pathological (disease causing) substances are removed from the body.

2.4.1 Pathogen

A pathogen is an organism that causes disease. Our body is naturally full of microbes. However, these microbes only cause a problem if your immune system is weakened or if they manage to enter a normally sterile part of your body (Seladi-Schulman, 2019) .Pathogens are different and can cause disease upon entering the body. All a pathogen needs to thrive and survive is a host. Once the pathogen sets itself up in a host's body, it manages to avoid the body's immune responses and uses the body's resources to replicate before exiting and spreading to a new host. Pathogens can be transmitted a few ways depending on the type. They can be spread through skin contact, bodily fluids, airborne particles, contact with faces, and touching a surface touched by an infected person.

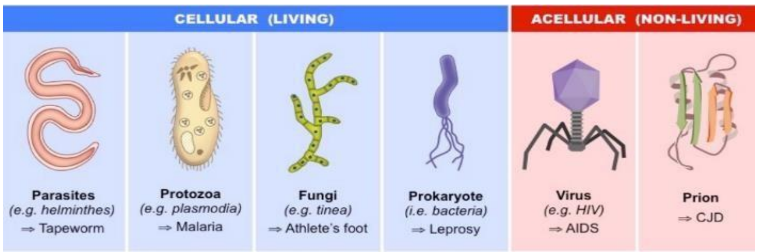

Figure 2.11: Different types of Pathogens.
Source: (Hafeez, n.d.)

Microorganisms such as viruses or bacteria that are transported in the bloodstream and can cause disease in humans are known as blood borne pathogens (2021, 2019) .Pathogenic microorganisms that are present in human blood called blood borne pathogen (BBP). Malaria, syphilis, and brucellosis are among the many bloods borne diseases, as are Hepatitis B (HBV), Hepatitis C (HCV), and the Human Immunodeficiency Virus (HIV) (HIV). Infected human blood and other potentially infectious bodily fluids such as semen, vaginal secretions, cerebrospinal fluid, amniotic fluid, saliva (in dental operations), and any bodily fluid clearly contaminated with blood can spread blood borne infections including HBV and HIV.

2.5 Nitric Oxide (NOx)

One of the earliest gases to be found was nitric oxide. In 1772, Joseph Priestley discovered it. For more than two centuries, this colourless, odourless gas was thought to be extremely dangerous. (Historic & Landmark, 2000).

Nitric oxide is formed by the high temperature oxidation of nitrogen, Equation, or the platinum catalysed oxidation of ammonia at 800 °C, which has a chemical Equation of,

$$N_2 + O_2 \rightarrow 2NO \tag{2.1}$$

$$4NH_3 + 5O_2 \rightarrow 4NO + 6H_2O \tag{2.2}$$

Nitric oxides have been discovered to play a substantial biological role in the last ten years. Endothelial cells secrete a chemical that causes the smooth muscle in the arteries to relax. (Historic & Landmark, 2000) This molecule is referred to as endothelium-derived relaxing factor (EDRF). The oxidation of L-arginine produces EDRF, which is Nitric Oxide.

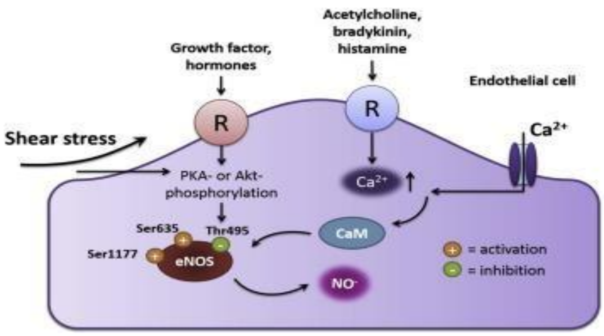

Figure 2.12: Nitric Oxide Content in endothelium cell.
Source: (Paper, 2017)

2.6 The Role of Nitric Oxide in The Human Body

Nitric oxide is a naturally occurring chemical that plays a crucial role in many aspects of your health. Its primary function is vasodilation, which involves relaxing the inner muscles of blood arteries, allowing them to widen and enhance circulation. (Chen et al., 2008) Nitric oxide production is critical for overall health because it permits blood, nutrients, and oxygen to flow properly and efficiently to all parts of the body. In fact, a lack of nitric oxide production is linked to heart disease, diabetes, and erectile dysfunction.

2.6.1 Nitric Oxide as a Regulator of Cardiovascular System

Calcium-dependent NOS is present in vascular endothelial cells. NOS synthesises NO to keep blood pressure in check.

Endothelial cells produce NO, which diffuses in all directions. About 70%–90% of the NO generated by the endothelium is carried away by the blood, where it is used to prevent platelet aggregation and blood clot formation. The remaining NO diffuses to the inner surfaces of arteries and veins, causing smooth muscle relaxation. The surrounding smooth muscle relaxes, allowing the blood artery to widen and lowering blood pressure. At a given blood flow, the cardiovascular system maintains a consistent quantity of NO. The endothelium releases more NO to maintain a steady concentration in the blood stream when blood flow increases.

NO can also be released by platelets in the blood. Platelets release NO, which prevents blood coagulation, the creation of 50 thrombi, and artery obstruction. This process' pathophysiology causes coronary thrombosis, which is a significant cause of stroke. (Badimon et al., 2012) The figure below shoe Nitric Oxide in the cardiovascular system.

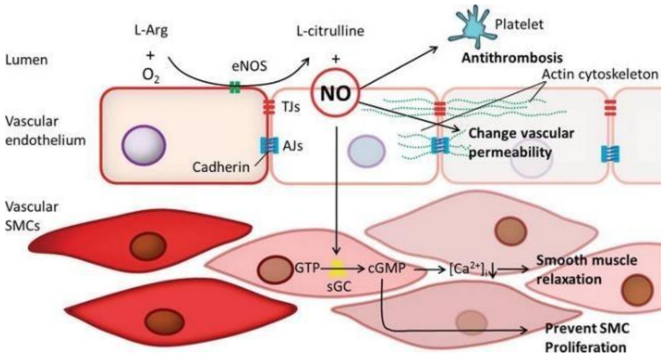

Figure 2.13: Nitric Oxide in the cardiovascular system.
Source: (He et al., 2020)

2.6.2 Nitric Oxide in the Nervous System

NO is a neurotransmitter produced in the peripheral nervous system that aids in the control of the circulatory, respiratory, and digestive systems.

NO is a neurotransmitter in the cerebellum of the central nervous system. In a blood artery, its activity mediates the contact between endothelial cells and smooth- muscle cells. Postsynaptic neurons emit NO, which activates adjacent neurons. The figure below shows the nitric oxide signal in the central nervous system.

In this process, NO might operate as a retrograde messenger. The hippocampus's suppression of NO release limits long-term potential and reduces learning capacity. (Badimon et al., 2012)(He et al., 2020)

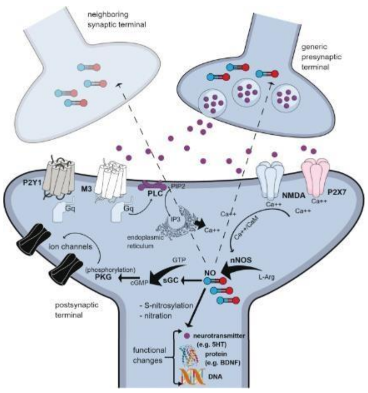

Figure 2.14: Nitric oxide signal in the central nervous system.
Source: (He et al., 2020)

2.6.3 Pathology of Nitric Oxide release

One of the ten smallest molecules present in biological systems is nitric oxide. Many cells and tissues in the body rely on nitric oxide for their daily functions. As a result, any abnormality in NO production in the body might result in 53 types of different diseases. (Badimon et al., 2012)(He et al., 2020)

Table 2.1:Physiological and pathological effects of NOx in respiratory system.

Target	Physiology	Pathology
Airway smooth muscle	**Relaxation-bronchodilation**	• **Hyperactivity depending on activity of iNOS** • **Proliferation, airway narrowing**
Vessels	**Relaxation-vasodilation**	• **Washout of brochonstrictory mediators** • **Exudation and edema**
Immune system	**Anti-inflammatory effects** • **Function of leukocytes** • **Permeability of endothelial cells** • **Activation of mast cells**	**Pro-inflammatory effects** • **Eosinophilic infiltration** • **Vascular permeability** • **Airway narrowing**
Epithelium	**Regulation of mucociliary transport** • **Rate of ciliary beat** • **Mucus viscosity**	**Regulation of mucocilliary transport** • **Mucus output**

The table above shows clearly shows that, Nitric oxide is a necessary chemical for general health and wellbeing. Nitric oxide acts as a vasodilator, causing blood vessels to relax and expand.

Blood, nutrients, and oxygen can readily circulate to all parts of your body because of this effect. However, if your nitric oxide production is reduced, your health may be jeopardized. As a result, it is critical to reach and maintain appropriate nitric oxide levels in your body.

2.7 Available Research

Based on the current available research, a thesis has been done one the subject of Development of gas detection on cupping practice by a University Malaysia Pahang student by the name of Nursyazwani binti Khazanah (Development Of Gas Detection On Cupping Practice, Nursyazwani Binti Khazanah.2016.).

Based on her research, she has found that Nitric Oxide Gas does appear inside the cup during the cupping process and a microorganism called pathogen produces the gas. The pathogen secreted by this microorganism is found to be dangerous and has the potential to cause deadly diseases. It is also worth mentioning that, the gas produced inside the cup is detected by using the sensors that have been chosen which are MQ4 (Natural gas sensor), MQ7 (Carbon Monoxide Sensor), MQ8 (Hydrogen gas Sensor) and MQ8 (LPG gas sensor). The design used for the sensor to detect gas is in array design. This type of design was able to detect the gas inside the cup, which is unknown gas and produced the patent while doing dry and wet cupping. The gas was then analysed while doing dry and wet cupping. The comparison between both this processes is done based on the time taken. The pattern while doing dry and wet cupping is plotted based on the readings by the serial monitor.

(Development Of Gas Detection On Cupping Practice, Nursyazwani Binti Khazanah.2016.).

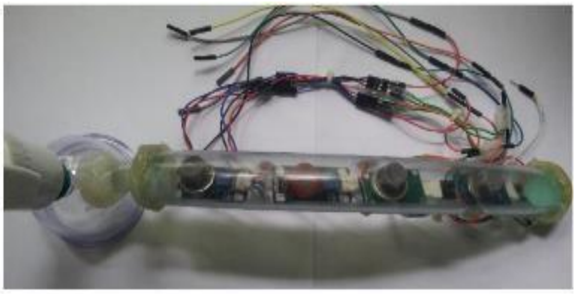

Figure 2.15: Gas sensor detection Mechanism done by the student.
Source: (Development Of Gas Detection On Cupping Practice, Nursyazwani Binti Khazanah.2016.)

2.7.1 Cupping Therapy: An Overview from a Modern Medicine Perspective

(Tamer S. Aboushanab, Saud AlSanad, 7 February 2018)

Early classification of cupping therapy categorized it broadly into dry and wet cupping. Another classification of cupping therapy was developed in 2013, categorizing cupping into five categories. The classification was updated in 2016. The updated classification categorized cupping therapy into six categories. The first category is “technical types”, which includes dry, wet, massage, and flash cupping. The second category is “power of suction”, which includes light, medium, and strong cupping. The third category is “method of suction”, which includes fire, manual vacuum, and electrical vacuum cupping. The fourth category is the “materials inside cups”, which includes herbal, water, ozone, moxa, needle, and magnetic cupping. The fifth category is “area treated”, which includes facial, abdominal, female, male, and orthopedic cupping. The sixth category is “other cupping types”, which includes sports, cosmetic, and aquatic cupping.

2.7.2 Cupping Therapy for acute and chronic pain management: a systematic review of randomized clinical trials

(Huijuan Cao, Xun Li, Xue Yan, Nissi S. Wang, Alan Bensoussan, Jiaping Liu, 9 December 2014)

A typical cupping therapy set should contain six or more different-sized cups and a method of suction. Cupping therapy sets can be classified into three main categories: the first category is “cupping sets related to the types of cups”, which includes plastic, glass, rubber, bamboo, ceramic, metal, and silicone cupping sets. The second category is “cupping sets related to the methods of suction”, which includes manual, automatic, and self-suction cupping sets. The third category is “cupping sets related to uses”, which includes facial, female, male, and massage cupping sets.

2.7.3 Interfacing of Ammonia Gas Sensors Using IoT Technology

(Tarun, G. Swetha, S. and Abhishek, M. ,2017)

The sensor used in this project is MQ-137 while using an ATMEGA64 as the microcontroller. This project uses an alarm and led display for audio and visual warning if there is an ammonia gas leakage. The project also proposed multiple sensors to cover a wide area and uses a decoder to pin point which sensor detects the leak. 2.1.2 Ammonia Gas Leakage Monitoring System Using MQ-137 Sensors, IoT and Framing suitable Reflexive Actions. (S. Vishesh, S. Manu, R.B Nakul, A. Vivek, P.K. Pragathi, and S. Swathi, 2016) The system also uses MQ-137 sensor but uses Arduino for its microcontroller. The purpose of the project is to detect ammonia gas leakage for an ammonia refrigeration system. The system utilizes multiple sensors as well to cover a wider area and is controlled by 1 microcontroller in which feeds readings from the sensor to an IoT cloud for recording and display of concentration of ammonia under a graph of concentration against time. The system implements a follow-up reflexive action, which requires manual operation of alarm and water sprinklers when sensors detect leakage.

2.8 Sensors

A gas sensor is a device, which detects the presence or concentration of gases in the atmosphere. Based on the concentration of the gas the sensor produces a corresponding potential difference by changing the resistance of the material inside the sensor, which can be measured as output voltage. Based on this voltage value the type and concentration of the gas can be estimated. The type of gas the sensor could detect depends on the sensing material present inside the sensor. Normally these sensors are available as modules with comparators as shown below. There are many gas sensors can be used to detect the Nitric Oxide gas inside the cup. There are MQ gas sensor which is general gas sensor, electrochemical gas sensor, catalytic gas sensor, and gas sensor array.

2.8.1 Electrochemical Sensor

Electrochemical sensor is for toxic gases, which cannot be otherwise, be detected. This sensor is suitable for Ammonia but not referents, where gas can undergo an oxidation or reduction reaction.

This sensor is very selective measure at very low levels and are highly accurate. The lifespan of the sensor is three years. The figure below shows example of the electrochemical sensor, which is nitric oxide gas sensor.

Figure 2.16:Electrochemical Sensor.

Source: (Monoxide et al., n.d.)

2.8.2 Catalytic Sensor

Catalytic sensors are based on flammable gas oxidation: when a combustible gas encounters the catalyst surface, it is oxidized. The reaction releases heat, which causes the resistance of the wire to change.

Environmental conditions such as temperature, humidity and pressure variation, and influence both of the beads (the active sensor and the reference) therefore the Wheatstone bridge will not be unbalanced.

Figure 2.17: Catalytic Sensor.
Source: (Kit & Producto, n.d.)

2.8.3 MQ Gas Sensor

MQ Gas sensor have many types which is MQ-2, MQ-3, MQ-4, MQ-5, MQ-6, MQ-7 and many more as shown below. This sensor uses a small heater inside with an electrochemical sensor. Sensitive for a range of gases and used indoors at room temperature. Output analogue signal and can be read with an analogue input of Arduino.

Figure 2.18: MQ Gas Sensor.
Source: (Cart, n.d.-a)

2.8.4 Caron Monoxide Sensor (MQ7)

The MQ7 is a simple-to-use Carbon Monoxide (CO) sensor suitable for sensing CO concentrations in the air. It can detect CO-gas concentrations anywhere from 20 to 2000ppm. The sensitivity can be adjusted by the potentiometer.

This sensor has a high sensitivity and fast response time. The sensor's output is an analogue resistance. The drive circuit is very simple, just power the heater coil with 5V, add a load resistance, and connect the output to an ADC.

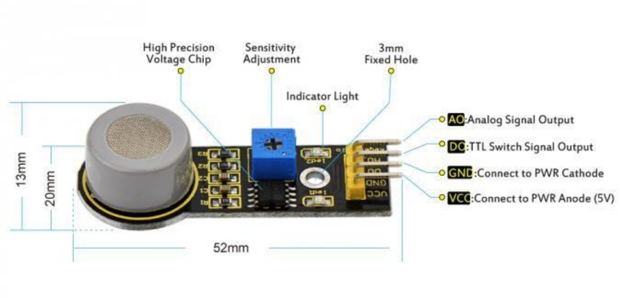

Figure 2.19: Carbon Monoxide Sensor (MQ7).
Source:(Components & Request, n.d.)

Table 2.2: Specification table of MQ7

Symbol	Parameters	Technical parameters	Remark
Rs	Surface resistance of sensitive body	2-20K	In 100ppm Carbon Monoxide
a(300/100ppm)	Concentration slope rate	Less than 0.5	Rs(300ppm)/Rs(100ppm)

Symbol	Parameters	Technical parameters	Remark
Standard Working condition	Temperature -20°C ± relative humidity 65% ± 5% RL:10KΩ ±5% Vc:5V ± 0.1V VH:5V ± 0.1V VH:1.4V ±0.1V		
Preheat time	No less than 48 hours	Detecting range: 20ppm-200ppm carbon monoxide	

2.8.5 Caron Dioxide Gas (Mq5)

The Gas Sensor (MQ5) module is useful for gas leakage detection (in home and industry). It is suitable for detecting H2 (Hydrogen), LPG (Liquid Petroleum Gas), CH4 (Methane), CO2 (Carbon Dioxide) and Alcohol. Due to its high sensitivity and fast response time, measurements could be obtained quickly. The sensitivity of the sensor could be adjusted by using the potentiometer. The minimum concentration we can test is 200ppm and the maximum is 10000ppm.

Figure 2.20: Carbon Dioxide Gas (MQ5).
Source:(Here et al., n.d.)

Table 2.3: Specification Table of Gas Sensor MQ5

Symbol	Parameters	Technical parameters	Remark
Rs	Sensing resistance	10k Ω-60k Ω (5000ppm methane)	In 100ppm Carbon Monoxide
a(5000ppm/1000ppm CH4)	Concentration slope rate	Less than 0.6	Detecting concentration scope: 200-1000ppm
Standard Working condition	Temperature -20°C ± 2°C relative humidity 65% ± 5% Vc:5V ± 0.1V VH:5V ± 0.1V Vh:5V ±0.1V		LPG,LNG Natural gas, iso-butane, propane Town gas.
Preheat time	No less than 48 hours		

2.8.6 Ammonia Oxide GAS SENSOR (MQ135)

The MQ135 gas sensors used to detect Nitric oxide gas. It is normally used to detect leakage/excess of gases like Ammonia, nitrogen oxide, alcohols, aromatic compounds, sulphide and smoke. The MQ135 could detect Nitric Oxide gas anywhere from 400 – 1000ppm. This sensor has a wide detecting scope as well as also having the ability of fast response with High Sensitivity. The sensor can be easily configured as an alarm unit. The sensor can also sense Alcohol and Benzene Gas.

Figure 2.21 : Ammonia Oxide Gas Sensor (MQ135).
Source:(More, n.d.)

Table 2.4: Specification Table of Gas Sensor MQ135

Symbol	Parameters	Technical parameters	Remark
Rs	Sensing resistance	30k Ω-200k Ω (1000ppm NH3)	Detecting concentration scope: 10-300ppm NH3 10ppm-1000ppm Benzene 10ppm-300ppm Alcohol
a(200/50 NH3)	Concentration slope rate	Less than 0.65	
Standard Working condition	Temperature -20°C ± 2°C relative humidity 65% ± 5% Vc:5V ± 0.1V VH:5V ± 0.1V Vh:5V ±0.1V		
Preheat time	No less than 24hours		

2.8.7 Ammonia Oxide Gas Sensor (Mq131)

The MQ131 will be used in this experiment to detect Nitric Oxide gas. The MQ-131 Gas sensor can detect or measure gasses like Ammonia (NH3) and Nitric Oxide (NOx). For the sensor, that we used in this project, which is MQ131, used tin dioxide (SnO2) for the gas-sensitive material, which has low conductivity in clean air. When the Nitric Oxide (NOx) exists, the sensor's conductivity gets higher along with the gas concentration rising.

Figure 2.22: Nitric Oxide Gas Sensor (MQ131).
Source: (Cart, n.d.-b)

Table 2.5: Specification Table of Gas Sensor MQ131

Symbol	Parameters	Technical parameters	Remark
Rs	Sensing resistance	30k Ω-200k Ω (2000ppm O3)	Detecting concentration scope: 10-300ppm O3 10ppm-1000ppm Benzene 10ppm-300ppm Alcohol
a(200/50 O3)	Concentration slope rate	Less than 0.6	
Standard Working condition	Temperature -20°C ± 2°C relative humidity 55% ± 5%RH Vc:5V ± 0.1V VH:5V ± 0.1V Vh:5V ±0.1V		
Preheat time	No less than 48hours		

2.8.8 Gas Measurement Concept

The electronic nose or eNose is "an instrument which comprises an array of electronic chemical sensors with partial specificity and an appropriate patter-recognition system, capable of recognizing simple or complex odours. (Kauer & White, 2009)The response of this sensor array constitutes an odour pattern. A single sensor in the array should not be highly specific to its response but should respond to a broad range compounds, so that different patterns are expected to be related to different odour.

2.9 Microcontroller

The microcontroller used in the project is ESP 32. Espressif Systems' latest product, the ESP32, is designed for Internet of Things and embedded system projects. The ESP32 is a low-cost, low-power microcontroller series with Wi-Fi and Bluetooth capabilities, as well as a highly integrated structure driven by a dual-core Tensilica Xtensa LX6 microprocessor. It is a low-cost, low-power system-on-a-chip microcontroller with Wi-Fi and dual-mode Bluetooth built in. The ESP32 is the project's brains. A microcontroller board links all of the sensors together. The board is programmed with the source code to carry out the project's functions. On the ESP32, the source code is saved in the on-chip memory. This block serves as a conduit between the coder and the end user. As a result, it is regarded as the project's heart. The operating voltage range for the ESP32 is 2.2 to 3.6V. In normal operation, the ESP32 device will supply 3.3V to the chip. Figure 3 shows the pin description for the ESP32.

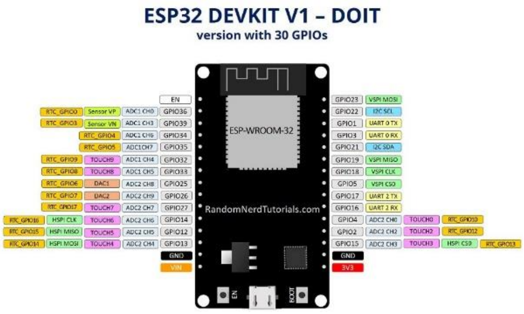

Figure 2.23; ESP 32.

Source: (Santos, 2018)

2.10 Display

To display the reading of the sensor for the user, BLYNK app is used. Blynk is an iOS and Android platform for controlling Arduino, Raspberry Pi, and other Internet-connected devices. It is a digital dashboard where you may drag and drop widgets to create a graphic interface for your project. Blynk is not bound to any particular board or shield. Instead, it is about allowing you to use whatever gear you want. Blynk will be online and ready for the Internet of Things whether you are Arduino or Wi-Fi, Ethernet, or an ESP32 microchip connects Raspberry Pi to the Internet.

Figure 2.24: Blynk as a display.
Source: (Ryan & Jonathan, n.d.)

2.11 Database System

A database is a logically structured collection of data that is often stored and accessed electronically through a computer system. Where databases are more complicated, formal design and modelling techniques are frequently used. The database management system (DBMS) is the software that captures and analyses data through interacting with end users, applications, and the database itself. The database management system (DBMS) software also includes the essential tools for managing the database. A "database system" is the combination of the database, the database management system, and the accompanying applications.

2.11.1 Internet Of Things (IoT)

The Internet of Things, commonly known as simply IoT. This is an emerging field of technology where devices or objects have the ability to connect and transfer data over a network without human intervention. These objects or things have sensing capabilities, and they have unique identifiers for addressing and communication. To transfer data from the devices over the internet, cloud computing provides the infrastructure for that data to travel to its destination. Over the years, vendors have created many connected devices, and in the same vein, a lot of IoT cloud platforms have been developed. Examples of IoT cloud platforms include ThingsBoard, ThingWork, IBM Watson IoT, Node-RED, Thinger, and ThingSpeak.

2.11.2 The Cloud

Recent advances in information and communication technologies have given rise to a new style of computing. In this era, external users can access capabilities such as on- demand data storage and computing power over the internet. This is commonly known as cloud computing. We will discuss the process of writing data to the cloud. We will then use the ESP32, MQ7, MQ 5, MQ135, MQ131 for writing data to the cloud.

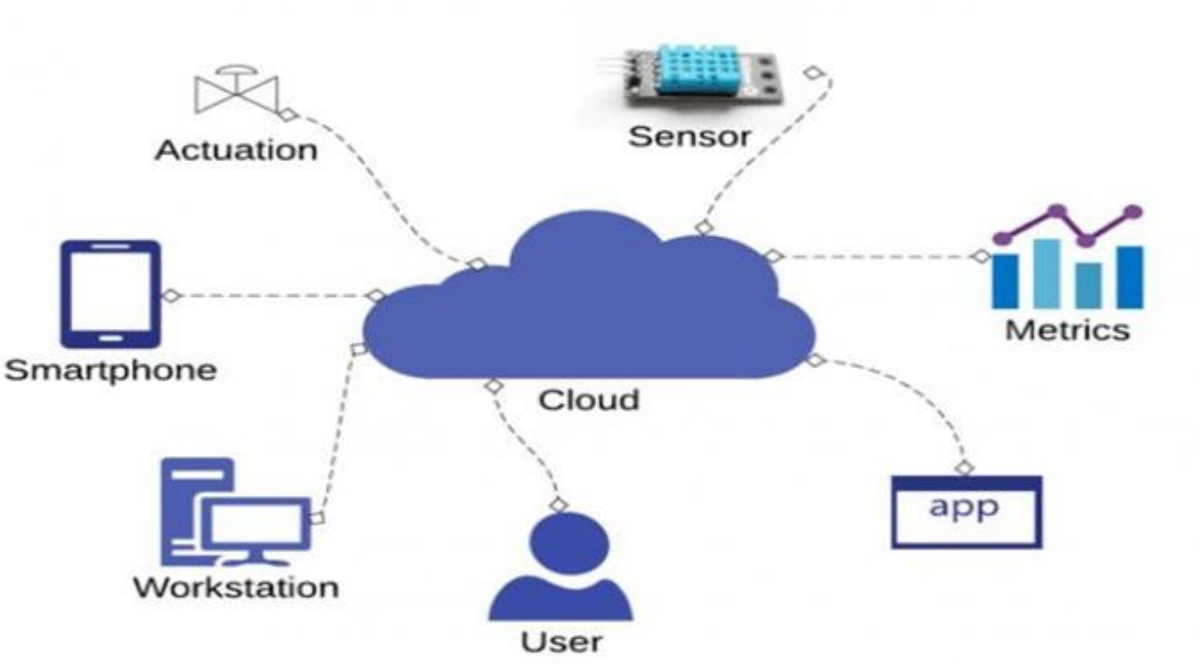

Figure 2.25: IoT Computing Diagram.
Source: (Pi, n.d.)

The diagram above demonstrates the concept of the IoT cloud. In general, computing, storage, and databases are handled by third-party entities on remote data centres instead of the user's devices or infrastructure. The same files can be accessed from any device via the internet. Additionally, users are allowed to create and manage their accounts.

2.11.3 Interface Technology

There are plenty of control unit can be used on this project. The main uses of the interface are to allow the users to interact or control the prototype with comfortable and easier manner. There are quite a varied of controller exist in this information era. There are some pros and cons exist in this entire control unit. In this literature review we will talk about the type of the controllers and their functionality

2.11.4 User Interface

User interface (UI) the means by which user or human and a computer system interact, the use of input devices and software. UI existed when the era of computer begins. That time even the Human-Computer Interaction filed by primly focusing on the graphical interface (GUI). The early futurists for this graphical interface such as Bush, Engelbart and Kay. One of example is a journal published the role of user interface in the laboratory. This allows them to conduct their research effectively. Many variations of UI are used every day.

Figure 2.26: Example of one of the User Interface we are currently used.

Based on (Weinberg & Stephen, 2002) they stated that there are some evidences that computer technology enhances the quality life of the user based on their understanding how the application works. User interface also worked as static presentation. A simple animation can fully get the attention of the user and makes the user interface much appealing. This allows the user to be more engaging. An example a simple cartoon animation can even fully engages audience, even the events that are bizarre or strange are easily comprehend. Besides that, the application of cartoon animation techniques as a means of making the interface easier to understand and more pleasant to use.

Figure 2.27: An example of animation.

2.11.5 Graphical Interface

The term or idea for a graphical user interface came from Vannevar Bush, at MIT (Massachusetts Institute of Technology) during the Second World War. Vannevar Bush is one of the famous engineers that they stated, “No man has had greater influence in the growth of science and technology than Vannevar Bush, and the 20th century may yet not produce his equal.". He also represents as a science advisor for the former president, which is John Fitzgerald Kennedy. His contribution towards UI lead to new generation of UI which enhance its efficiency (Paintbox et al., 2014).

Figure 2.28: The first mouse plugged into its display workstation – circa 1964.
Source: (Text & Today, 2021)

Now, there are GUIs for many systems. Besides using a text-based command system, users can now click on icons to carry out functions on various devices and systems. The mobile technology has been renowned to be as a new generation communication technology. This leads a new era for the GUI technology. Teacher and researchers are also interested to use the technology to engage learners to practice frequently and learn anytime, anywhere without any special technical requirements. This is one of the biggest breakthroughs that allows enhancing the existing user interface technology to something even greater.

The statistic shows the overall score of the usability are in acceptance level. The findings show the learner accepted that the UI helps to improve mobile learning application but need some few readjustments to make the whole experience even better. There are plenty of interface are used to enhance the user experience here are some of the designs that some author has proposed.

2.11.6 Working Principle of G.U.I.

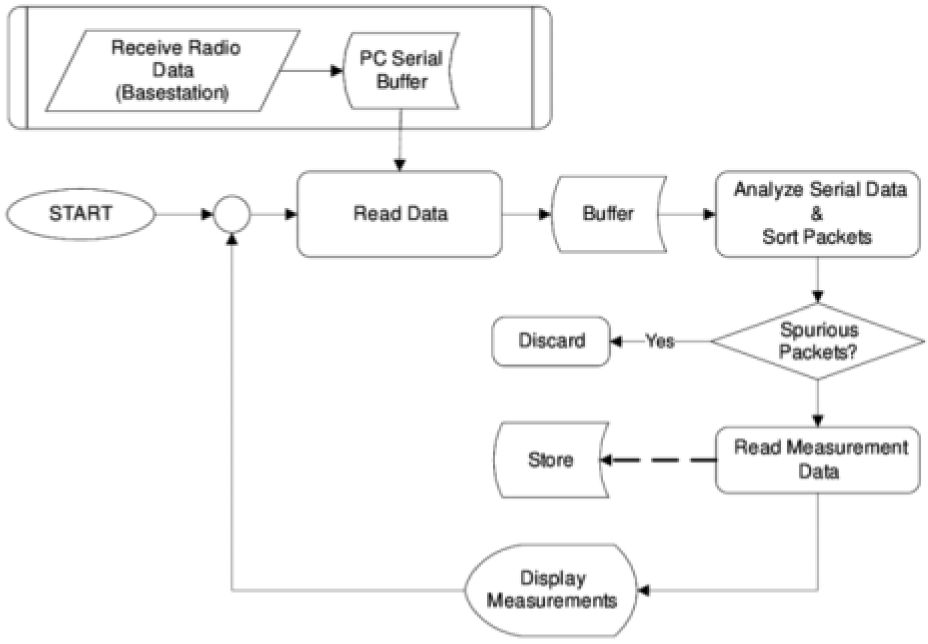

Figure 2.29: GUI working principle.

Furthermore, GUI works based on how the user interact on the image or icon that's pop up. An example when the user sees the home button in their smartphone that indicates that they are going to the homepage. The respond is received as a data by the sensors and analyses the data or information and display the result based on what does the user interact towards it.

Nevertheless, there are few design principles that to ensure to give the best performance for users. There are several crucial things that are involved on designing the GUI. Which are

- Aesthetically pleasing
- Clarity
- Compatibility
- Configurability

- Control

For aesthetically pleasing the GUI must provide meaningful contrast and use color and graphic effectively and simple. Besides that, it will best to provide three-dimensional representation. Furthermore, for clarity aspect the interface should be visually, conceptually and linguistically clear. The words and the sentence structures should be in order and simple to understand and this allows the user to use it with ease. Next, the compatibility of the GUI should be compatible with the user and adapt the user's perspective. Moreover, the GUI should be easier to configure which means that the user able personalize or customize it. Finally, the action should result from explicit user request and should be perform quickly.

CHAPTER 3

METHODOLOGY

3.1 Introduction

This chapter will cover the general flow of a cupping system, design of a database system, block diagram of a database system, general flow of a database system, design of a cupping mechanism, block diagram of a gas detection system, hardware design, cupping system circuit, and combination of system flow on a cupping system.

3.2 General Flow of Cupping System

A literature review on the issue of cupping therapy practise is necessary to begin the investigation. There will be two independent subjects that will require a literature review. A literature review of database systems and a research of cupping gas mechanics are among the subjects covered.

A database system software was designed after performing a literature review on the subject. The system is next put through its paces. If the system proves to be functional, the project may continue forwards with combining the two processes. If it does not work, the process must be repeated by re-evaluating the literature review for the subject.

After performing a literature review on the subject, develop a cupping gas mechanism. The functionality of the mechanism would then be tested. If all goes well, the project may continue forwards with combining the two processes. If it does not work, the process must be repeated by re-evaluating the literature review for the subject.

Both systems will be merged to work on the project once they are finished. To test the system's operation, an experiment on the gas contained in dry and wet cupping would be conducted. If it works, we will receive data on nitric gas concentrations, which will be sent to our database system. We will have to rethink our system combination if that does not work. After the information on nitric gas has been acquired, the project will be completed.

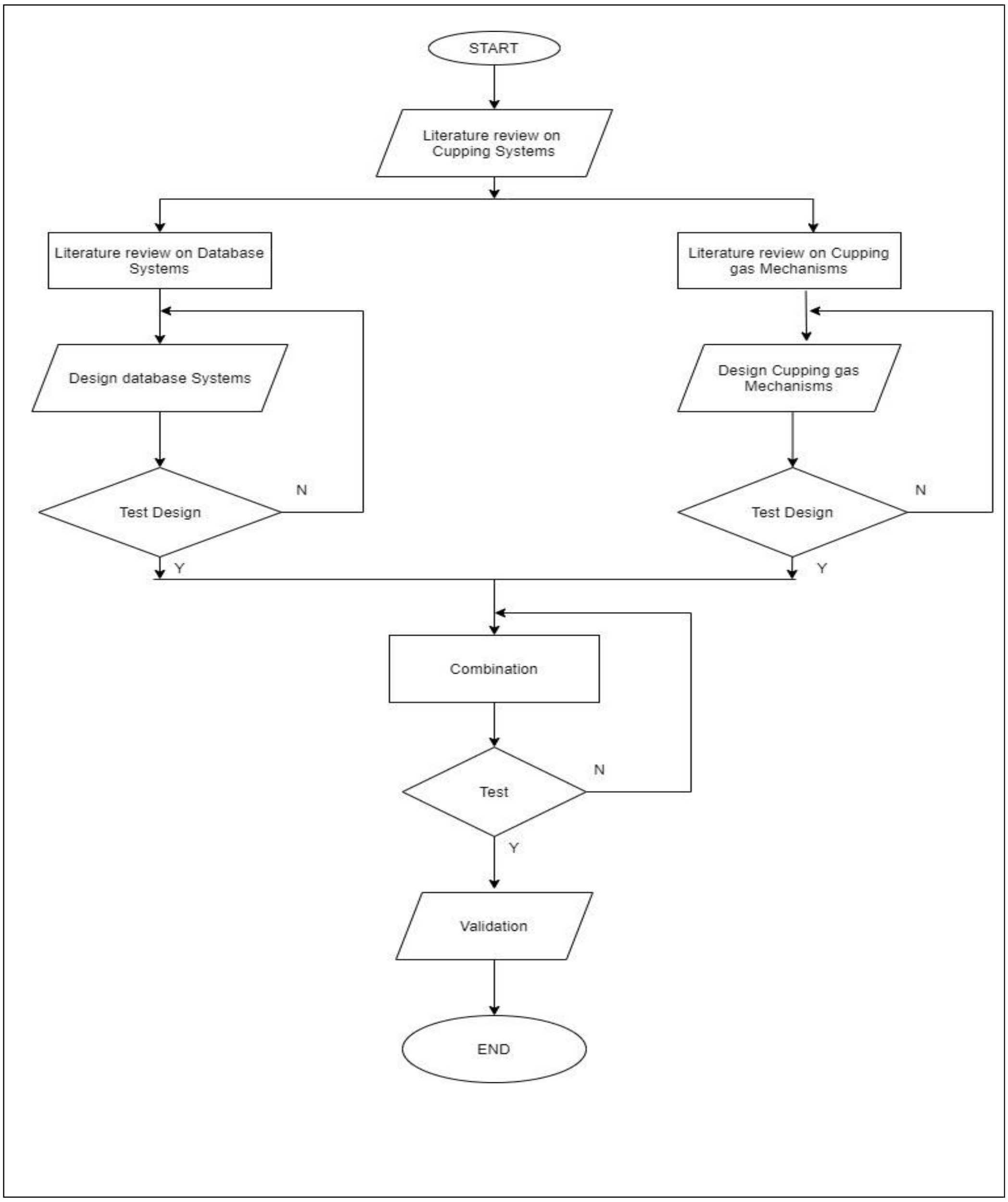

Figure 3.1: General Flow of Database System and Cupping Gas Mechanism.

3.2.1 Design Cupping Gas Mechanism

The hardware flow as in Figure 3.2 shows the hardware consists of a "Gas Chamber" Which traps the gas during the cupping process and four general Gas Sensors which is MQ7 (Carbon Monoxide gas sensor), MQ5 (Carbon Dioxide gas Sensor), MQ135(Ammonia Oxide) and MQ131 (Nitric Oxide Gas Sensor) which is placed inside the gas chamber.

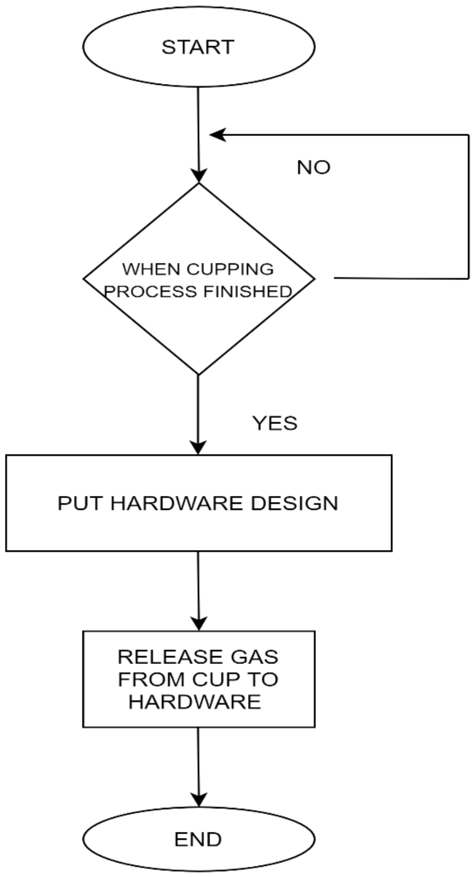

Figure 3.2: Flow of gas detection by hardware.

3.2.2 Block Diagram of Gas Detection System

During the cupping process, the practitioner would start by selecting the cupping point on the body. Then the cup would be attached towards the skin of the patient for a few minutes. Within that time, we would attach the gas chamber on the cup. When it is time to release the cup, a mechanism will pull the cupping valve, which would then release the gas. When the gas is released, all the four sensors, MQ7, MQ5, MQ135, and MQ131 will sense the gas inside the gas chamber. Then the sensor reading will be displayed on the serial monitor of ESP 32 and the Blynk App display. The figure below shows the block diagram of the gas detection on the cupping system.

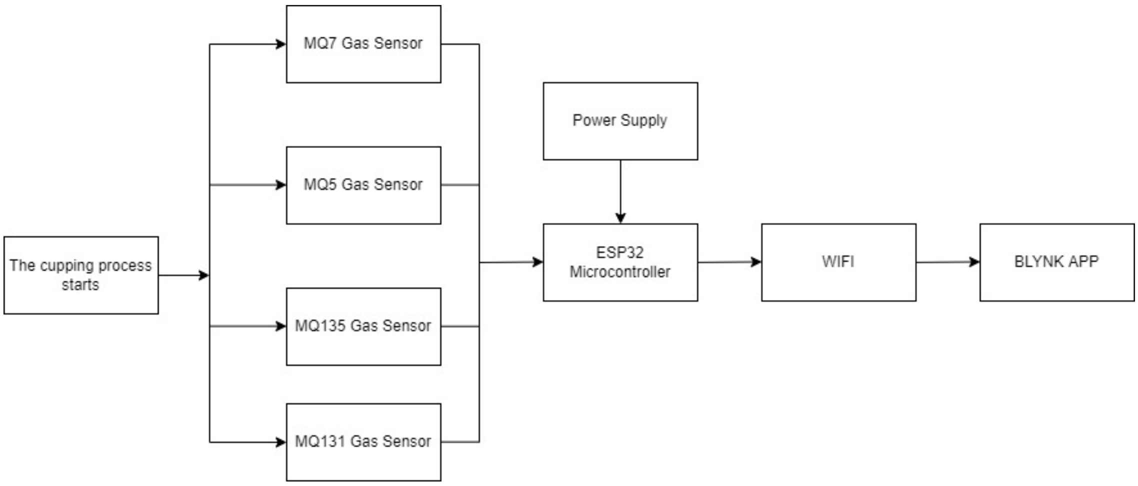

Figure 3.3: Block Diagram of Gas Detection System.

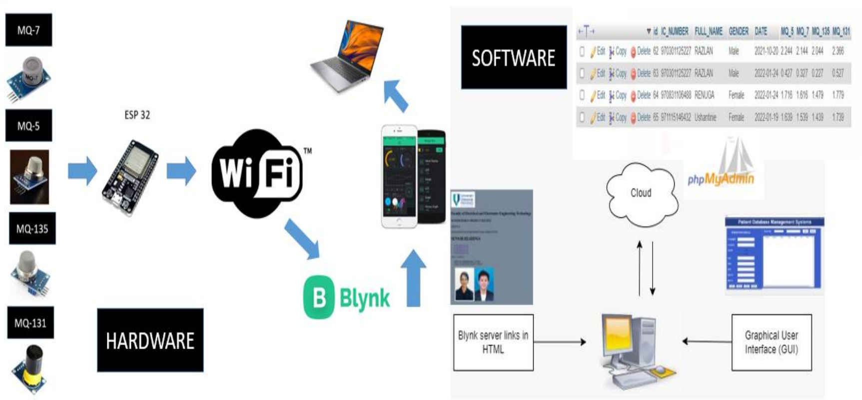

Figure 3.4: Overall system.

3.2.3 Flow

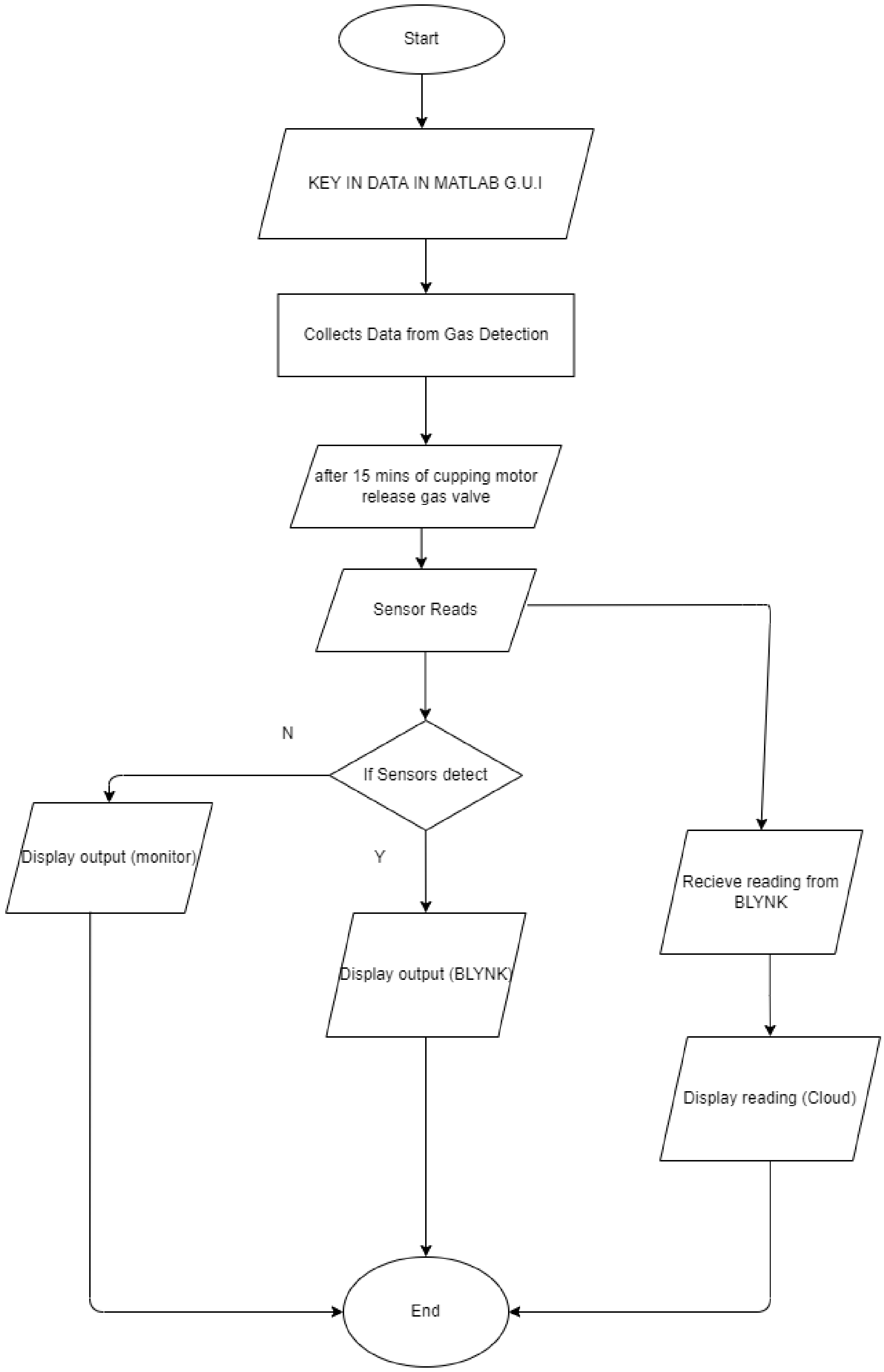

Figure 3.5: Combination of system flow.

3.3 Cupping Process

For this project, two cupping therapy methods are implemented. The cupping therapy methods are, Dry cupping, where a cup is placed on the surface of the skin according to the cupping point and then, with a suction device, the cups oxygen will be sucked out of it which creates a vacuum inside the cup which would make it attach to the skin. The other therapy used for this project is wet cupping. Wet cupping is a process where it involves puncturing the skin, which would create scratch marks to allow blood flowing out of the skin. Then the cupping process is repeated which would draw out blood using the cup.

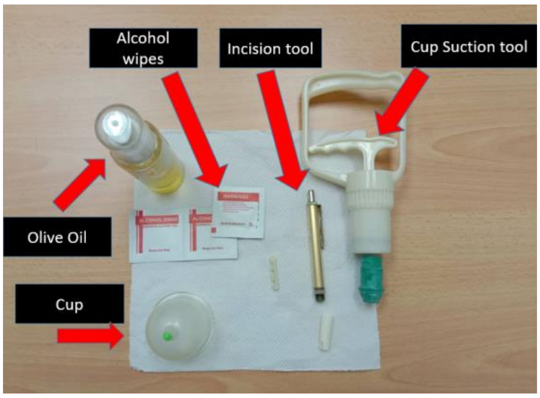

Figure 3.6:Cupping Therapy tools.

3.3.1 Dry Cupping

To start the dry cupping process, a cup is set on the surface of the skin, then a suction device is used to suck the air out of the cup when it is applied to the body which creates a vacuum that makes the cup attach to the body .the cups are applied according to cupping points and leave them on anywhere from three to 15 minutes. After the time duration, pull the lever on top of the cup to release gas inside the cup to relieve its pressure.

Figure 3.7: Sucking the cup using suction device.

Figure 3.8:Patient going through dry cupping therapy.

3.3.2 Wet Cupping

In Contrast with the dry cupping process, the wet cupping technique has more process. Because wet cupping involves the drawing out of blood, hygiene is taken into priority because blood being drawn out has the potential to cause infection. Thus, before starting the cupping process, we must first use latex gloves to prevent contaminants from the hand entering the patients' blood stream and then, alcohol wipes are used to clean out contaminants from the skin.

Figure 3.9: Alcohol Wipes applied towards the skin.

After the application of alcohol wipes towards the skin, then it is safe to use an incision tool to draw out blood from the skin. The incision tool is used to puncture the skin in a circular pattern to create scratch marks towards the skin.

Figure 3.10: Incision tool used to apply to create scratch marks.

After puncturing the patients skin, the cupping process can be repeated same as the dry cupping process where a cup is placed on top of the skin and then, by using a suction device, the cup would then be attached towards the skin and would be left with the patient for about 5-7 minutes before releasing the cup by using the lever on top of the cup.

Figure 3.11:Wet cupping in procedure.

Figure 3.12: Aftermath of wet Cupping.

3.4 Mechanism Design

Gas Chamber mechanical Design

The figure below shows the simulation of Design using AUTOCAD to simulate The "Gas Chamber" that would trap the gas on the cup by using the real specifications of a cup set. Sensors MQ5, MQ7, MQ135 and MQ131 is also simulated.

In the first design as shown in Figure, the gas chamber is sketched in the shape of a torch light design. The design is later modified so that sensors can be placed more firmly and efficiently and to prevent major amount of gas loss during gas detection in the cupping process. The other hardware parts were added to complete the overall design.

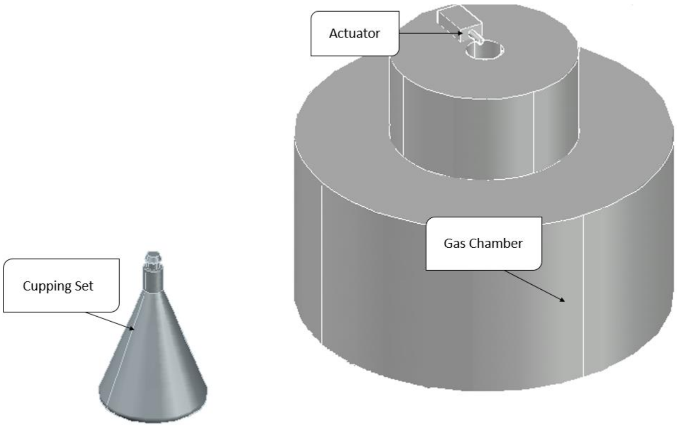

Figure 3.13: Design of the 1st illustration of the “Gas Chamber”.

The gas chamber contains four sensors, which are MQ5, MQ7, MQ135 and MQ137. The sensors is attached to the top of the “Gas Chamber” to get its reading.

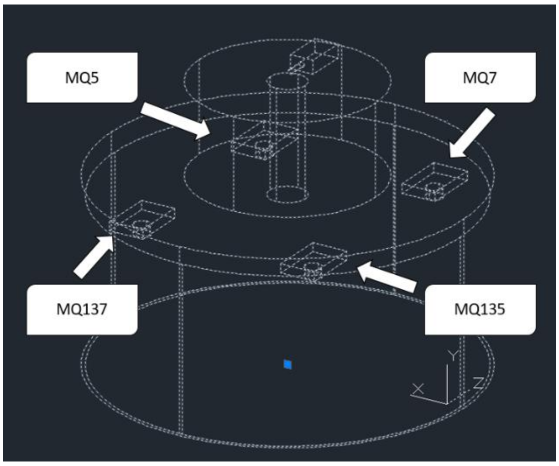

Figure 3.14: Sensor Placement of the firs “Gas Chamber”.

The gas chamber is then placed over the cup to trap the gas to get a better reading for the gas sensors. In this process, the specifications of a cup are met for the process to proceed.

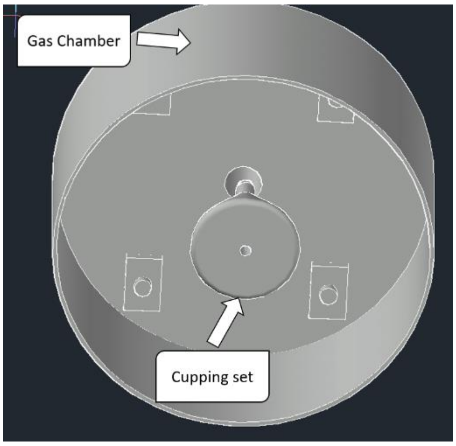

Figure 3.15: Simulation of Gas detection of the first design.

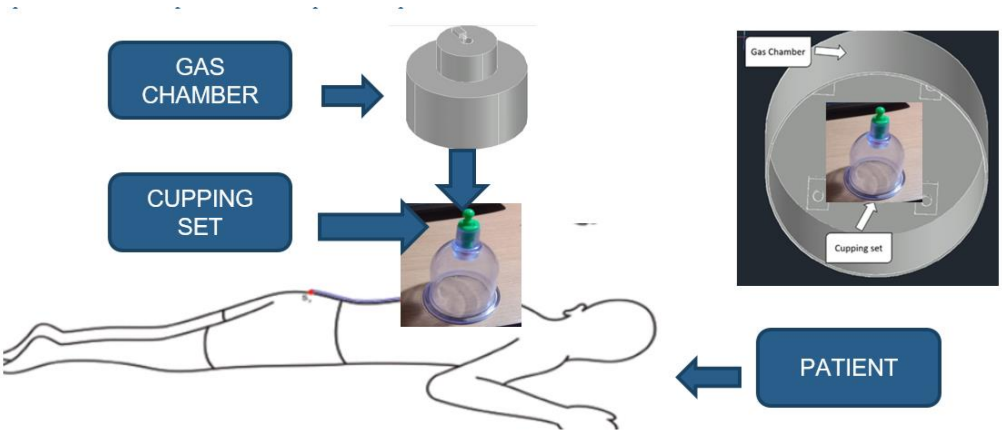

Figure 3.16: Illustration of the use of the “Gas Chamber”.

3.4.1 The second design of the “Gas Chamber”.

After further study from the first design, it is found out that the sensors would not attach well towards the “Gas Chamber” in real life application. Thus, The Second design Figure below was made. This is because after further discussions with Supervisor, a change is made towards the design of the Gas Chamber. These changes were made to make the Gas Chamber design more attractive and to have a mechanism that could better hold the four sensors and previous version. Same as the first version, hardware is also added to make a complete overview of the prototype.

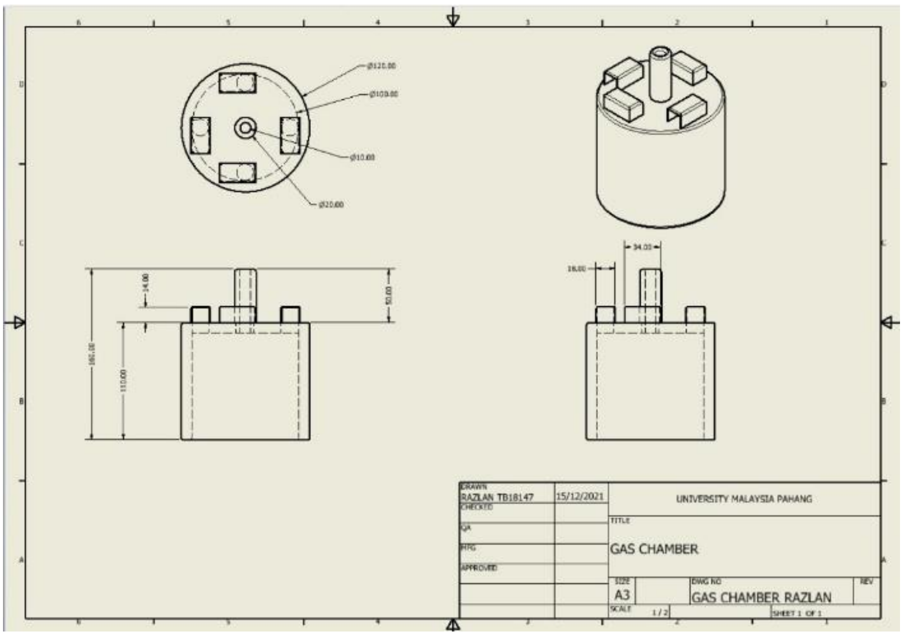

Figure 3.17: Dimensions of the Second design of the “Gas Chamber”.

3.4.2 The third design of the “Gas Chamber”.

After further study from the second design, it is found out that if the sensor placement is placed on top of the “Gas Chamber”, the amount of gas released towards the sensor placement mechanism is significant and the sensor gas reading will be unreliable due to the gas released outside of the “Gas Chamber”. Thus, The Third design at the Figure below was made. This is due to a change in the design of the Gas Chamber following further talks with the Supervisor. These adjustments were made to improve the Gas Chamber design and provide a mechanism that could better hold the four sensors while also preventing gas leakage than the prior version. Hardware is added to the prototype, just as it was in the original iteration, to give it a complete look.

Figure 3.18: Third Design of the “ Gas Chamber”.

3.4.3 The final design of the “Gas Chamber”.

The third version's final sketching was then turned into a software design. AUTOCAD INVENTOR 2021 was used to create the design. Drawings for the sensor placement mechanism and the cylinder to fit in the cupping for all sizes are involved in the process of constructing the "Gas Chamber." The microprocessor enclosure, cable management, and power source positioning are all taken into account in the design. The cup sizes were the only consideration in the early design of the gas chamber. Various versions of the “Gas Chamber " have been created in order for the design to be able to house the sensors, the microcontroller housing, the power source positioning, and have an appealing appearance. As more functions were added, the design was improved as well, as this would affect the "Gas Chamber's" stability and capability. The drawing has been updated throughout time until it reaches the final version, as shown in Figure 3.19 in which the new "Gas Chamber" concept has been fully realised and fabricated.

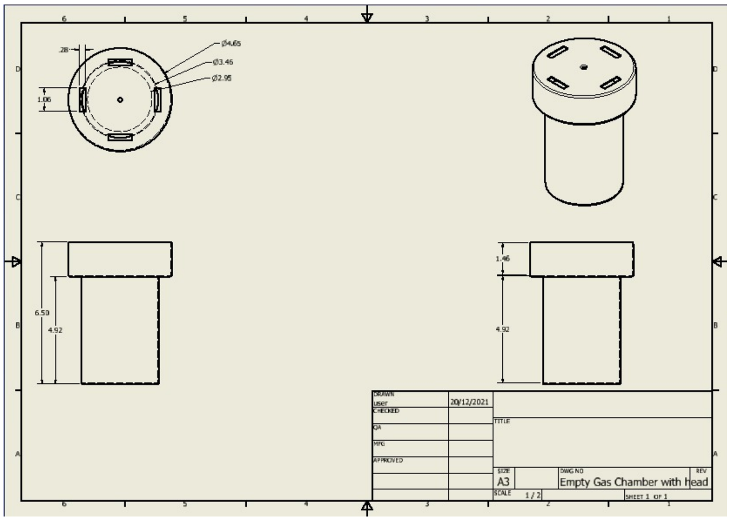

Figure 3.19: Dimension of the final design of the “Gas Chamber”.

3.4.4 The Sensor Placement

The Final version of the “Gas Camber” from AUTODESK INVENTOR 2021 is then implement into real life. The first prototype is fabricated using the 3D printer creality ender 5 pro. The material is of PLA and the design dimensions follow the cup sizes 7cm that is the biggest cup size, which would mean that the gas chamber could fit in with all cupping therapy cups standard sizes. The initial height of the “Gas Chamber” is 16cm and is used during the current design. Shown in the figure below are the individual parts of the “Gas Chamber” dimensions.

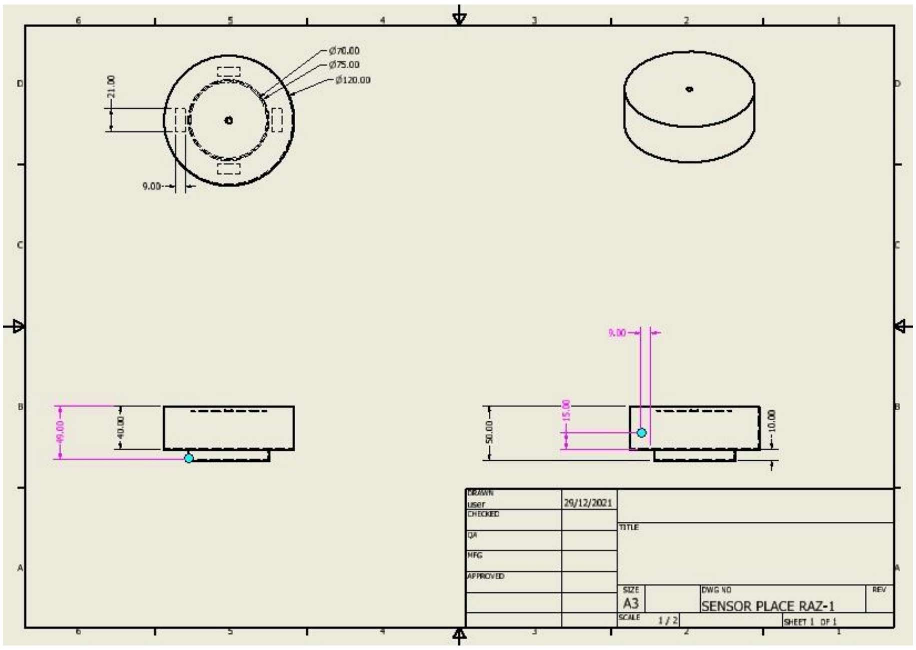

Figure 3.20: Dimensions of Sensor Placement mechanism.

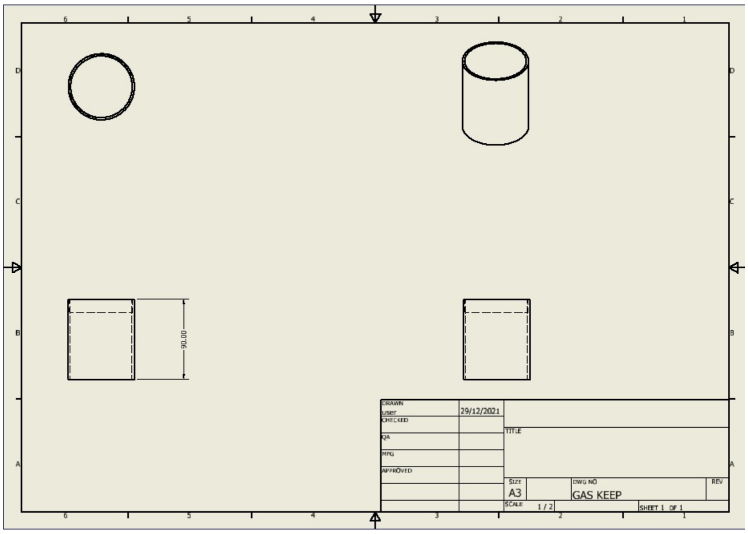

Figure 3.21: Cup placement Mechanism.

In the assembly of both mechanism, each part has a role to play during the gas sensor detection during the cupping process. For the first mechanism, which is the sensor placement mechanism, the part is detachable so that it is easier to place sensors and so that the sensors could detect the gas when the gas is released in the cup more efficiently. The dimensions of the sensor placement mechanism serves an important purpose. The diameter is set as 120mm is implemented so that the four gas sensors used in this project can be placed in the mechanism. The sensors used are already measured and calculated so that all the sensors could fit neatly towards the mechanism and would not interrupt the cupping process. Distinctively, for the cylinder cup placing mechanism is designed so that the part can be cleaned after a cupping session as for hygienic purposes. The height of the mechanism is 90mm and diameter is 75mm is implemented so that the cup could be placed neatly towards the "Gas Chamber" despite sizes of the cupping therapy cups.

3.4.5 3D printing.

During the fabrication of the "Gas Chamber", a 3D printer, Creality ender 5 machine is used. The machine would later heat up its filament and produce a material that is made of PLA (Poliactic acid). The 3D printed machine will print in accordance with the STL file uploaded to its driver and will estimate the weight of the fabricated part. For the sensor placement mechanism, the weight of PLA material that would be used is estimated at about 263 grams while the cylinder to place the cup is about 71 grams and the estimated time needed to fabricate both 3D printed items are 22 hours 46 minutes and 11 hours 43 minutes respectively.

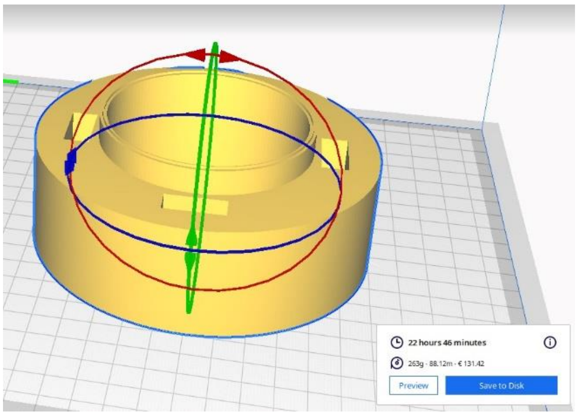

Figure 3.22: G-Code Simulation of Sensor Placement Mechanism.

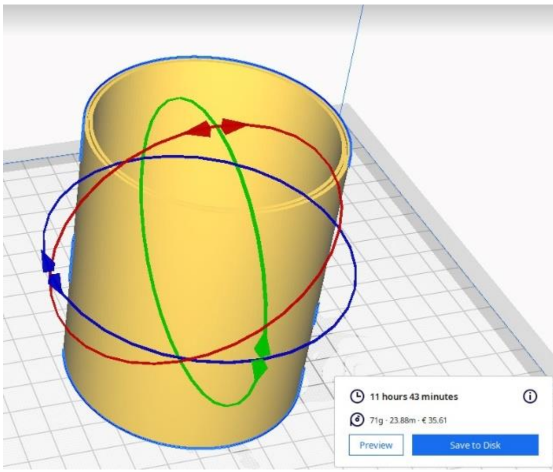

Figure 3.23: G-Code Simulation of Cup Placement Mechanism.

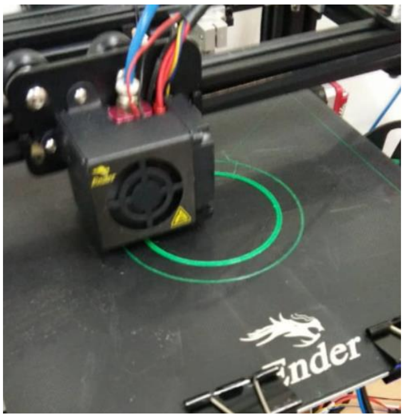

Figure 3.24: 3D printing progress of the Sensor Placement Mechanism.

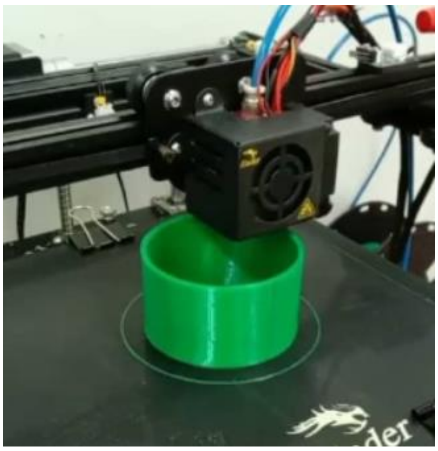

Figure 3.25: 3D printing progress of the Cup Placement Mechanism.

After the 3D fabrications were finished, the fabricated part were tested to check if the sizing was correct and it is found out that the fabrication is a success and both mechanism can serve its purpose of placing sensors and also fit in the cupping therapy cups.

Figure 3.26: 3D printed product Sensor Placement Mechanism.

Figure 3.27: 3D printed product of the Cup Placement Mechanism.

3.5 Circuit

The hardware design for this project is based on the components that were acquired. The project's process flow is depicted in Figure 3-3. When the sensors MQ7, MQ5, MQ135 and MQ131 detect gases released in the gas chamber, they send analogue data to the ESP 32, which causes the microcontroller to read the data and manipulate it using the coding to generate the PPM of gas. The data is then sent via Wi-Fi to the BLYNK app, which displays the data while also sending the BLYNK data to the BLYNK internet server with its authenticated credentials.

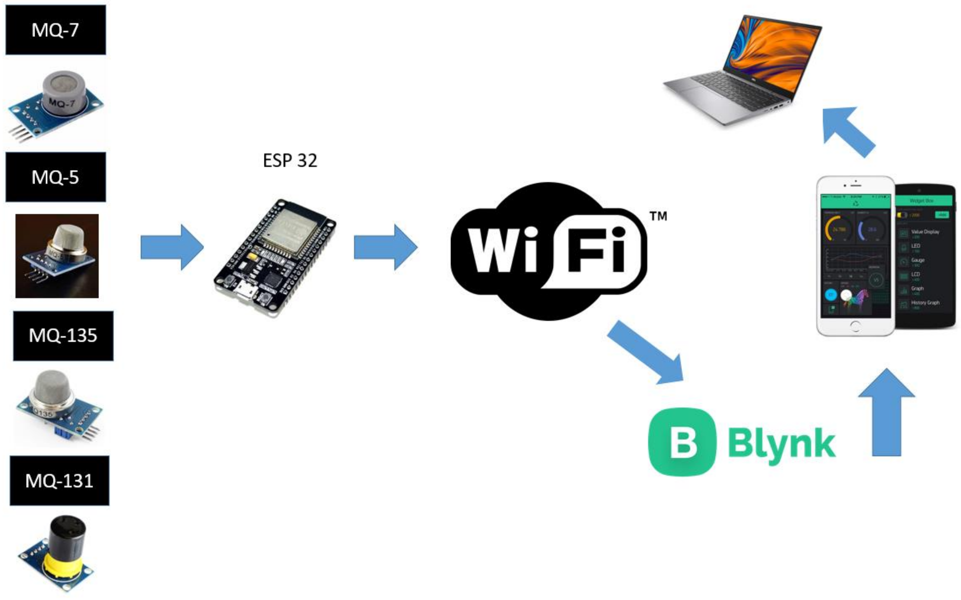

Figure 3.28: Process flow of gas detection.

3.5.1 Circuit Design

The figure below shows the design for the hardware circuit of the project that comprised of electrical components ESP 32 Dev Board microcontroller and sensors MQ7, MQ5, MQ135, MQ131. MQ7 is used for detect Carbon Monoxide gas, MQ5 Is used for detect Carbon Dioxide gas, MQ135 is used for detect Ammonia Oxide and MQ131 is used for detect Ammonia Oxide gas.

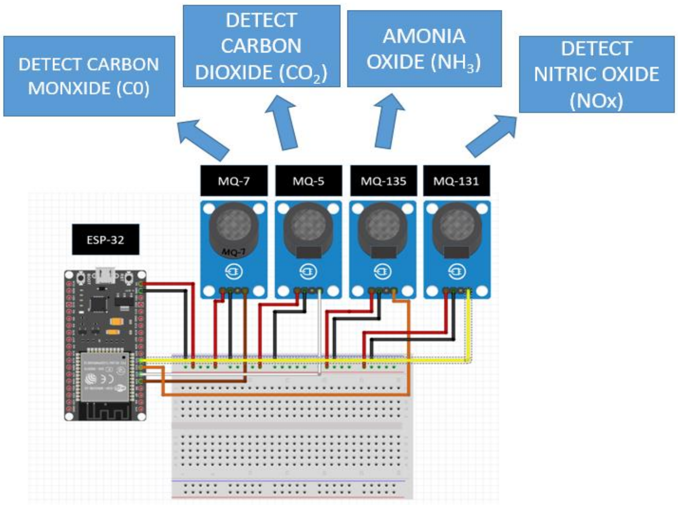

Figure 3.29: Gas sensor connection design.

3.5.2 CODING FOR GAS DETECTION

The sensors that are connected towards the ESP32 will provide an analog data triggered by the detected gas. The detected gas would be read by the microcontroller and then would manipulate the data to get PPM using a mathematical equation. The ppm data would then be transferred to the BLYNK application via WIFI. The app would then display the data for the user to see.

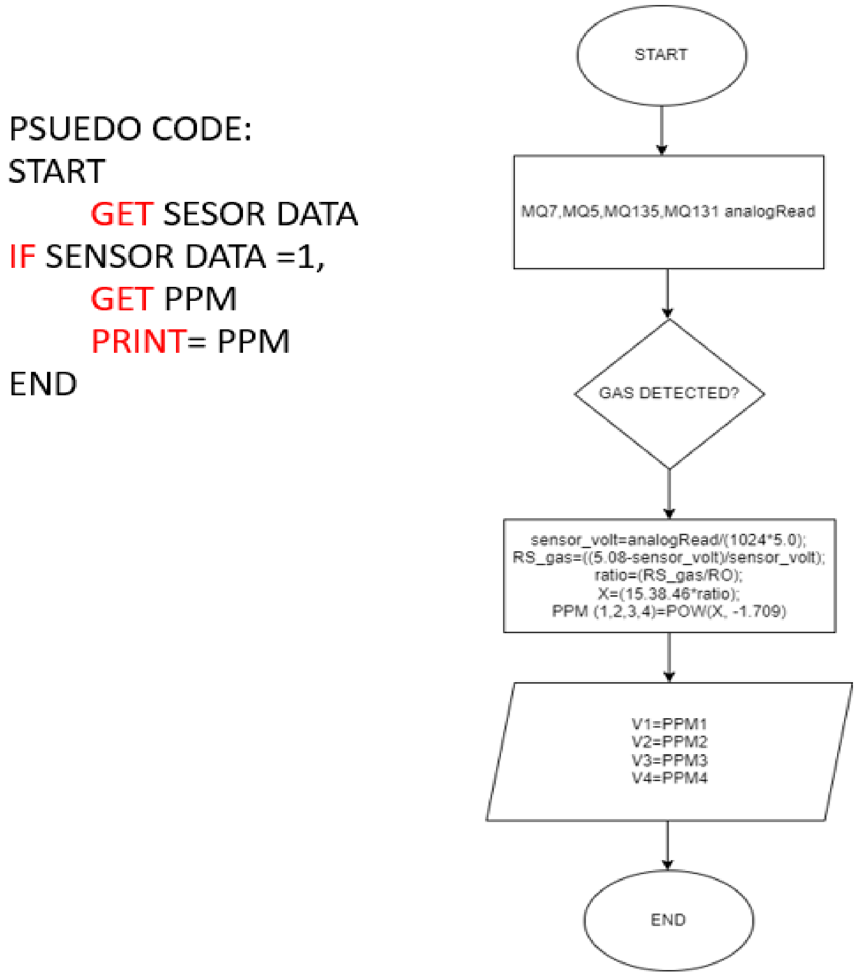

Figure 3.30: Psuedo Code of Gas Detection Mechanism.

3.5.3 Gas Sensor Connection with ESP 32

The ESP32 Analog to Digital Converter will be used to acquire the analogue voltage output by the sensor (ADC). analogRead function will be utilized , which returns inconsistencies. This is due to the ADC's nonlinearity, which is not properly adjusted in the analogRead function. Nonetheless, we will assume a linear behavior of the ADC in the 0 V to 3.3 V range. Naturally, this will create some uncertainty in the gas measurements. Because the gas sensor outputs an analogue voltage, it must be linked to an analogue pin of the ESP32, as previously stated. The pins from each sensor that must be connected to the ESP32 are identified as data in the software, although they are unlabelled in the physical devices. As a result, the colours of the wires linked to them must be considered. The red wire in both devices corresponds to VCC, whereas the black wire corresponds to GND. A 3.3V Power Source powers the ESP 32, as well as its sensors. MQ7 sensors are allocated to pin D34, MQ5 sensors to pin D35, MQ135 sensors to pin D32, and MQ131 sensors to pin D33.

3.5.4 Connecting with Global Variables

The first step is to write all of the included required for our code to function. We will need to include three distinct libraries because we'll be employing a variety of different functionalities. The WiFi.h and WiFiClient.h libraries are required to connect the ESP32 to the WiFi network so that clients can access our web server.

```
#include "WiFi.h"
#include <WIFICline.h>
```

This project makes use of a unified library for MQ sensors, which makes it simple to receive MQ signals from Arduino, Genuino, ESP8266, and ESP-32 boards with the MQ2, MQ3, MQ4, MQ5, MQ6, MQ7, MQ8, MQ9, MQ131, MQ135, MQ303A, MQ309A references.

```
#include <MQUnifiedsensor.h>
```

To connect with the Blynk App, an Auth Token is needed, the Auth Token is so that only persons with the Auth Token can access the data obtained by its microcontroller.

```
char auth[] = "43YPzj_ZQZ4j7tspD1sZ4XYTKFs0NYmw";
```

The credentials of the Wi-Fi network to which the ESP32 will join will be required to complete the global variables declaration. We will need the network name (SSID) and password in particular.

```
const char* ssid = "YourNetworkName";
```

```
const char* password = "YourNetworkPass";
```

3.6 Cost Analysis

For Senior Design Project, each group members were allocated with RM300.00. As the total for two members in this group, the total allocated budget is RM600.00.

3.6.1 Controller

Table 3.1: Cost of Controller.

No.	Description	Quantity	Price per Unit (RM)	Total (RM)
1.	NodeMCU V2 / LoLin V3 / ESP32 ESP-32 for Arduino Lua IoT ESP8266 ESP-12E ESP 12 WIFI Wi-Fi Module Bluetooth Board	1	37.40	37.40
Test	Total			37.40

3.6.2 Sensors

Table 3.2: Cost of Sensors.

No.	Description	Quantity	Price per Unit (RM)	Total (RM)
1.	MQ7 MQ-7 Carbon Monoxide CO Gas Sensor Module Detector for Arduino	1	9.15	9.15
2.	MQ5 Carbon Dioxide Sensor	1	7.75	7.75
3	Mq-135 Air Quality Sensor Detection Module for Arduino	1	13.94	13.94
4	MQ-131 MQ131 Ozone Gas ule Ozone Sensor ule Wei	1	80.48	80.48
Total				111.32

3.6.3 Mechanism

Table 3.3: Cost of Mechanism.

No.	Description	Quantity	Price per Unit (RM)	Total (RM)
1.	3D MAKER STUDIO White PLA-Multiplier x1gram = 405 Quantity	1	81.00	81.00
2	Vacuum Cupping Set with Magnetic 6 Cups or 12 Cups Therapy	1	14.99	14.99
Total				95.90

3.6.4 Overall Total Costing

Table 3.4: Overall toal costing of project.

No.	Parts	Total Costs (RM)
	Controller	**37.40**
	Sensors	**111.32**
	Mechanism	**95.90**
Total		**198.57**

CHAPTER 4

RESULTS AND DISCUSSION

4.1 Introduction

This chapter will go through the hardware development as well as the outcomes of all of the trials. Four general gas sensors, an ESP 32, a BLYNK app display, and a cupping set make up the hardware. The outcome of each experiment is kept track of. Before conducting the experiment on gas detection in an open-air environment, the sensor readings for all sensors MQ7, MQ5, MQ135 and MQ131 were changed. It indicates that the sensor is in good working order. Before completing dry and wet cupping, the overall sensor reading increased in experiment 2 and 3. Aside from that, a pattern for 5 to 7 minute wet and dry cupping is generated depending on the sensor data displayed on the Blynk app display.

4.2 Hardware Design

The figure below shows the simulation of Design using AUTOCAD INVENTOR PRO 2021 to simulate the “Gas Chamber” that would trap the gas on the cup by using the real specifications of a cup set. Sensors MQ5, MQ7, MQ135 and MQ131 is also simulated. The gas chamber contains 4 sensors which are MQ5, MQ7, MQ135 and MQ137.The sensors is attached to the top of the “Gas Chamber” to get its reading.

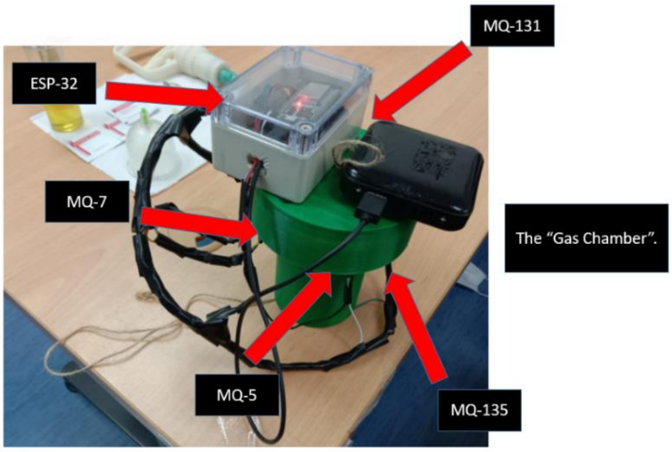

Figure 4.1: The Hardware Design of the "Gas Chamber".

4.3 Experiment On Open Air Environment.

The Blynk display ppm data when the gas sensors are exposed to an open-air environment where there is no strong concentration of gas found. This is to test the ppm reading during room temperature so that there are no defects of the sensor during the testing of cupping process.

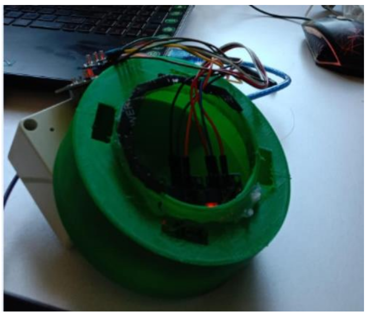

Figure 4.2: Gas Sensor Placement Mechanism tested on Open Air Envioroment.

4.3.1 Datasheet

To know if the sensors are well adjusted for its environment, the sensor datasheet is need to be compared with real life situations. The sensors MQ7, MQ5, MQ135 and MQ131's data is compared and adjusted with the datasheet.

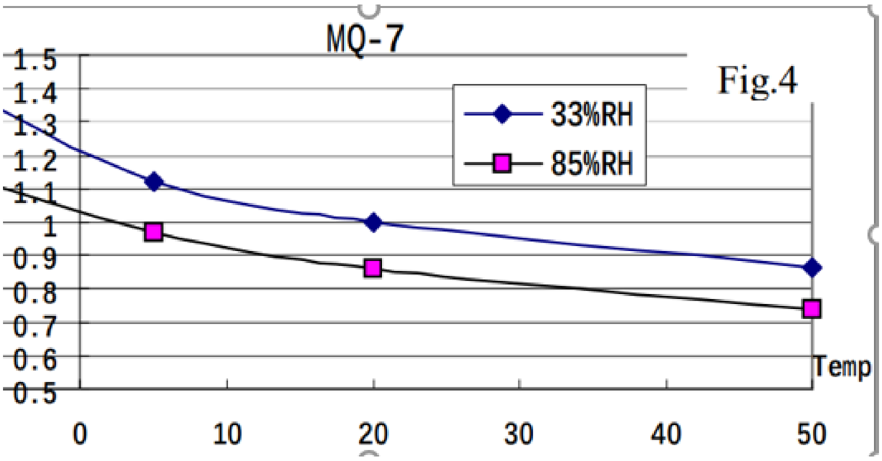

Figure 4.3: Datasheet for MQ7 sensor.

Source: (Monoxide, n.d.)

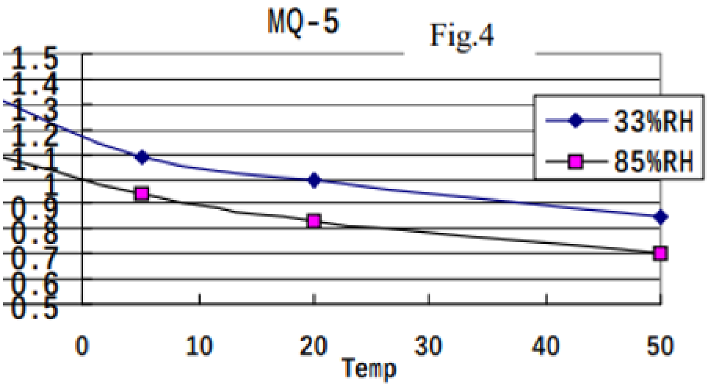

Figure 4.4: Datasheet for MQ5 sensor.

Source: (Strucyure, n.d.)

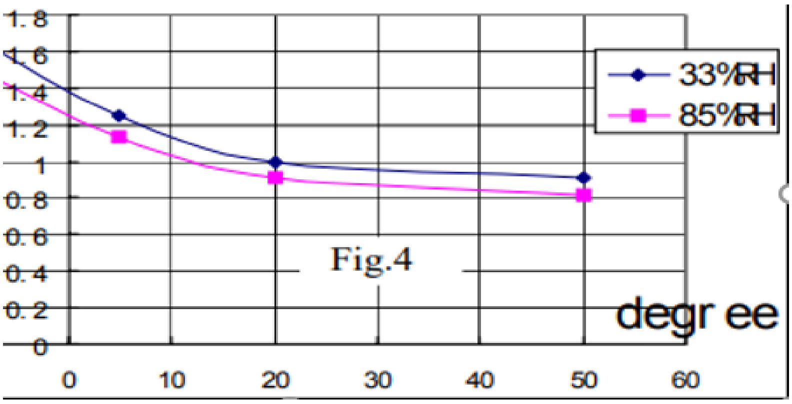

Figure 4.5: Datasheet for MQ135 sensor.

Source: (Tem et al., n.d.)

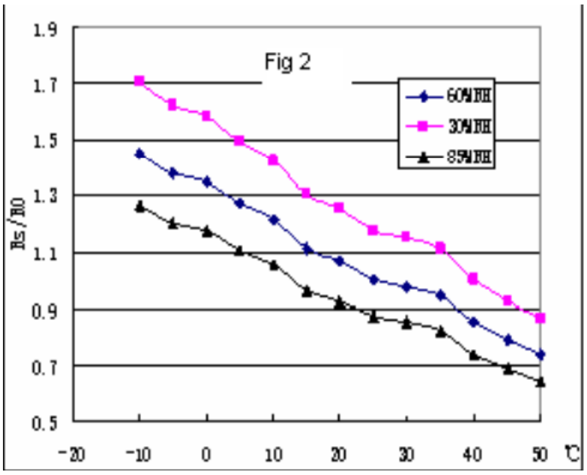

Figure 4.6: Datasheet for MQ131 sensor.

Source: (Winsen, 2014)

After the re-adjustment of the sensors, calibration, the data is set to be perfect for its condition in the open-air environment and the BLYNK data displays its output.

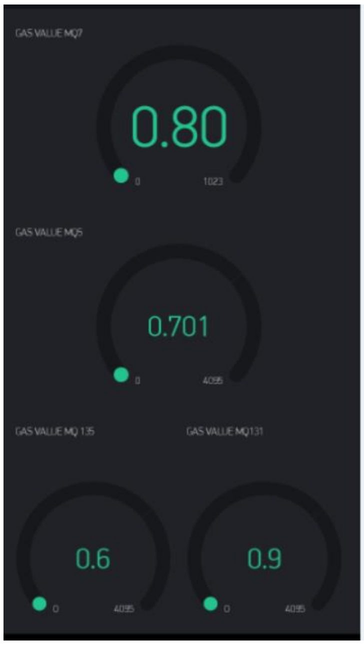

Figure 4.7: Blynk Data Display on open air envioroment.

Figure 4.8: Serial Monitor Display on open air envioroment.

4.4 Experiment on Dry Cupping Process.

During the dry cupping process, a patient who wishes to join the therapy will need to provide personal details to the secretary of the practitioner. Then, the details would be stored in the cloud.

Figure 4.9: Secretary obtaining details of patient.

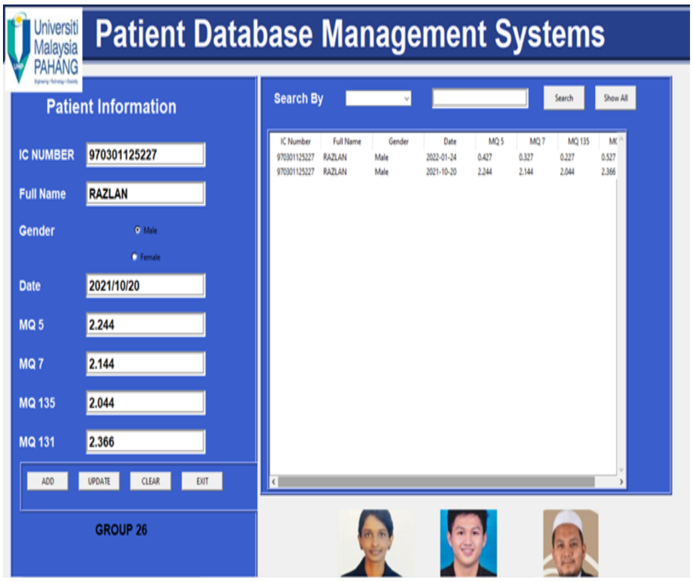

Figure 4.10: G.U.I of Patient’s Details.

4.4.1 Dry Cupping Process

After the patient's details are keyed in, the cupping process can now be initiated. The cups are placed towards the patient's body and then a suction device would suck the gas inside the cup, which would create a vacuum and attach the cup towards the body. Then, the cup would be left for about 5-20 minutes.

Figure 4.11: Pateint undergoing cupping therapy.

4.4.2 Gas Chamber Placement

The gas chamber is then placed over the cup to trap the gas to get a better reading for the gas sensors. In this process, the specifications of a cup are met for the process to proceed.

Figure 4.12: Gas Chamber place on the patient to get reading of gas.

Once the gas chamber is placed above the cup, the gas would then be released by pulling a sting and sensors will read the data, which would be then sent to the blynk app.

Figure 4.13: Blynk data displayed in the app.

Table 4.1 shows the entire sensor reading dry cupping in 5 minutes, 10 minutes and 20 minutes and table show the pattern produced in dry cupping.

Table 4.1: Gas data on dry cupping patient.

	MQ5 (ppm %)	**MQ7 (ppm %)**	**MQ135 (ppm %)**	**MQ131 (ppm %)**
Open air environment	**1.53**	**1.431**	**1.33**	**1.63**
Dry Cupping 5mins	**3.72**	**3.628**	**3.53**	**3.83**
Dry Cupping 10mins	**2.55**	**2.453**	**2.35**	**2.15**
Dry Cupping 20mins	**2.76**	**2.667**	**2.57**	**2.87**

Based on Table 4.1, which shows the graph, all the MQ5, MQ7, MQ135 and MQ131 gas sensors increased dramatically for 5, 10, and 20 minutes. The overall reading for all the gas sensor readings increased after doing cupping.

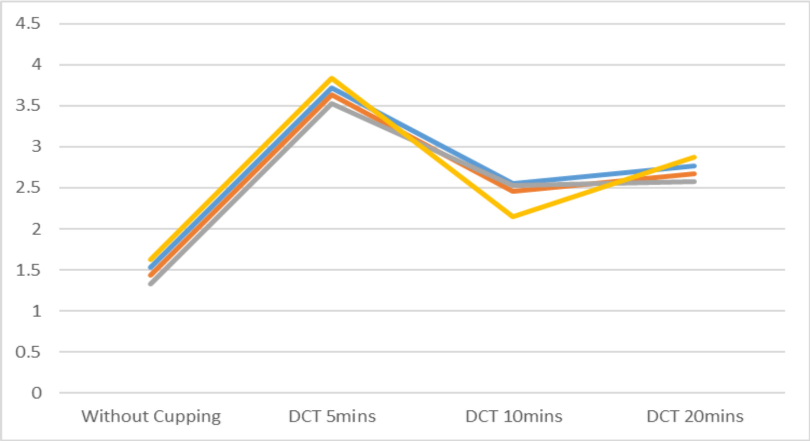

Figure 4.14: Graph of Gas concentration of Patient(PPM%).

The time during the cupping process does not matter because released gas has different values from different cups at different cupping points for both cupping process. The main point of the data is that oxide gases such as carbon monoxide, carbon dioxide, ammonia oxide, and nitric oxide are present and can be detected by mq7, mq5, mq135 and mq131. The gases released determine the existence of oxide gas release during the both cupping process.

After the BLYNK app has displayed the data through its application, simultaneously, the data would then be transferred to the BLYNK data website. The data would then be keyed in manually towards the G.U.I from python coding.

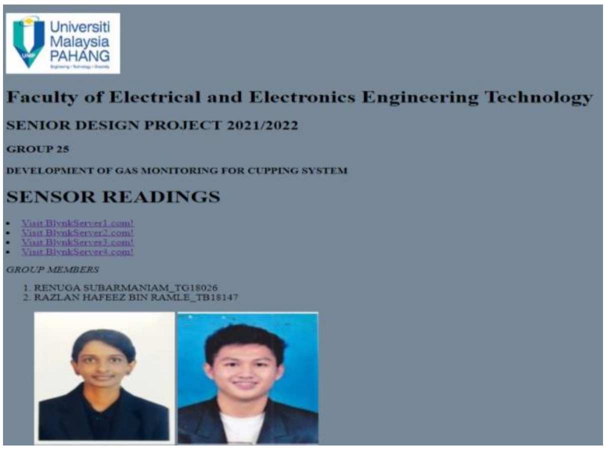

Figure 4.15: G.U.I of Blynk data server website.

After the secretary, keys the data in, the data would be sent to myPHP, which is the database system, which stores the data of the patient.

Figure 4.16: Secretary manually typing out received data from blynk.

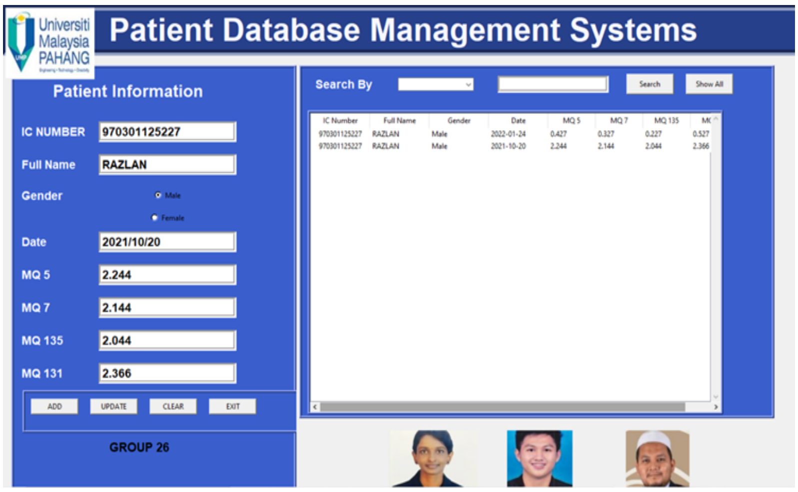

Figure 4.17: Gas Value typed in the G.U.I.

Thus, whenever the practitioner or the patient's want to review the data, it could be looked up by entering the patient's ID number and directly searched in the Database system.

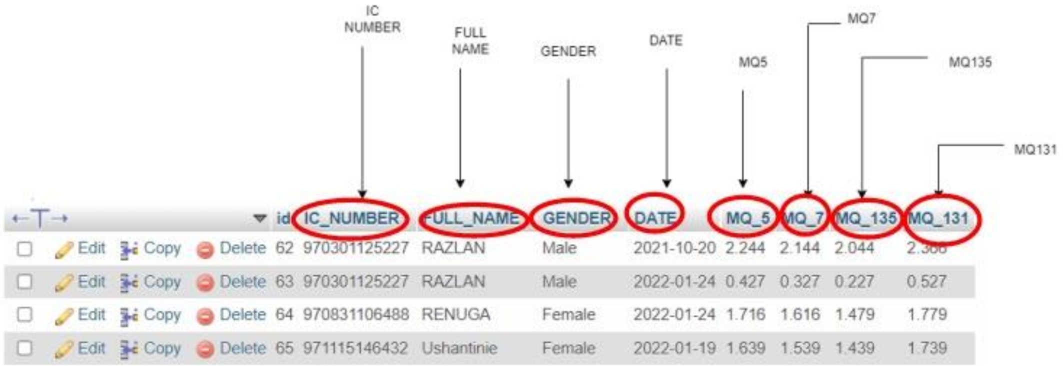

Figure 4.18: Myphp as database program.

CHAPTER 5

CONCLUSION

5.1 Introduction

In conclusion, so far, only two objectives have been achieved. For the first objective, the mechanism for gas detection and database systems in cupping therapy has been developed and realized. The design and structuring of gas sensor using array for sensor by using MQ7 (C0), MQ(CO_2), MQ135(NH_3) and MQ131(NO_x) has been developed. Unfortunately, the mechanism is only test in dry cupping procedure. For doing the wet cupping procedure, we require a medical license to practice is which the group members do not possess. We were able to make progress on the project by following our supervisor's instructions. We realized that by working on this project, we would be able to broaden our horizons beyond the confines of the university. It has also taught us about current world issues and how to address them.

5.2 Conclusion

This project reviews the development of gas detection and database systems in cupping therapy theoretically and through experiments. It is found out that the study of gas release from cupping therapy has not been well researched and revealed in the scientific and healthcare society. There is a lack of evidence and report to show that the specific gas released from the body and if it is harmful or not harmful towards either the patient or the practioner.It is found out that there is a lack of data of gas concentration of patients in cupping therapy. Thus, this research focuses more on the gas detection and database systems so that we could obtain the data of gasses released in the body and store the data of the patient during the cupping therapy process.

According form the experiments made in this project, it can be concluded that the "Gas Chamber" mechanism can be used to trap gas to get a better reading for the sensors. As the "Gas Chamber" traps its gas due to its airtight design, the gas sensors attached to it can easily detect the gas concentration in that environment inside of the mechanism increases and the gas release from the cup.

The performance of the gas chamber has been proven successful as the gas detection for all sensors, which are MQ5 (CO_2), MQ7 (CO_2), MQ135 (NH_3) and MQ131 (NO), can be detected and the sensors are well calibrated referring to the sensor datasheet. The ppm value in an open-air environment has been taken into consideration during the development of this project. The value of ppm should be more or less 1.00 in an open-air environment and it has been proven that the sensor deliver the data perfectly with its ppm.

For this objective, the sensors has on been tested well on dry cupping system. The dry cupping system has been tested with the gas chamber and the data obtained for the cupping system has been recorded and stored in the cloud. It is found out that the data for each cup is inconsistent. Which means that no matter how long the cup is placed in the body, the changes are not significant but the data obtained is received. It could be because each point where the cup is released has different values. However, for the wet cupping process, the data could not be obtained because to do a wet cupping session, only a person with a medical license could practice the therapy, which our group do not possess.

5.2 Recommendation for future project.

In this research, the experiment to determine the gas released in cupping therapy and database systems were conducted in dry cupping. The results acquired can be improved in terms of accuracy and reliability. There are some suggestions for future work to improve the results of this project. For example, the “Gas Chamber” design could be improved so that the microcontroller and power source could fit in nicely. Next, the cable management for the project could be improved with a better design. Next and LCD could be fitted in so that the data could be displayed during the cupping process as an alternative if there is no data signal in the area where the “Gas Chamber” is operated. In addition, the design could be improved for meeting a good safety standard so that the material is safe to use.

Next, for the database system, the GUI. Could be improved so that the data of patient’s details of gas detected could instantaneously be recorded to the cloud rather than the secretary applying it manually towards the G.U.I. lastly, the design of the G.U.I could be improved to be more user friendly and recreated to have a nicer appearance.

REFERENCES

Use a reference manager such as *Mendeley*, *EndNote* or any reference manager software to generate all your list of references here. Once all the references are included then apply *Caption for Reference* style.

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APPENDICES

Appendix A: Gantt Chart of development of project.

DEVELOPMENT OF GAS DETECTION AND DATABASE SYSTEMS ON CUPPING PRACTICE																				
	OCT 21				**NOV 21**				**DEC 21**				**JAN 22**				**FEB 22**			
TASK	W1	W2	W3	W4	W1	W2	W3	W4	W1	W2	W3	W4	W1	W2	W3	W4	W1	W2	W3	W4
SDP2 briefing																				
Project Meeting																				
Develop prototype																				
Specify detail requirement																				
First draft Of thesis																				
Apply final correction																				
Implementation Final design																				
SDP2 presentation																				
Thesis Evaluation																				

Appendix B: Coding of the mechanism.

```
#define BLYNK_PRINT Serial

#include <MQUnifiedsensor.h>

#define Board ("ESP 32")

#define Pin_MQ7 34

#define Pin_MQ135 35

#define Pin_MQ131 32

#define Pin_MQ137 33

#define Voltage_Resolution (5)

#define ADC_Bit_Resolution (10)

#define RatioMQ135CleanAir 3.6 //RS / R0 = 3.6 ppm

#define RatioMQ131CleanAir 15 //RS / R0 = 15 ppm

#define RatioMQ137CleanAir 15 //RS / R0 = 15 ppm

#include <WiFi.h>

#include <WiFiClient.h>

#include <BlynkSimpleEsp32.h>

BlynkTimer timer;
```

```
// You should get Auth Token in the Blynk App.

// Go to the Project Settings (nut icon).

char auth[] = "43YPzj_ZQZ4j7tspD1sZ4XYTKFs0NYmw";



// Your WiFi credentials.

// Set password to "" for open networks.

char ssid[] = "HamsterDRB";

char pass[] = "Razlanhafeez97!";






MQUnifiedsensor MQ135(Board, Voltage_Resolution, ADC_Bit_Resolution, Pin_MQ135, "MQ-135");

MQUnifiedsensor MQ131(Board, Voltage_Resolution, ADC_Bit_Resolution, Pin_MQ131, "MQ-131");

MQUnifiedsensor MQ137(Board, Voltage_Resolution, ADC_Bit_Resolution, Pin_MQ137, "MQ-137");



float R0= 20000.0;
```

```
int j = 1;


//rf init
void setup()
{
  // Debug console
  Serial.begin(115200);
  Blynk.begin(auth, ssid, pass);
  pinMode(Pin_MQ7, INPUT);
  pinMode(Pin_MQ135, INPUT);
  pinMode(Pin_MQ131, INPUT);
  pinMode(Pin_MQ137, INPUT);
  sensorsetup();

}

void loop()
```

```
{
  float sensordata[2];
  float reading1 = 0;
  float reading2 = 0;
  float reading3 = 0;
  float reading4 = 0;
  float gas=0;
  float gas2=0;
  float gas3=0;
  int i;

   for (i=0;i<20;i++)
  {
    reading1 += analogRead(Pin_MQ7);
    delay(50);
  }
  (reading1/= 20);
  float sensor_volt = reading1/(1024*5.0);
```

```
float RS_gas = (5.08-sensor_volt)/sensor_volt;

 float ratio = (RS_gas/R0);

 float x = (1538.46 * ratio);

 float ppm = pow(x,-1.709);      // formula for conversion to ppm value



(sensordata[1] = ppm);



for (i=0;i<20;i++)

  {

    MQ135.update();

    (reading2 += MQ135.readSensor());

    delay(50);

  }

  (reading2/= 20);

(sensordata[2] = reading2);



for (i=0;i<20;i++)

  {
```

```
    MQ131.update();
    (reading3 += MQ131.readSensor());
    delay(50);
  }
  (reading3/= 20);
(sensordata[3] = reading3);


 for (i=0;i<20;i++)
  {
    MQ137.update();
    reading4 += MQ137.readSensor();
    delay(50);
  }
  (reading4/= 20);
(sensordata[4] = reading4);
```

```
Serial.print("Reading Number  : ");
Serial.println(j);
Serial.print("Carbon Monoxide : ");
Blynk.virtualWrite(V1, sensordata[1]);
Serial.println(sensordata[1]);
delay(10);
Serial.print("Carbon Dioxide : ");
Blynk.virtualWrite(V2, sensordata[2]);
Serial.println(sensordata[2]);
delay(10);
Serial.print("Ammonia Oxide : ");
Blynk.virtualWrite(V3, sensordata[3]);
Serial.println(sensordata[3]);
delay(10);
Serial.print("Nitric Oxide : ");
Blynk.virtualWrite(V4, sensordata[4]);
Serial.println(sensordata[4]);
```

```
  delay(10);
  Blynk.run();
  timer.run();
  j+=1;
}

void sensorsetup()
{
  float calcR0;
  int i = 0;

   MQ135.setRegressionMethod(1);   //_PPM
   MQ131.setRegressionMethod(1);
   MQ137.setRegressionMethod(1);
```

```
MQ135.setA(102.2); MQ135.setB(-2.473);//GLv O3 math

MQ131.setA(23.943); MQ131.setB(-1.11);//CO2 math

MQ137.setA(23.943); MQ137.setB(-1.11);//NOx math



//init the sensor

MQ135.init();

MQ131.init();

MQ137.init();


//calibrate sensors


calcR0 = 0;

for(i = 0; i<10; i ++)

{

  MQ135.update(); // Update data

  (calcR0 += MQ135.calibrate(RatioMQ135CleanAir));
```

```
}
(MQ135.setR0(calcR0/10));
delay(50);

 calcR0 = 0;
for(i = 0; i<10; i ++)
{
  MQ131.update(); // Update data
  (calcR0 += MQ131.calibrate(RatioMQ131CleanAir));
}
(MQ131.setR0(calcR0/10));
delay(50);

 calcR0 = 0;
for(i = 0; i<10; i ++)
{
  MQ137.update(); // Update data
  (calcR0 += MQ137.calibrate(RatioMQ137CleanAir));
```

```
  }
  (MQ137.setR0(calcR0/10));
  delay(50);
  Serial.println("Sensor fired");

}
```