FACULTY OF ELECTRONICS AND COMPUTER TECHNOLOGY AND ENGINEERING

DEVELOPMENT OF SAUCE DIPENSER MACHINE WITH IoT FEATURE USING ESP 32 FOR FAST FOOD OPERATION

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Bachelor of Electronics Engineering Technology (Telecommunications) with Honours

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DEVELOPMENT OF SAUCE DIPENSER MACHINE WITH IoT FEATURE USING ESP 32 FOR FAST FOOD OPERATION

MUMTAZ AQILAH BINTI MOHD FAUZI

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I hereby declare that I have checked this project report and in my opinion, this project report is adequate in terms of scope and quality for the award of the degree of Bachelor of Electronics Engineering Technology (Telecommunications) with Honours.

Signature :

Supervisor Name : Ts. Fakhrullah bin Idris

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DEDICATION

This project is dedicated to my family, whose love and understanding have been an anchor during my academic journey, for their unfailing support and encouragement. Your belief in my ability has strengthened my will to accomplish this goal.

In addition, I want to thank my supervisor for all his knowledge and wisdom, as well as for his patient and knowledgeable guidance. Your priceless advice has influenced my intellectual development and motivated me to strive for greatness.

I would want to express my gratitude to those around me who have been there for me throughout this academic journey, giving me with jokes during times of stress. With your help, problems have become successes and important events have become beloved memories.

Finally, I would want to dedicate this project to my own perseverance and the many hours of hard effort that went into it. I hope this serves as evidence of the knowledge gained, the abilities developed, and the personal development achieved.

I'm taking the knowledge gained, the experiences created, and the connections I've made with me as I start this new phase of my journey. This accomplishment does not represent me alone rather, it is a result of everyone's help and collaboration in helping to build me into the person I am today.

ABSTRACT

The automatic sauce dispenser was designed to improve the quality of manual sauce dispenser commonly used in fast food restaurants in order to ease consumer convenience. Users frequently find it difficult to push the pump to dispense the sauce, especially when their hands are full and dirty. This project will reduce the burden by only requiring the sensor to be placed in front of the sauce plate. The goal of the project is to design and construct a prototype self- sufficient sauce dispenser. ESP 32 will be used as a controller for controlling the flow of sauce. The sauce's flow will be regulated by a motor pump, and a sensor will monitor the sauce's volume in the container. All data is sent to the Cloud so that it can be tracked. The IoT devices will keep track of the number of sauces are in stock and notify users are aware when the supply is getting low. The controller will be linked to a cloud-based platform that can assist owners check on the machine's performance, set up alerts for low inventory, and control the dispensing process remotely. Users will be able to customise the quantity of sauce dispensed, the pace of the dispenser, and the frequency of dispensing. The machine will also have an LCD display with a simple interface for controlling it. The display will show the quantity of sauce in stock, dispensing statistics, and other useful information in real time.

ABSTRAK

Pembahagi sos automatik direka untuk meningkatkan kualiti dispenser sos manual yang biasa digunakan di restoran makanan segera untuk memudahkan pengguna. Pengguna sering merasa sukar untuk menekan pam untuk mengeluarkan sos, terutamanya apabila tangan mereka penuh dan kotor. Projek ini akan mengurangkan beban dengan hanya memerlukan penderia diletakkan di hadapan plat sos. Matlamat projek ini adalah untuk merancang dan membina prototaip pembahagi sos yang mencukupi. ESP 32 akan digunakan sebagai pengawal untuk mengawal aliran sos. Aliran sos akan dikawal oleh pam motor, dan penderia akan memantau jumlah sos dalam bekas. Semua data akan dihantar ke Cloud supaya ia boleh dijejaki. Peranti IoT akan menjejaki bilangan sos dalam stok dan memberitahu pengguna sedar apabila bekalan semakin rendah. Pengawal akan dipautkan ke platform berasaskan Cloud yang boleh membantu pemilik menyemak prestasi mesin, menyediakan makluman untuk inventori rendah dan mengawal proses dari jauh. Pengguna akan dapat menyesuaikan kuantiti sos yang dikeluarkan, kadar pembahagi, dan kekerapan pengeluaran. Mesin ini juga akan mempunyai paparan LCD dengan antara muka yang mudah untuk mengawalnya. Paparan akan menunjukkan kuantiti sos dalam stok, statistik pengeluaran, dan maklumat berguna lain dalam masa nyata.

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An infinite amount of appreciation is due to my parents, Mohd Fauzi bin Abdullah and Maisarah binti Badri. The foundation of my academic effort has been laid by your selfless efforts, limitless love, and everlasting encouragement. I am driven to overcome hurdles and achieve great things because of your constant faith in my abilities. The credit for this success goes to both of us.

My deepest gratitude goes out to all my friends who have been there for me through the thick and thin of this undertaking, providing support and cheering me on. This academic journey has become an unforgettable experience because of your friendship, shared laughter, and support, which have turned periods of struggle into successes.

Last but not least, the project is a tribute to all of these people and many more for their combined efforts and support. I am grateful to everyone who has supported me during this academic journey. I hope that the lessons learned, and the relationships formed serve as permanent reminders of this shared academic chapter in our lives.

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LIST OF ABBREVIATIONS

IoT	-	Internet of Things
RTE	-	Ready to Eat
ATP	-	Adonesine Triphosphate
FFR	-	Fast Food Restaurant
AI	-	Artificial Intelligence
LCD	-	Liquid-Crystal Display
IT	-	Information Technology
Wi-Fi	-	Wireless Fidality
SARS-COV-2	-	Severe Acute Respirotary Syndrome Corona Virus-2
Covid-19	-	Coronavirus Disease 2019
PPE	-	Personal Protective Equipment

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CHAPTER 1

INTRODUCTION

1.1 Background

A sauce is typically a liquid or semi-liquid substance used to add flavor, moisture, or aesthetic appeal to a dish. Some sauces may also provide a dish with a beautiful sheen and color, making the food appear more lively and appetising. Advances in technology have led to a wide variety of foods, textures, and flavours. Different sauces on the plate play an essential role in optimising flavours and enhancing a dish's authentic essence. Adding a sauce to a dish provides an additional flavour, be it salty, spicy, sweet, or acidic. There are numerous ingredients that can be used to create sauces, like herbs, spices, vegetables, fruits, and products made from milk. Tomato sauce, gravy, barbecue sauce, spicy sauce, soy sauce, and mayonnaise are common forms of sauces. They can be eaten heated or chilled and used as a sauce, marinade, or ingredient in cookery. Sauces play a major part in maximising flavour, adding moisture, and enhancing the texture of a dish. For example, when eating a burger, putting it with a sauce makes everything difference.

1.2 Sauce Dispenser Must Have at All Restaurant

In general, the fast-food sector is a strongly competitive and fast-paced industry in which quickness and efficiency are crucial to success. The need to rapidly and precisely dispense sauces for clients is one of the greatest obstacles for fast food operators. Currently, the majority of fast food outlets dispense sauces using manual methods, such as squeeze

tubes or portion containers. On the other hand, these methods can be inefficient, untidy and leading to waste. The way it operates is affected by buyers who want the sauce.

Figure 1.1 Manual Sauce Dispenser

In these situations, the work environment is typically demanding, which makes it challenging for the employees to perform multiple duties simultaneously and may result in poor customer service. As they are repetitive, certain actions could be automated, which is an advantage. For example, refilling the sauce dispenser is a simple and repetitive task. This problem can be readily resolved by substituting an automatic machine for the human workforce. This strategy can be seen in this initiative, which aims to develop an automatic sauce dispenser. Several design considerations were required for the development of an automatic sauce dispenser.

1.3 Problem Statement

The problem with sauce dispensers in fast food outlets is that they frequently become obstructed or run out of sauce, which causes service delays and frustrates customers. This can occur for a variety of reasons, including improper cleansing of the dispenser nozzles or insufficient sauce container refilling[1].

The sauce dispensers may dispense a lot or not enough sauce, resulting in waste or dissatisfied customers. This can be caused by issues with the dispensing system, such as faulty compressors or sensors[2].

Some consumers might have complaints about the hygiene of the sauce dispensers, particularly if they observe sauce that has been poured or crusted on the dispenser or its surroundings. This can result in hygiene and food quality concerns, which can harm the company's image and customer loyalty[3].

1.4 Project Objective

The main purpose of this project is to provide a method that is systematic and efficient. In order to achieve the goal of this project, which is to design and develop an automated sauce dispenser that gives precise and convenient sauce dispensing. Specifically, the objectives are as follows:

a) To develop a sauce dispenser that precisely measures sauces and dispenses them while preserving flavor consistency and cutting waste.

b) To design an automated system that requires minimum human involvement as possible while still ensuring effective and uninterrupted sauce distribution by the dispenser be fitted with sensors or controls that can identify containers.

c) To analyze feedback from potential fast food operator and customer on the efficiency, capable of accurately dispensing and user-friendly.

1.5 Scope of Project

The project will focus on monitoring IoT system with ESP 32 board. Ultrasonic and infrared sensors is possible to construct an IoT-based liquid level monitoring system. Using an ESP board, the liquid level can be observed and compared to the container's depth. An

LCD panel can be used to show the status of the liquid level in the containers. Additionally, a web page can be developed for remote monitoring of the liquid level.

Develop a machine that can dispense sauces, as they are all commonly founding at fast food restaurants, and make sure it is compatible with those sauces. Some of the largest commercial fast-food chains currently use dispensing solutions, and quantity-controlled dispenser systems allow for fast pouring of sauces. These systems are perfectly suited for chaotic situation and can be found in many restaurants.

Include sensors and actuators to detect container, determine sauce level and activate the dispensing mechanism. A proximity sensor is a sensor that can detect the presence of nearby objects without having direct contact with those objects. Next, fluid level sensors have been designed to monitor the amount of sauce that is contained within a type of container and size of the container. This eliminates the need for service staff to visually verify the supply of sauce. Most of these sensors monitor the fluid level by employing high-priced optics and infrared measuring equipment.

Capabilities to enable remote control and monitoring of the dispenser via a mobile application or website. This provides for improved accessibility and convenience, as well as the ability to track usage and dispensing data. The specific components applied will depend on the machine's functionality and design.

CHAPTER 2

LITERATURE REVIEW

2.1 Introduction

Automation and technology have made significant improvements in the fast-food business, enhancing operational effectiveness and improving customer satisfaction. Dispensing sauces, which play a key part in providing tasty and balanced meals, is perfect for improvement. The purpose of this project is to develop an IoT enabled sauce dispenser based on ESP and designed specifically for fast food restaurants. This system provides effectiveness, accuracy, and data-driven insights for effective sauce handling by incorporating IoT capabilities, such as remote monitoring and control.

2.2 Foodborne Disease Risk Factor

About 1.8 million deaths globally are caused by acute gastroenteritis, making it a major health problem in many parts of the world. Acute diarrhea was defined as three or more loose stool in a 24-hour period during the previous four weeks. Acute diarrhea lasted for a certain amount of time, and the severity was based on that and the other symptoms. A variety of factors, including age, sex, ethnicity, highest level of education, total monthly household income, and place of residence, were investigated as potential determinants [4].

2.2.1 Foodborne Disease in Malaysia

The incidence of acute diarrhea over a four-week period was 5%. Young adults aged 20–29 years old, other Bumiputras, citizens with tertiary-level education, those living in households with a monthly income of less than RM 400, and people living in countryside

areas had the greatest percentages of acute diarrhea. According to the results of a bivariate study, the only factors that were significantly linked with acute diarrhea were age, ethnicity, the highest level of education achieved, and locality. Using multivariate analysis, it was discovered that the factors which cause acute diarrhea are these four variables. Both sexual orientation and the average monthly income of the household were eliminated from the subject of the study. In most cases, acute gastroenteritis lasted for a period of two days. Pain in the abdomen area was experienced by 46% of patients who had the disease. The findings showed that acute diarrhea continues to be an important concern for the public health in Malaysia and that it is badly underreported. Efforts made by the public health sector need to be increased in order to reduce the total amount of people affected by severe diarrhea, as well as to improve disease management and reporting [4].

There are many factors that bring children under the age of five at risk of experiencing diarrhea, and these factors have been discovered. The rate of diarrhea varied significantly by race, parents' education and work, family wealth, water supply, cleanliness, and waste management. Since people now know what causes diarrhea, they might have predicted all of the variations. Other Bumiputras were the most likely to have diarrhea which is 8.8%, followed by Indians with 5.3% and others for 5%. Chinese kids were the least likely to have diarrhea which is 3.2% [5]. 13.4% of the Malaysian population that drank untreated water suffered from diarrhea [6]. Water that is contaminated may contain pathogens that can cause diarrhea.

Diarrhea was more common among kids whose parents had lower levels of education compared to those whose parents had higher levels of education. Parents and carers can get education and training on hygienic practices and disease control in relation to the prevention of diarrhea, regardless of the level of education they have had. The poorest households with a frequency of 5.8%, were the most likely to have diarrhea. This might be because children

living in poorer homes lack access to sanitary facilities, are exposed to filthy conditions in the home, and practice poor hygiene, all of which contribute to greater incidence of diarrhea in these children compared to their peers living in richer households[5]. Children who were raised in households that lacked access to clean toilet and waste disposal were most likely to suffer from diarrhea than their counterparts who did have access to such facilities. The prevalence of diarrhea was 6.8% among those who used improper waste disposal, whereas the figure remained at 6.3% among those who used dirty latrines [5].

2.2.2 Foodborne Disease in Saudi Arabia

Consuming foods that have been improperly stored is typically the cause of foodborne disease. In Dammam, Saudi Arabia, restaurant supervisor knows how to keep food in a safe temperature. Between January and May of 2019, a closed-ended survey was conducted to find out how much restaurant supervisor knew about keeping food at the right temperature and where they got their knowledge. 97 people which are 80.8% took part in the study. The demographic profile and knowledge scores of restaurant supervisors are reported as a percentage. Majority of restaurant supervisors had expertise in the safe temperatures for storing chilled food which is 93.8%, frozen food with 83.5%, and refrigerated food 79.5%. However, restaurant supervisors had not enough understood of the safe temperature for hot food which is 14.4% and the temperature range at which bacteria spread rapidly in food with 15.5%[7].

All the restaurant owners said that the food and environment tester was their main source of information about how to keep food at the right temperature. There was an important connection between the education level and occupation of restaurant supervisor and the safest temperature for storing food in the refrigerator and the most effective method for determining the safe heating temperature. One of the greatest threats to

public health is caused by the large number of restaurant supervisor who are inexperienced about suitable temperature management for prepared foods and the danger zone temperature. The findings highlight the need for organized training and education program for restaurant supervisor who are responsible for ensuring that customers are not infected with food-borne diseases [7].

2.2.3 Step To Prevent Foodborne Disease

Only 68 people which are 15.5% reported giving their children unwashed fruits to eat, whereas 372 people with 84.5% reported not doing that way. 368 of the respondents which is 83.6% said they did not give their children raw food, while 72 with 16.4% said they did it. There were 308 mothers cleansed their hands at the most crucial time. Three hundred and five respondents with 69.3% washed their hands with soap and water, whereas 135 with 30.7% only used water. Among the respondents, 270 which are 61.4% said they had access to cleaner water. Among the participants, only 61 with 13.9% had their water treated at home. In the bivariate analysis, at a significance level of 25%, the number of under-five children in the home, the age of the children, the order in which they were born, the children's immunization against the Rota virus, the mothers' level of education, the total size of the family, child feeding practices, breastfeeding, history of breastfeeding in the first six months of life, the beginning of breastfeeding time, duration of exclusively breastfeeding and duration of breastfeeding continuation, age at first complementary feeding, and prepaediatric care.

On the other hand, at this level of relevance, there is no connection between the interruptions and the development of diarrhea. Diarrhea was seen in children 4.7 times more often if they were not nursed exclusively for the first six months of life compared to children who were breastfed. The risk of diarrhea in kids was reduced by 2.8 when they ate freshly

cooked meals. Children were more likely to suffer from diarrhea if their mothers or other carers washed their hands with just the water during the crucial time. This was in opposite situations where mothers or other carers were required to clean their hands with both water and soap. Compared to children from families that got their drinking water from an untreated source, children from families who got it from an untreated source were less likely to get diarrhea. Diarrhea in children under the age of five was not associated with the mother's level of education, the time of breastfeeding initiation, the duration of exclusive breastfeeding, the age at critical feeding, the feeding method used, the frequency with which children washed their hands before eating, or the frequency with which children washed their hands after eating [8].

It was determined that adult consumers had a decent general understanding of food safety, but they had a significant lack of knowledge when it came to temperature management. Similarly, a survey on the safe use of microwave ovens proved low levels of knowledge and secure training. More than seventy percent of those who took the survey did not stir their meal while it was being reheated and did not reheat it at regular intervals. It is possible that this could result in non-uniform heating, which will lead to the formation of cold patches. These cold spots will enable bacteria, if they are already present, to survive and multiply when circumstances are favorable. Consumers and food handlers have a limited understanding of temperature control. This is supported by a research study that discovered food safety training did not enhance knowledge of temperature control, including understanding the temperature danger zone and the ideal temperatures for food storage and heating. The control of temperatures and thermometer usage continue to be challenging in Malaysia among commercial and domestic food handlers. The environment, which is generally warm and humid, provides ideal conditions for the development of most mesophilic foodborne pathogens [9].

2.3 Hygiene Issue

In fast food companies, there is a low percentage of compliance with hand hygiene among both food handlers and customers. Customers frequently used napkins to clean their hands after touching RTE food that had been exposed. Workers in the food business were observed changing into new gloves before handling possibly contaminated RTE foods. However, they did not properly wash their hands before handling the foods [10].

Figure 2.1 Proper Step to Hand Wash

2.3.1 Hygiene Issue When Handling Foods

Among the 151 people that participated in the study, a total of 4530 different hand actions were seen. There was a total of 4530 hand activities seen among the 151 consumers who were examined. There were 178 hand hygiene activities that needed to be completed out of the total of 4,530 transactions. However, only 0.33% of the of purchases included customers participating in hand hygiene activities, defined as using wipes or sanitizers 180 times. Consumers should have washed their hands before handling exposed RTE items is 42.32% of the time, but only 1% did it of the time[10]. After handling RTE food that had

been exposed, maximum frequency of washing was required. Following the handling of potentially contaminated RTE, a greater number of people engage in hand hygiene activities. There was either no hand hygiene practice at all or very minimal practice after handling electronic gadgets, personal items and even cigarettes.

One customer was observed using hand sanitizer, regardless the fact that around thirty percent of consumers touched their faces, hair and other portions of their bodies, as well as licked their fingers or sneezed or coughed onto their hands. There was an increase in the use of napkins to sanitize hands, although this is not considered hand hygiene. Most fast food is in variations of finger foods such as sandwiches, burgers, fries, bakery products, and chicken pieces, therefore customers were spotted wiping their hands on napkins between bites. This was the case in 58.0% of the cases studied. In total, 47 food handlers were observed doing 1,410 different hand movements, of which 1,157 required additional training in proper hand hygiene. The highest frequency of hand hygiene was reported before touching exposed RTE food at 21.28 %, but none was conducted prior to donning new gloves, after handling exposed RTE, unclean items, or body parts. However, 21.12% of those who put on new gloves before handling food did not wash their hands first. Only one staff was seen using napkins to clean hands after handling cooking equipment. This is considering the fact that 274 different equipment-related actions needed hand hygiene activity. [10].

2.3.2 Hygiene Issue When Using Restroom

In total, swabs were taken from 16 women's restrooms, 6 men's restrooms, and 7 facilities that were shared by both genders. Fifteen of them were of the type that could only be used once, while the rest were of the multi-use variety with at least two distinct toilet stalls. There was a significant amount of range in the ATP values. However, the mean results for each surface were more than 30 RLU. This suggests that the surface sections were

unclean and should be re-cleaned as soon as possible. The level of ATP that was found to be highest in FFR 1 was consistent across all surfaces. Two of the bathrooms out of the total of 29 did not have any soap, and one of the hand dryers did not operate properly. There were 27 bathrooms with sensor-operated hand dryers, four bathrooms with sensor-operated taps, and two bathrooms with sensor-operated flushes. Compared to the other FFRs, FFR1 had a lot more toilet flushes, sink taps, soap dispensers, and exit doors. The male restrooms had the highest values recorded across the board for all surfaces, except for the door locks. Swab results from men's toilet exit doors were significantly more contaminated than those from women's doors [10].

2.3.3 Step Need to Take Before Handling Foods

According to the statistics, only 31.2% of food facility managers and 32.7% of food handlers participated in training dealing with sanitation and hygiene [11]. These percentages are for food facility managers and food handlers, respectively. However, many food handlers and managers had not received training, ignoring the fact that experienced food handlers and managers can reduce foodborne infections and increase cleanliness and hygiene practices in food outlets. As a result, it became clear that the government and other responsible bodies are not doing enough to raise public awareness and focus on the issue of food safety.

In addition, food establishments with managers who had received training on sanitation and hygiene were 6.10 times more likely to have a high sanitation and hygiene status when compared to their counterparts. This was proven by comparing the high sanitation and hygiene status of food companies with managers who had received training on sanitation and hygiene to the high sanitation and hygiene status of their counterparts. The knowledge and training of managers and staff on matters of sanitation and hygiene have a direct effect on the overall improvement of sanitation and hygiene in food facilities. Training

improved sanitation and hygiene of food facilities and their food safety practices, resulting in effected reduce the number of cases of foodborne disease [12].

2.3.4 Step to Do After Using Restroom

Wet hands have been found to have a greater possibility of obtaining germs from polluted things and of passing them to uncontaminated materials. Due to the fact that bacteria are more likely to multiply in humid environments and water is easily transferred from one object to another, drying one's hands thoroughly after washing is a crucial part of the procedure for preventing the spread of disease. Hand washing is not enough to kill all microorganisms, so the drying technique can affect the number of microbes spread from washed hands into the environment. However, it is unclear which drying methods contribute the least to user and environmental contamination [13]. Handwashing with soap is an important habit that may help stop the spread of possibly harmful microbes.

However, liquid soaps with refillable dispensers are more likely to contain bacteria from outside the soap than other kinds of soap. This research looked on the bacterial contamination of liquid soaps in 58 public restrooms across 6 buildings. Biochemical analysis as well as MALDI-TOF mass spectrophotometry were used to identify the bacterium. The Vitek II technique was used to ascertain the level of antimicrobial susceptibility. In the 58 restrooms that were investigated, 27 (or 46.55%) made use of a refill dispenser. Of those 27 refill dispensers, 25 (or 92.59%) were infected with bacteria. The CFU/mL counts of the bacteria that were extracted from the soaps varied from 1.6 x 103 to 2.7 x 105. Microorganisms such Serratia liquefaciens, A. xylosoxidans, S. marcescens, S. pastueri, and A. spanius were found. Except for one A. xylosoxidans, bacteria of the same species that were isolated in the same building all shown an uncommon resistance pattern. In conclusion, it is possible that washing hands with contaminated soap contributes to the

spread of germs in public health contexts. Regarding this reason, hospitals should prevent the use of liquid soaps that can be refilled from being used in the bathrooms used by patients with weakened immune systems[14].

2.4 Covid-19 Affected Fast Food Operation

The SARS-CoV-2 virus is the cause of the Covid-19 pandemic, which is now a threat to the entire world. In addition to the risk that is posed by eating of food that has not been properly inspected for safety, there is also this chance of harm. Washing hands with water and soap or rubbing them with alcohol or sanitizer, as well as wearing the appropriate PPE, are all important precautions that the World Health Organization recommends as a primary line of defense against the Covid-19 pandemic. Good respiratory hygiene should also be practiced, as well as maintaining a safe physical distance [15]. The importance of personal hygiene measures and food hygiene principles in reducing the risk of contamination of food surfaces and packaging materials with respiratory disease causing viruses from food workers is crucial, despite the lack of evidence supporting the spread of such viruses through food or food packaging.

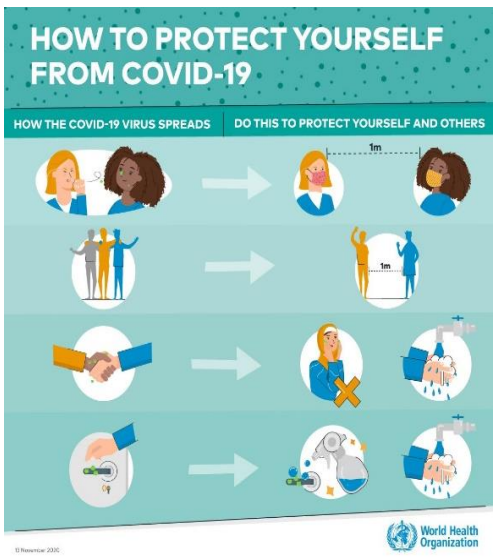


Figure 2.2 Step to Prevent Covid-19

Therefore, it is important for restaurants to priorities the implementation of the steps and make sure that food workers are properly trained. These methods will not only reduce the incidence of Covid-19 in the workplace, but they will also protect employees from other food-borne disease and keep workers healthy [15], [16]. It was thought that during the Covid-19 pandemic, food handlers who worked in places that served food would be more careful about following good food hygiene practices. During the Covid-19 pandemic, little research was done on how food workers in restaurants and other food service businesses kept food clean and what other factors were involved. Therefore, measure the level of food hygiene practices among food handlers working in food outlets during the Covid-19 pandemic and find out what factors are related to the level of food hygiene practices [17].

2.5 Internet of Things (IoT)

The Covid-19 outbreak, which has been going on for a long time, has caused changes in many aspects of life. People wear masks every day have changed the fashion industry by adding mask decorations to clothes where there weren't any before. In the fields of planning and architecture, the same kinds of things need to be thought about in order to fit into the "new normal era" and meet the needs of the space's role. IoT and AI technologies will make planning and building design work better. These technologies will also help building users feel safer, more comfortable, and more confident about their health. The use of QR menus in restaurants is an example of how IoT and AI can be used if the QR Menu has features that are linked to other devices, like a refrigerator or a place to store food. The "New Normal Era" has led to a few small changes in the architectural design, such as the use of automatic doors and buttons that do not need to be touched, like those on lifts and parking ticket machines. Even though designing buildings for the New Normal Era and rooms is expensive, it has to be done because health is now the top priority in this Era. In

this pandemic situation, where technology is optimized to have less movement and human touch, which are no longer needed. The use of IoT and AI technology automation in the building will be supported [18].

FFR hard to keep up with production and usage, especially during peak hours. As the queue of customers gets longer, the restaurant needs to speed up its production to meet the demand as quickly as possible. In opposed to standard table-service restaurants, customers expect to get their food in a few minutes or less. Therefore, it's not the right time to switch to a reactive service model. In other words, if a product is made right after a customer place an order, customers will have to wait longer and have a worse experience [19]. Automation solutions built on the IoT have been increasingly popular in many sectors over the past decade. Sensors and other data sources in such systems make a lot of data, which is usually sent to cloud data centers for analysis [20], [21].

IoT is used to describe a network that allows devices (human and otherwise) to exchange data with one another without requiring human intervention. A larger audience is expected by 2020 which is more than 50 billion gadgets[22]. A few systems that work together are smart houses, health care, and transportation. Environmental smart gadgets can work based on their surroundings, which can't be done with manual monitoring. When sensors are used to smart things, they get smarter and give humans a greater ability to make the monitoring process better. There are devices that can be placed on the body and link to a network of sensors. Smart devices and smartwatches help make this possible. By look at the smartwatches on the market right now, most of them are linked to sensors that can measure your heart rate and temperature [22].

Table 2.1 shares comparison between 5 different mechanism and components used from previous studies in a clear and organized way. By comparing these elements, reader may see their similarities, differences, and most important characteristics.

Table 2.1 Table of Comparison

Mechanism	Components	Ref.
The infrared distance sensor detects suitable surface, then the sauce will dispense. Next, when the dispenser is full of sauce, the red LED lights will turn off, while if the sauce level is lower, the red LED lights will be blinking to indicate that the dispenser needs to be refilled.	• Arduino UNO • 12V motor pump • Infrared Distance Sensor • Ultrasonic Sensor • LED • 12V Adapter • 5V Relay	[23]
DC pumps are controlled by push buttons, which determine the dispensing pattern for pump, LCD display and the Arduino UNO to operates the program. In the default state, if a sauce bowl is detected and a button is tapped, the DC pumps will dispense the sauce.	• Arduino UNO • Relay Module • 4 DC pumps • 12V power supply • Push button • LCD • Infrared sensor	[24]
Placing a sauce bottle on the touch sensor. The touch sensor will turn on and activate the motor to pull the sauce container to the infrared sensor. The manufacturer chooses the interval at which the sauce is distributed and sets the timer accordingly. When the sauce bottle gets close to the sensor, the sauce will dispense with time set, and the motor will move the sauce back into place. The LED blinks to show that there is not much sauce.	• Infrared sensor module • Ultrasonic sensor • TTP223 sensor • Arduino • Driver L298N • Motor gearbox • LED • Relay • Power supply	[25]
Ultrasonic sensor detect glass placed on dispenser. Water will flow out when energized and stop when de-energized using a solenoid valve. Arduino program was developed to detect whether anything is near the tap and turns on the solenoid till the object is removed, then turns off automatically to shut off the water supply.	• Arduino UNO • RFID reader RC522 • SPDT Relay 12 V • Battery 5 V • Solenoid tap	[26]
There are 3 buttons which means water quantity that user needed. It has 150ml, 250ml, and 500ml. Buttons will pump the right amount of water. Then, each time the button is pressed, the microcontroller will calculate and add the number of times it has been pressed and display it on an LCD. If the water level is below 2 liters in the dispenser the green LED will turn on.	• Arduino mega 2560 • Wi-Fi module • LED • LCD • Piezo • Water pump • Relay • Push button	[22]

2.6 Summary

In this chapter, it discusses issues in relation and previous project related to this project. In this chapter as well, approaches method that used by other researchers in their studies. The study by the researcher is important information to review and help to differentiate the features of past research that can guide in this journal.

CHAPTER 3

METHODOLOGY

3.1 Introduction

In this chapter will explains and discusses the project methodology and design. Thus, the design of hardware and software will be covered in this chapter. In this chapter, each component usage and function will be explained on and discussed. The software design for creating a low-cost automatic sauce dispenser will be analyzed and described in detail. This chapter will also discuss about the final step of hardware development.

3.2 Selecting Equipment

This project is basically to develop an innovative and efficient automatic sauce dispenser system that improves food service efficiency, quality, and management. The combination of IoT and ESP technology creates an excellent platform for monitoring from afar, accurate dispensing can further improve the system performance. Below is the main component of this project:

- ESP 32
- Ultrasonic sensor
- Infrared sensor
- LCD
- Motor pump
- Load cell sensor
- Relay module
- Buzzer

- Blynk application
- Cloud platform

ESP 32 will be microcontroller and connected to ultrasonic sensor, infrared sensor, load cell sensor and Blynk application.

3.2.1 ESP 32

Figure 3.1 ESP 32

The ESP32 microcontroller is a game-changer in the field of embedded technology, offering a range of impressive features such as affordability, low power usage, and built-in Wi-Fi and Bluetooth capabilities. This unique combination opens a world of possibilities for creators to develop connected devices, including smart homes, wearables, and industrial solutions. Powered by the high-performance Tensilica Xtensa LX6 microprocessor, the ESP32 excels in both speed and efficiency. Its exceptionally low power consumption makes it particularly well-suited for applications that rely on battery power. The ESP32's versatility is truly remarkable, as it can operate as a standalone system or seamlessly integrate with other microcontrollers. Furthermore, its ability to withstand extreme temperatures and the abundance of development resources available make it a dependable and user-friendly platform for creators of all skill levels.

3.2.2 Ultrasonic Sensor

Figure 3.2 HC-SR04 Ultrasonic Sensor

The HC-SR04 is a SONAR-based ultrasonic sensor used for measuring distance. It has ability to measure distances from 2 cm to 400 cm (1 inch to 13 feet) without need for physical contact. It is easy to use to gets accurate and stable readings. It makes no difference to the procedure whether there is light or darkness present. Anyway, it may be difficult to hear through materials that are soft, such as cloth. It has a module that functions as both an ultrasonic receiver and transmitter built in. The sensor measures the time between when the ultrasonic pulse is sent and when the echo pulse is received. Using the speed of sound, it turns this time into distance. The liquid level is then found by taking the total tank depth and removing the distance between the transducer and the surface of the liquid.

3.2.3 Infrared Sensor

Figure 3.3 Infrared Sensor

The infrared devices send out and pick up infrared waves as heat. It detecting the infrared radiation emitted by things to identify moving objects, and to detect human presence. Infrared detectors are pyroelectric sensors that detect the infrared wavelength of

the light spectrum. Infrared detectors can be made of a phototransistor, photodiode, or photoresistor because these three components are basically the same device. The sensing is achieved when a wave transmitted by the sensor hits the target object and returns to the sensor.

3.2.4 Liquid-Crystal Display (LCD)

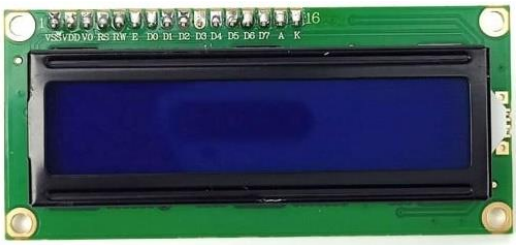


Figure 3.4 Liquid-Crystal Display (LCD)

LCDs are flat-panel displays or other optical devices that use polarizers and the light-modulating properties of liquid crystals to create images. LCD displays need a backlight or reflector to produce color or monochrome images. It can show random pictures, like a general-purpose computer screen, or fixed images with low information value including words, numbers, and seven-segment displays. They share the same fundamental technology, but one uses a grid of tiny pixels while the other use larger components to create images.

3.2.5 Load Cell Sensor

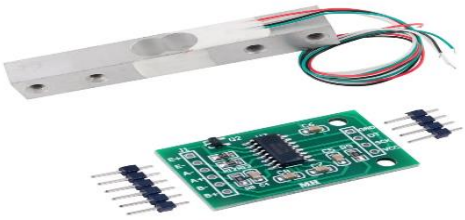


Figure 3.5 Load Cell Sensor

The load cell is a straight bar load cell, often known as a strain gauge. It can convert force (pressure) into an electrical signal. Each load cell can measure the electrical resistance, which differs in reaction to and proportionate to the strain (e.g., pressure or force) applied to the bar. This gauge can tell how heavy an object is, whether the weight of an object varies over time, or if you merely need to detect the presence of an object by measuring strain or force applied to a surface.

3.2.6 Relay Module

Figure 3.6 Relay Module

There are two metal contacts inside the relay section. Most of the time, these connections do not touch or connect with each other. Relays have a switch inside that connects these contacts to make an electrical circuit that lets electricity move. The switch inside a relay is turned on and off by electric pulses. supply a voltage power current on one side of the circuit so that it can power an electromagnetic coil. The electromagnetic coil is responsible for pulling the metal contacts closer together. So, this makes the current run through the relay on the other side.

3.2.7 Buzzer

Figure 3.7 Buzzer

A buzzer is a form of voice technology that converts an audio model into a sound signal. Typically, it serves as a reminder or alarm. To make a piezo buzzer, electrical contacts are placed on opposite sides of a disc made of piezoelectric material and the disc is then held in place by the edges of the disc. Mechanical deformation occurs in piezoelectric material when an electric current is passed between two electrodes. The alarm's piezo disc vibrates to create noise.

3.2.8 Blynk Application

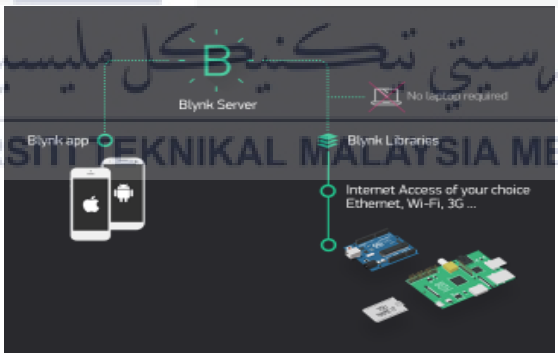


Figure 3.8 Blynk Application

Blynk is an IoT app for smartphones that makes it easy for people to handle microcontrollers. The main purpose of the Blynk software is to make it very easy to build apps for mobile phones. Consumer can make a mobile app that connects to ESP 32 by dragging a button and setting up a pin. With Blynk, consumer can use phone to control an LED or a motor without having to do any code.

3.2.9 Cloud Platform

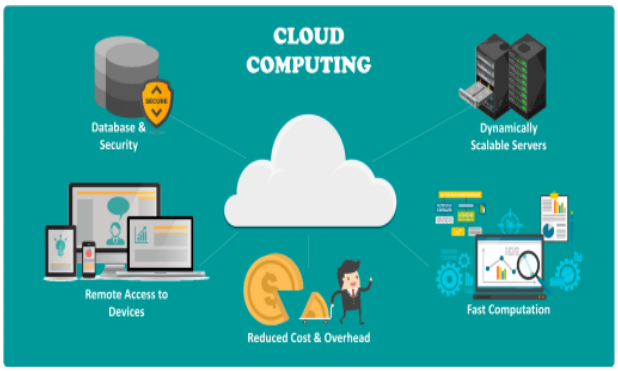


Figure 3.9 Cloud Platform

Cloud platform refers to the software and operating system that are installed on a server that located in a data center and connects to the Internet. It enables remote and large-scale collaboration between software and hardware. Information Technology (IT) services like computers, databases, storage, analytics, networking, software, and intelligence can be used by organizations. Companies don't have to build and own their own data centers or computer systems and they only need to pay for the services they only used. Organizations can use a cloud platform to create and test cloud-native applications, create backups, and recover data, and create and construct cloud-based applications. Organizations can also stream video and audio, add intelligence to their operations, and give software on-demand all over the world.

In this project, Blynk.Cloud is used because users can connect devices to the cloud and build mobile apps to control, monitor, and handle users and products remotely. Blynk is a multi-tenant solution that gives users access to devices and data based on their jobs and permissions.

3.3 Block Diagram

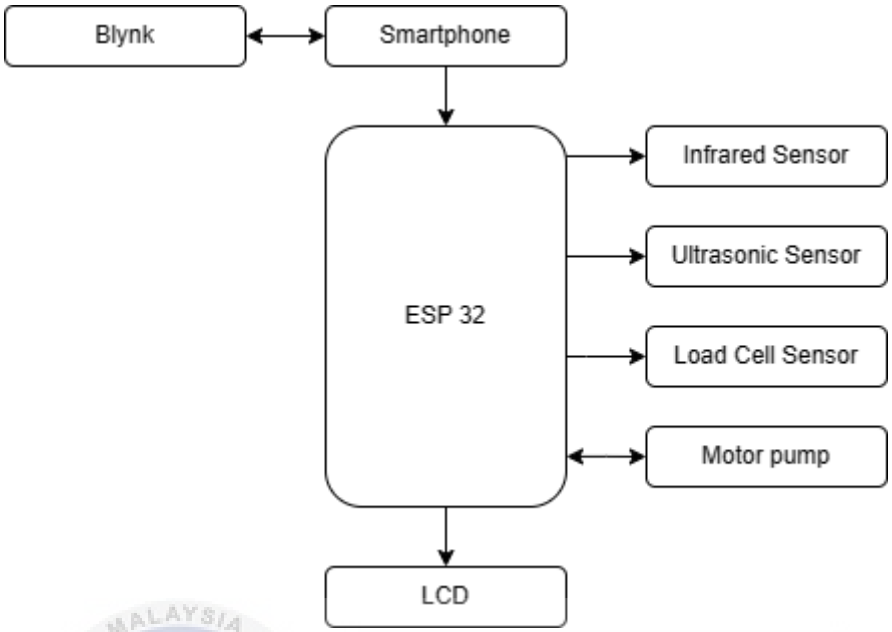


Figure 3.10 Block Diagram Project

Figure 3.10 show in order to construct a system that is capable of detecting things on the load cell platform using infrared and ultrasonic sensors, the block diagram explains how the components are connected to one another and how they work during the development process. The system can also work together to construct other types of detection systems. The ESP 32 is the main processor. It gets information from the sensors and sends commands to the motor pump and LCD screen. Blynk and the smartphone make it easy to handle and check on the system from afar.

3.4 Flow Chart

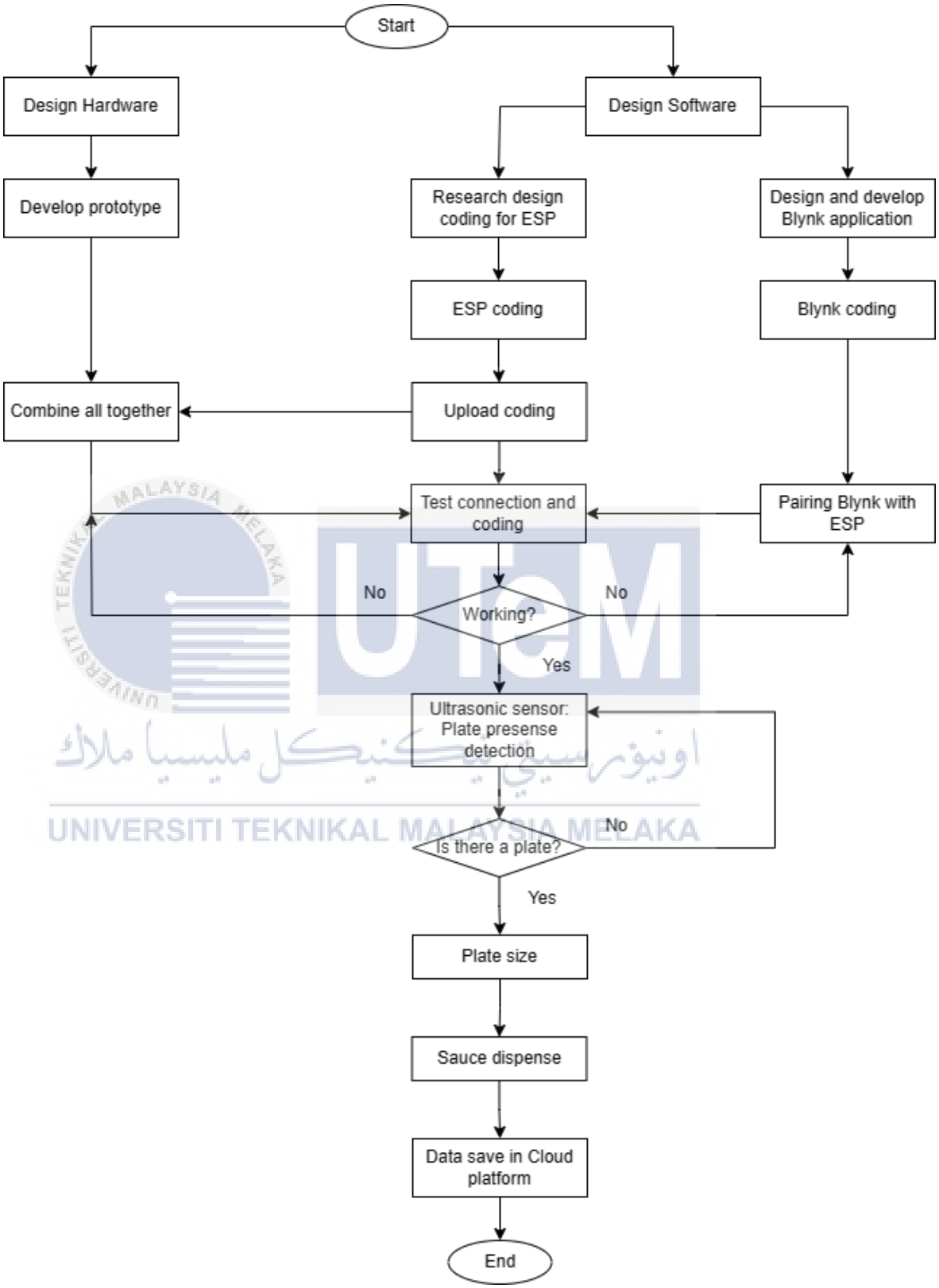


Figure 3.11 Flow Chart Project

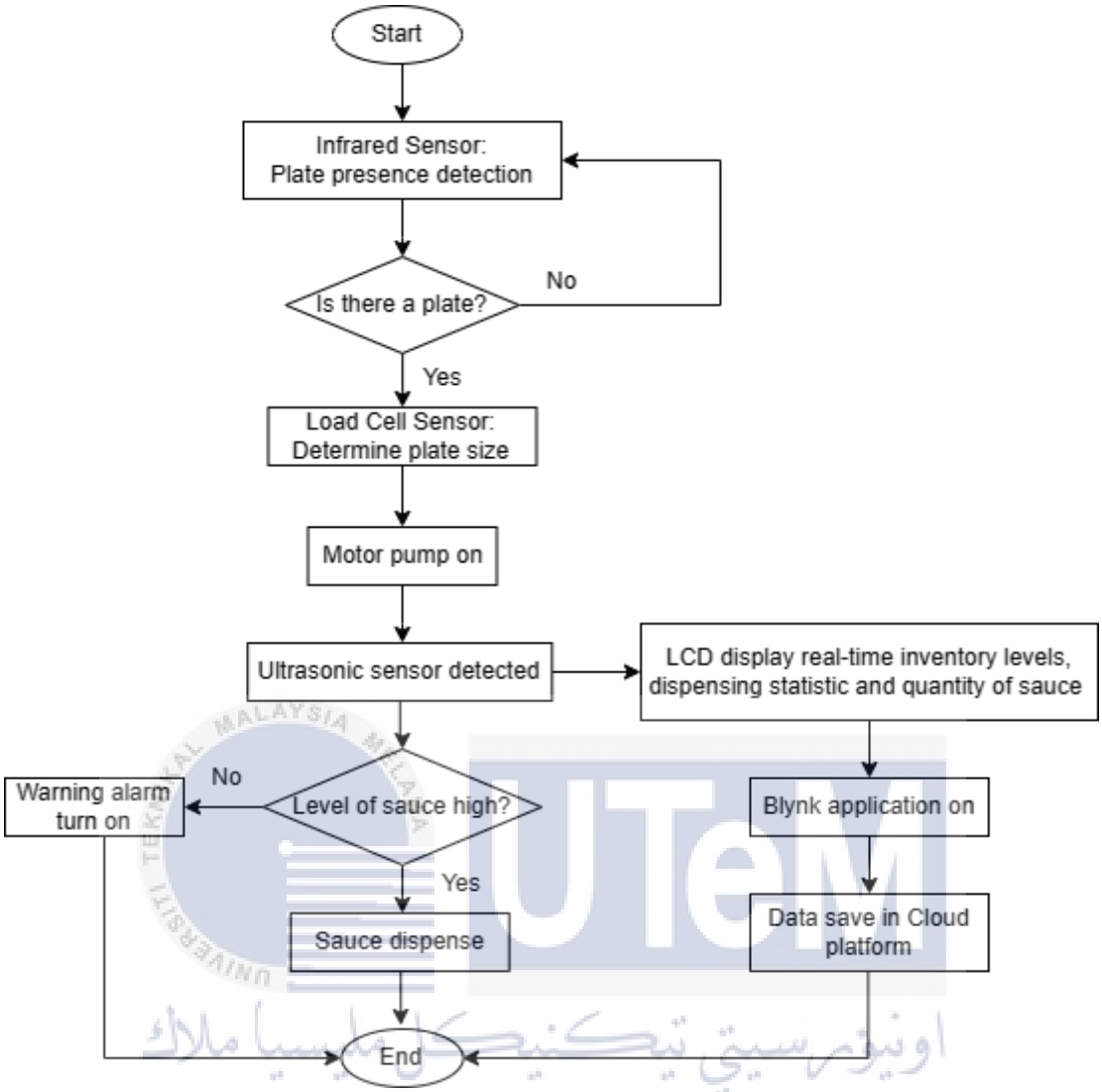


Figure 3.12 Flow Chart Working Project

Figure 3.11 shows flow chart for full project including steps for hardware and software designing while figure 3.12 shows step-by step project working procedure. The flow diagram outlines the steps involved in detecting a plate using an infrared sensor, a load cell sensor, and an ultrasonic sensor. First, the infrared sensor checks for the presence of a plate. If no plate is detected, the process ends. If a plate is present, the load cell sensor determines its size. Then, the ultrasonic sensor measures the level of sauce remaining in the dispenser. Based on the plate size and sauce level, the motor pump dispenses the appropriate amount of sauce. The LCD displays real-time information about inventory levels, dispensing

statistics, and sauce quantity. Additionally, a warning alarm can be triggered if the sauce level is high. Finally, data is saved in a cloud platform for further analysis.

3.5 Design Project Prototype

Project prototype have designed to improve the process of sauce dispensing in fast food restaurants. The main purpose is to provide a practical and hygienic method for properly dispensing sauces onto a variety of dishes.

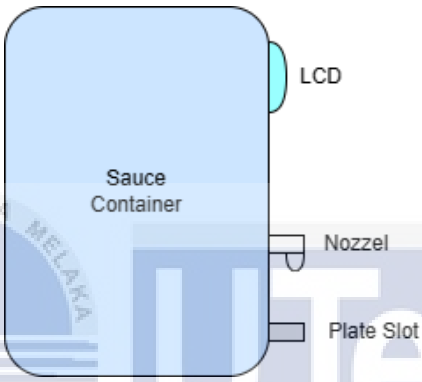


Figure 3.13 Prototype Design

Figure 3.13 show sauce container prototype designed to store sauces that are used in the automatic dispenser in an environmentally friendly manner. Its purpose is to provide a clean, focused way to store sauces that keeps them fresh and makes them easy to dispense when needed. The ultrasonic sensor is used to measure the quantity of sauce left in the container. The purpose of the sensor is to give accurate, real-time information about the sauce, so that the nozzle is able to dispense the sauce exactly where it needs to be. The infrared sensor will detect if there are plates in the plate slot where the food is dispensed. The function of this sensor is to let the dispenser know where the food is in real time so that it can put the sauce on the targeted area accurately. The LCD is designed to display real-time inventory levels, dispensing statistics and quantity sauce left in the container.

3.6 Limitation of Proposed Methodology

Sauce dispenser need to be cleaned regularly to keep them from getting clogged and to keep them clean. It can be hard to make a system that is easy to clean and maintain it. All parts of the dispenser need to be accessible while also being resistant to collect of residue.

An automatic sauce dispenser needs a feedback system that works well. It should be able to tell when a sauce container is empty or almost empty so that sauce does not get wasted or dispensed inconsistently. Develop a strong sensing system that can correctly detect the sauce level or the state of the container can be challenging.

It can be challenging to make an automatic sauce container that is cheap, especially for home or small-scale use. It is important to think about how to balance the cost of the system with its speed and reliability.

Infrared sensor requires the reflection of the clear plate in order to detect its existence. The project has a blind area as a result of its invisibility. This is resolved by colouring the plate, which gives the sensor a clear signal when the plate reaches them.

3.7 Summary

In conclusion, this chapter helps provide information on programs that develop. It also help to gain better understanding project concept and methodology. Next, the procedure of this project can be seen in flowchart which describes the project in detail. After that, software development process used to provide deeper knowledge and serve as a guideline for making this project.

CHAPTER 4

RESULTS AND DISCUSSIONS

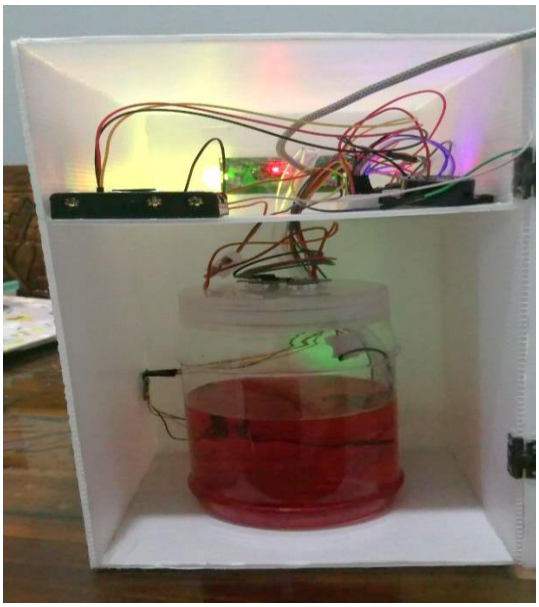
4.1 Introduction

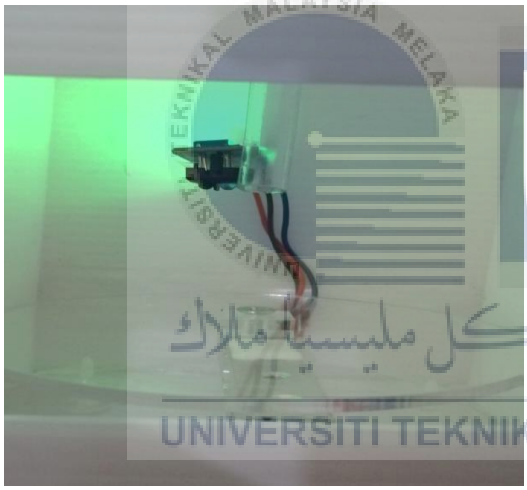
This chapter will eloborate the outcomes of this project. With the data as it has been programmed, the desired outcome can be achieved. As a result, the outcomes are very important if one to figure out the outcomes will remain the same once the project has been finished.

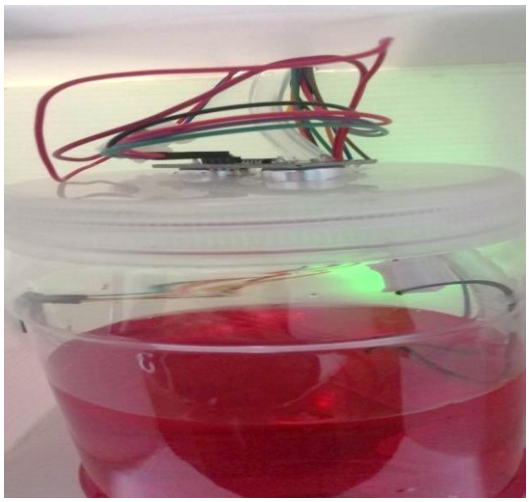
4.2 Results and Analysis

Once all the designs and prototypes have been developed, as was stated in chapter 3, this chapter will be where the results and analysis are presented. More attention needs to be taken with the data that is collected to provide an exact and precise analysis that is free of any errors that might cast doubt on the product. The data and analysis will be presented after the description related to the prototype.

The design shown in figure 4.1 has been completed, with all components and hardware attached as specified in this project. After that, a detailed explanation on the operational of this project will be provided after the display of the prototype design.







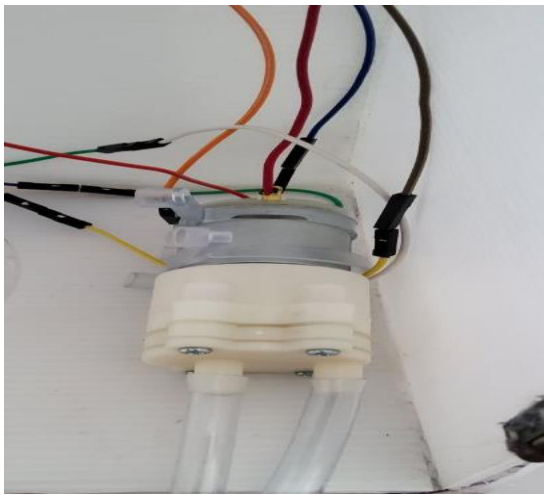


Figure 4.1 Product Prototype

The infrared sensor is the first point of contact and is effective in determining whether a plate is within its detecting range or not. It is possible to improve the responsiveness of the system by carefully examining the data collected by the sensors. This will ensure that the dispensing mechanism is engaged in a timely and precise manner upon the recognition of the plate. Adjusting the algorithmic settings according to the data from the infrared sensor allows the machine to smoothly adjust to different operating conditions, giving a quick and accurate dispensing procedure. Furthermore, this data analysis technique makes it easier to identify possible issues, such as false positives or negatives, allowing for the introduction of corrections to improve the overall accuracy of the plate recognition system.

The load cell sensor functions as an advanced mechanism that measures the weight of the plates, allowing the system to classify them into three sizes which are small, medium, and large. The weight data that was captured by the load cell sensor is carefully analyzed and interpreted within the parameters that have been set as part of the process of data analysis. A plate that weighs between 0.5 g and 1.5 g is considered small size, a plate that weighs between 2 g and 4.5 g is considered medium size, and a plate that weighs between 5 g and 10 g is considered large size. The sauce dispenser machine can make sure that the right amount of sauce is poured onto each plate by matching the data from the load cell sensor to the set weight ranges. The ultrasonic sensor precisely measures sauce level in the dispensing container in real time. Ultrasonic will trigger a buzzer when the sauce level reaches a critical distance of 15 cm from the sensor. A gap of 4 cm between the sensor and the sauce indicates that the container is full. The device can accurately calibrate the dispensing mechanism by correlating ultrasonic sensor readings with sauce volume through data analysis. Included connectivity features make it possible for the amount data to be sent automatically to the Blynk app, which makes tracking and controlling from afar easier. By connecting to the

Blynk app, fast-food owners can see how much sauce is left in real time and be notified when it needs to be refilled.

4.3 Project Analysis

There are two analyses that are presented in the following information. First, the data from the Blynk which relates to ultrasonic sensor. Second, the weight of the 3 different sizes of plates compared as measured by the weighing scale and load cell sensor. It is the output for this project that is included in the output in Blynk, and the results that are provided serve as the output.

Table 4.1 shows a full comparison between weighing scales and load cell sensor. It clearly shows the specific advantages of using a load cell monitor to precisely measure plate weights. Load cells are more accurate than regular scales, so the system can tell the difference between three different plate weights very precisely. The table lists important features like sensitivity, response, and flexibility. This comparison shows how the load cell sensor has contributed to technology progress and how important it is to making sauce dispensing system more efficient and flexible.

Table 4.1 Comparison Plate Weight Using Weighing Scale and Load Cell Sensor

	Small		Medium		Large	
	Actual(g)	Measurement(g)	Actual(g)	Measurement(g)	Actual(g)	Measurement(g)
1	0.5	0.85	4.0	4.32	6.0	6.60
2	0.5	1.10	4.0	4.43	6.0	6.73
3	0.5	0.82	4.0	4.37	6.0	6.54
4	0.5	0.90	4.0	4.43	6.0	6.59
5	0.5	0.90	4.0	4.39	6.0	6.65
6	0.5	0.84	4.0	4.26	6.0	6.51
7	0.5	0.90	4.0	4.37	6.0	6.71
8	0.5	0.80	4.0	4.36	6.0	6.56
9	0.5	0.91	4.0	4.25	6.0	6.61
10	0.5	0.80	4.0	4.36	6.0	6.57
11	0.5	0.76	4.0	4.43	6.0	6.61
12	0.5	0.72	4.0	4.31	6.0	6.52
13	0.5	0.83	4.0	4.27	6.0	6.40
14	0.5	0.77	4.0	4.30	6.0	6.62
15	0.5	0.82	4.0	4.21	6.0	6.48
16	0.5	0.74	4.0	4.56	6.0	6.45
17	0.5	0.75	4.0	4.22	6.0	6.69
18	0.5	0.83	4.0	4.21	6.0	6.47
19	0.5	0.79	4.0	4.16	6.0	6.40
20	0.5	0.83	4.0	4.31	6.0	6.52
21	0.5	0.54	4.0	4.26	6.0	6.44
22	0.5	0.81	4.0	4.19	6.0	6.40
23	0.5	0.75	4.0	4.07	6.0	6.73
24	0.5	0.71	4.0	4.21	6.0	6.51
25	0.5	0.65	4.0	4.43	6.0	6.71
26	0.5	0.68	4.0	4.25	6.0	6.56
27	0.5	0.92	4.0	4.36	6.0	6.46
28	0.5	0.90	4.0	4.43	6.0	6.61
29	0.5	0.84	4.0	4.27	6.0	6.57
30	0.5	0.72	4.0	4.30	6.0	6.61

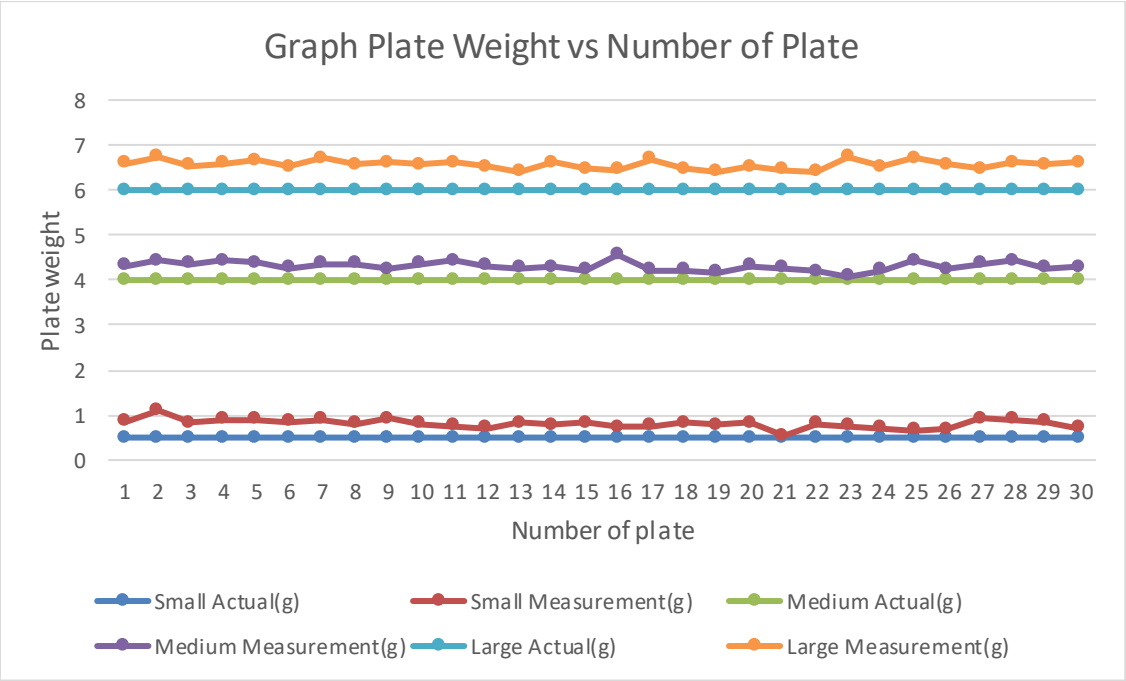


Figure 4.2 Graph Number of Reading vs Plate Weight Using Load Cell Sensor

Figure 4.2 compares graph plate weight data collected by two different methods which are a standard weighing scale and a load cell sensor. The graph's real measurements are obtained using a traditional weighing scale. This is proven technique has been used as the industry standard for weighing for a long time. However, the load cell sensor is where the measurement readings come from, which are shown next to the real measurements. A modern and sophisticated tool for precise and accurate weight readings is the load cell sensor.

Table 4.2 show the ultrasonic sensor is the most important part because it detects and measures the amount of sauce in the container. The sensor measures the distance to the sauce's surface by sending out high-frequency sound waves. This gives real-time information on how much sauce is left. This information is very important for strategic inventory management because it lets staff keep an eye on sauce amounts easily. The table shows how accurate and quick the sensor is, as well as how important it is for keeping the sauce dispensing process smooth and uninterrupted, which improves working efficiency and customer happiness.

Table 4.2 Ultrasonic Reading

Data	Result
	Sauce level: Full Quantity: 1000 ml Buzzer: Off Motor pump: On
	Sauce level: Medium Quantity: 200 ml Buzzer: Off Motor pump: On
	Sauce level: Low Quantity: 80 ml Buzzer: On Motor pump: Off

4.4 Summary

This chapter discusses how each of the components discussed in the previous chapter have been used and constructed in this chapter. As a result, the project prototype was built successfully according to the requirements in Chapter 3. In conclusion, this product is safe to use and can help solve the problem of sauce in fast food restaurants. There are categories of analysis covered which are efficiency, accurancy and consistency.

CHAPTER 5

CONCLUSION AND RECOMMENDATIONS

5.1 Conclusion

This chapter will recap and summerize overall of this report and the project that has been constructed. Review and suggestion also will be included in this chapter so it can be improved in the future.

Fast food operations have been much more automated and efficient with the use of ESP32, and a variety of sensors to create a Sauce Dispenser Machine with Internet of Things characteristics. The incorporation of state-of-the-art technologies, including load cell sensors, infrared sensors, ultrasonic sensors, and a Blynk application, significantly improves the system's overall functionality and user experience.

ESP32 microprocessor is used as the central processing unit to make sure that all of the machine's parts can talk to each other without any problems. When a plate is positioned correctly, the infrared sensor effectively detects its existence and initiates the dispensing process. This practice not only serves to reduce the amount of wasted sauce but also enhances the cleanliness and regulation of the dispensing procedure.

Load cell sensors are integrated into the apparatus, facilitating the differentiation of sauce dispensing based on the particular specifications of individual orders and three distinct plate weights. This functionality enhances the system's flexibility by accommodating a wide range of consumer preferences and serving sizes.

An ultrasonic sensor precisely determines the amount of sauce that remains in the container in order to avoid the difficulty associated with sauce level monitoring. Staff at the restaurant can replace the sauce containers before they run out because of this real-time

feedback. This keeps the pouring process running smoothly during busy times. The operational smoothness and overall dependability of the machine are enhanced by this predictive maintenance function.

For remote monitoring and control, the incorporation of a Blynk application provides an intuitive and user-friendly interface. Fast food personnel have the ability to effectively oversee the dispensing machine, monitor sauce levels, and be notified of technical issues or low inventory. The sauce dispensing system is not only more easily accessible and manageable, but its operations are also streamlined with the Blynk application. In addition to the technical features, the motor pump makes the dispensing mechanism steady and easy to control, making sure that the sauce is spread evenly on plates. This improves the overall appearance of the food and increases consumer pleasure.

Sauce Dispenser Machine with IoT features provides a strong answer to the problems that fast food restaurants have with easily handling the dispensing of sauces. Using smart sensors, microcontrollers, and an easy-to-use app together not only speeds up processes but also helps make the fast-paced food business more environmentally friendly and customer-focused. Putting this technology to good use could completely change how sauces are served in fast food restaurants, making things run more smoothly and giving customers a better experience.

5.2 Future Works

There is a significant amount of opportunity for further developments to be made in the future development of the Sauce Dispenser Machine with Internet of Things capabilities for fast food operations. These advancements have the objective of improving cleanliness and expanding usefulness. One potentially fruitful approach is to incorporate an autonomous robot system that is able to move plates from a rack of plates to the plate slot oat the

dispenser. Not only does this make the process more efficient, but it also reduces the amount of human touch, which adds to the overall improvement of hygiene standards in fast-food organizations. The device can limit the danger of contamination by automating plate handling, which in turn promotes a more hygienic environment in areas where food is being prepared.

Furthermore, there is the possibility of expanding the range of sauces available by including a dispenser mechanism that can accommodate and dispense several different kinds of sauces from one dispenser. Customers would have access to a wider variety of options due to this, which would appeal to a variety of preferences and tastes. Not only does having of such a function make the machine more versatile, but it also brings it in line with the ever-changing nature of menus in fast-food restaurants.

5.3 Project Potential

There is a loT of potential for developing an ESP32 sauce dispenser system with IoT capabilities for fast food operations. Through the integration of IoT technology, this device may provide instantaneous monitoring and control functionalities, enabling quick service restaurants to effectively oversee sauce stock levels and dispensing procedures. The machine has an ESP32 microcontroller that allows it to be connected to the internet, allowing remote access and operation from a computer or smartphone.

This innovative has the potential to greatly improve the operational efficiency of fast-food restaurants by automating sauce pouring, reducing wait times, and minimizing waste. Restaurant management may receive warnings when sauce levels are low, allowing them to restock quickly to match client demand. Furthermore, data acquired

by the system may be analysed to optimise inventory management strategies and improve overall productivity.

The sustainability and operational effectiveness of the fast food sector can be improved by using an IoT-based sauce dispenser system. Food waste and overproduction may be minimised by companies through the customisation of sauce options according to customer preferences, inventory management optimisation, and consumption pattern analysis. This strategy uses less energy and raw resources, which is in line with sustainable principles. Technology has the potential to transform the fast food sector by increasing resource efficiency, reducing environmental impact, and improving consumer experience.

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APPENDICES

Appendix A Arduino Program Code

```
#define BLYNK_TEMPLATE_ID "TMPL6OX0V8igC"
#define BLYNK_TEMPLATE_NAME "Sosdispenser"
#define BLYNK_AUTH_TOKEN "fEgiB5xciVN19Oi6iW1JMVRghi8s1Uz1"
#define BLYNK_PRINT Serial
#define SOUND_SPEED 0.034
#define CM_TO_INCH 0.393701
#define BUZZER_PIN 23 //buzzer
#define RELAY_PIN 15 //relay for motor
#include <WiFi.h>
#include <WiFiClient.h>
#include <Arduino.h>
//#include "soc/rtc.h"
#include "HX711.h"
#include <BlynkSimpleEsp32.h>
#include <LiquidCrystal_I2C.h>
const int irSensor = 4;
const int LOADCELL_DOUT_PIN = 5;
const int LOADCELL_SCK_PIN = 17;
HX711 scale;

char ssid[] = "MUMTAZ FAUZI"; //wifi name
char pass[] = "mumtazfauzi"; //wifi password
int lcdColumns = 16;
int lcdRows = 2;
LiquidCrystal_I2C lcd(0x27, lcdColumns, lcdRows);
const int trigPin = 19; //for ultrasonic sensor
const int echoPin = 18; //for ultrasonic sensor
long duration;
float distanceCm;
float distanceInch;
float distanceInch;
int irReading;
int sosquantitythresh = 15; //distance threshold for sauce quantity
void setup() {
  lcd.init();
  lcd.backlight();  // turn on LCD backlight
  lcd.clear();
  Serial.begin(9600); //Serial baud connction
  WiFi.begin(ssid, pass);  // Non-blocking if no WiFi available
  Blynk.config(BLYNK_AUTH_TOKEN);
  Blynk.connect();
  //Blynk.begin(BLYNK_AUTH_TOKEN,ssid,pass); //Connecting to Blynk
  pinMode(trigPin, OUTPUT); // Sets the trigPin as an Output
  pinMode(echoPin, INPUT); // Sets the echoPin as an Input
  //rtc_clk_cpu_freq_set(RTC_CPU_FREQ_80M);
  scale.begin(LOADCELL_DOUT_PIN, LOADCELL_SCK_PIN);
  Serial.println("Before setting up the scale:");
  Serial.print("read: \t\t");
  Serial.println(scale.read());      // print a raw reading from the ADC

  Serial.print("read average: \t\t");
  Serial.println(scale.read_average(20));   // print the average of 20 readings from the ADC

  Serial.print("get value: \t\t");
  Serial.println(scale.get_value(5));   // print the average of 5 readings from the ADC minus the tare weight (not set yet)

  Serial.print("get units: \t\t");
  Serial.println(scale.get_units(5), 1);  // print the average of 5 readings from the ADC minus tare weight (not set) divided
            // by the SCALE parameter (not set yet)


  scale.set_scale(-471.497);
  //scale.set_scale(-471.497);                      // this value is obtained by calibrating the scale with known weights; see the README for details
  scale.tare();               // reset the scale to 0

  Serial.println("After setting up the scale:");

  Serial.print("read: \t\t");
  Serial.println(scale.read());                 // print a raw reading from the ADC

  Serial.print("read average: \t\t");
  Serial.println(scale.read_average(20));       // print the average of 20 readings from the ADC

  Serial.print("get value: \t\t");
  Serial.println(scale.get_value(5));   // print the average of 5 readings from the ADC minus the tare weight, set with tare()
```

```
  Serial.print("get units: \t\t");
  Serial.println(scale.get_units(5), 1);        // print the average of 5 readings from the ADC minus tare weight, divided
            // by the SCALE parameter set with set_scale

  Serial.println("Readings:");
  pinMode(BUZZER_PIN, OUTPUT);
  pinMode(RELAY_PIN, OUTPUT);
  pinMode(irSensor, INPUT);

}

void loop() {
 caldis();
 Serial.println(scale.get_units());
 lcd.setCursor(0,1);
 lcd.print("Value:");
 lcd.setCursor(6,1);
 lcd.print(scale.get_units());
 irReading = digitalRead(irSensor);
 digitalWrite(RELAY_PIN, LOW);
  if (irReading == LOW)
  {
     scale.power_up();
     lcd.setCursor(0, 0);
     lcd.print("Plate Detected");
     delay(2000);
     lcd.clear();
     Serial.print("one reading:\t");
     Serial.print(scale.get_units(), 1);
     Serial.print("\t| average:\t");
     Serial.println(scale.get_units(10), 5);
     //scale.power_down();// put the ADC in sleep mode
     if(scale.get_units() >= 0.5 && scale.get_units() <= 1.5){
       lcd.setCursor(0, 0);
       lcd.print("Dispensing Sauce");
       delay(2000);
       lcd.clear();
       digitalWrite(RELAY_PIN, HIGH);


       /// ADJUST SINI TINGGIKAN DELAY DEKAT BAWAH (SOURCE)
       delay(1500);
       digitalWrite(RELAY_PIN, LOW);
       /// ADJUST SINI TINGGIKAN DELAY DEKAT BAWAH (ANGKAT PLATE)

       digitalWrite(BUZZER_PIN, HIGH);
       delay(500);
       digitalWrite(BUZZER_PIN, LOW);
       delay(30000);
       digitalWrite(BUZZER_PIN, HIGH);
       delay(1000);
       digitalWrite(BUZZER_PIN, LOW);
     }

    if(scale.get_units() >= 2 && scale.get_units() <= 4.5){
        lcd.setCursor(0, 0);
        lcd.print("Dispensing Sauce");
        delay(2000);
        lcd.clear();
        digitalWrite(RELAY_PIN, HIGH);
        /// ADJUST SINI TINGGIKAN DELAY DEKAT BAWAH (SOURCE)
        delay(2000);
        digitalWrite(RELAY_PIN, LOW);
        /// ADJUST SINI TINGGIKAN DELAY DEKAT BAWAH (ANGKAT PLATE)
       digitalWrite(BUZZER_PIN, HIGH);
       delay(500);
       digitalWrite(BUZZER_PIN, LOW);
       delay(30000);
       digitalWrite(BUZZER_PIN, HIGH);
       delay(500);
       digitalWrite(BUZZER_PIN, LOW);
       delay(30000);
       digitalWrite(BUZZER_PIN, HIGH);
       delay(1000);
       digitalWrite(BUZZER_PIN, LOW);
     }

     if(scale.get_units() >= 5 && scale.get_units() <= 10){
        lcd.setCursor(0, 0);
        lcd.print("Dispensing Sauce");
        delay(2000);
        lcd.clear();
        digitalWrite(RELAY_PIN, HIGH);
        /// ADJUST SINI TINGGIKAN DELAY DEKAT BAWAH (SOURCE)
        delay(3000);
        digitalWrite(RELAY_PIN, LOW);
        /// ADJUST SINI TINGGIKAN DELAY DEKAT BAWAH (ANGKAT PLATE)
       digitalWrite(BUZZER_PIN, HIGH);
       delay(500);
```

```
        digitalWrite(BUZZER_PIN, LOW);
        delay(30000);
        digitalWrite(BUZZER_PIN, HIGH);
        delay(1000);
        digitalWrite(BUZZER_PIN, LOW);
      }
  }
  else
  {
     lcd.setCursor(0, 0);
     lcd.print("Plate Not Detected");
     delay(500);
     lcd.clear();
  }

Blynk.run();
}

void caldis() {
  digitalWrite(trigPin, LOW);
  delayMicroseconds(2);
  digitalWrite(trigPin, HIGH);
  delayMicroseconds(10);  // Sets the trigPin on HIGH state for 10 micro seconds
  digitalWrite(trigPin, LOW);
  duration = pulseIn(echoPin, HIGH);  // Reads the echoPin, returns the sound wave travel time in microseconds
  distanceCm = duration * SOUND_SPEED/2;  // Calculate the distance
  distanceInch = distanceCm * CM_TO_INCH; // Convert to inchess
  Serial.print("Distance (cm): ");  // Prints the distance in the Serial Monitor
  Serial.println(distanceCm);
  Blynk.virtualWrite(V0,distanceCm);
  if(distanceCm >= sosquantitythresh){
    buzz();
    delay(500);
  }
  Serial.print("Distance (inch): ");
  Serial.println(distanceInch);
  delay(1000);
}

void buzz(){
  digitalWrite(BUZZER_PIN, HIGH);
  delay(500);
  digitalWrite(BUZZER_PIN, LOW);
}
```