# DEVELOPMENT OF VENDING MACHINE WITH PREPAID PAYMENT METHOD

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Report submitted in partial fulfilment of the requirements for the award of the degree of Bachelor of Mechanical Engineering

> Faculty of Mechanical Engineering UNIVERSITI MALAYSIA PAHANG

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# UNIVERSITI MALAYSIA PAHANG

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#### ABSTRACT

Vending machine is a coin operated machine for selling various products. There were some problem occur in the payment problem method. The payment cannot be accepted and stuck, also cannot get the product is the major problem for the payment method. So for the problem, new payment system was introduced which is using prepaid method. The objectives in this project are developing a vending machine and then insert a new payment method proposed into it. The system builds using plunger as a new design that insert into each funnel in vending machine. The plunger control by circuit that been built using parallel port and attached to the computer. The programming for parallel port was using C as language. The body for this vending machine was developing using acrylic which is material that cannot rust. The completed vending machine develops in this project will be using a PC as a guide to connect into the vending machine. The customers need to insert right code to use the vending machine. The product will be released regarding to the customer chosen. If wrong, the customer cannot use the vending machine.

#### ABSTRAK

Mesin Runcitan adalah mesin syiling beroperasi untuk menjual beraneka barang. Terdapat masalah yang muncul pada bahagian pembayaran. Pembayaran tidak dapat diterima dan tersekat, serta tidak dapat mengunakan barang selepas membuat pembayaran adalah masalah utama dalam pengunaan mesin runcitan. Untuk menyelesaikan masalah ini, kaedah pembayaran baru mengunakan kad tambah nilai diperkenalkan. Objektif projek ini adalah membina sebuah mesin runcitan dan disertakan dengan kaedah pembayaran baru yang dicadangkan. Sistem mesin runcitan ini dibina mengunakan *plunger* dan disertakan di setiap corong pada mesin runcitan. Plunger kemudian dikawal oleh litar yang dibina berdasarkan *parallel port* dan disertakan pada komputer. Program untuk mesin ini mengunakan bahasa C sebagai penghantar. Badan mesin runcitan ini pula dibina mengunakan acrylic iaitu sebuah bahan yang tahan lasak dan kekal lama iaitu tidak akan berkarat. Mesin runcitan yang sempurna dibina akan disambung terus kepada komputer untuk mengunakannya. Pelanggan perlu memasukkan kod yang betul untuk mengunakan mesin runcitan ini. Produk akan dikeluarkan mengikut kehendak penguna. Jika kod yang dimasukkan salah, mesin runcitan ini tidak akan beroperasi.

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# LIST OF ABBREVIATIONS

- ATM Automated Teller Machine
- B.C Before Christ
- U.S United state
- SD Secure Digital
- PSP PlayStation® Portable
- UMD Universal Media Disc
- DVD Digital Video Disc
- CD Compact Disc
- SKU Stock Keeping Unit
- EMV Europay, MasterCard, Visa
- RFID Radio-frequency identification
- MDB Multi Drop Bus

#### **CHAPTER 1**

## **INTRODUCTION**

#### **1.1 PROJECT MOTIVATION**

Vending machine is a coin operated machine for selling merchandise (Merriam Webster Dictionary). Vending machine provides various product such as snacks, beverages, water, tickets, and others product. Vending machine has many benefits such as no need human energy, flexible in time, and saving time [10].

Firstly vending machine benefit is not using any human energy on it. The vending machine is managed by operator. Machine manufacturers sell machines to the operator that decides which payment system [11]. The labor work can be saving from having operators that's operated on it.

Secondly, vending machine is flexible in time that does can operate in 24 hours a day, seven days a week; each consuming between 2,500 to 4,400 kWh per year [9]. The vending machine can be operated anytime although that was holiday or weekend.

Thirdly, vending machine can save a time. In a business, an employee does not need to waste time for lunch. With a vending machine in the cafeteria, all they have to do is place some coins and push some buttons to get a drink or a snack [12].

As conclusion, the vending sector has seen significant growth over the years and it will continue to do so in the years to come [12]. The vending machine now needs to improve to give more contribution and benefits to human being.

#### **1.2 PROJECT BACKGROUND**

The specific problem having with vending machine is technical problem. Vending machine has many technical problems such as method of payment, level of security, very heavy structure, and product capacity.

Firstly, problems occur with payment method. <u>Coin acceptors</u> often jam up, especially if a bill or other foreign object is inserted into the coin slot. When the coin box was full with the coins, no more payment can be accepted thus preventing from another purchase [10].

Secondly, problems occur with the security level. Many vending machines today easy broke and the money also easily can be taken by a thief. The doors are pried open, coin mechanisms; money bill acceptors with the bills in tact, money pans, the money and the products in the vending machines are stolen [13].

Thirdly, problems occur with the machine weight. Every year, a few people are killed when machines topple over on them, either while trying to steal from them, or venting frustration on them, especially when a malfunction causes the machine to fail to dispense the purchased item or the proper change. 15 cases recorded which men trying to get a can out of the machine were crushed [3].

Lastly is the problem with machine capacity. Vending machine actually cannot exceed many products. For the example vending machine made from china named *Glass front Snack and beverage Vending Machine* having a large body dimensions (height:(183cm), width:(73.5cm), depth:(78.5cm) ). This machine can have 153 product capacities. While others product *Box or Bag Living Consumable Vending Machine (LT-X64)* having a small dimensions (height:( 42cm), width :( 20cm), depth :( 60cm)) can have only 60 product capacities. This prove that a big vending machine to insert more product in it [14].

For the conclusion, the vending machine needs more improvement to overcome the problem that's occurring. This project wants to solve a problem in vending machine that related to the payment method.

#### **1.3 PROJECT PROBLEM STATEMENT**

From the previous project background, the problem that the project wants to solve is the problem with the payment method. The method used now is using a coin and note money. The problem with the payment is the tank full with a coin; the notes cannot be read and also the notes or coin always stuck in the machine [15].

Firstly, problems occur for vending machine in tank area. When the tank was full, no more coin can be accepted. This will cause no more purchase can be made thus vending machine will stop the operated [10].

Secondly, the problem with the notes cannot be read. For vending machine using notes as method payment, the notes must be in good condition. The term of good condition refer to the good shape of the notes, not folded, and original one. When using notes with bad condition such as crumpled and dirty, the vending machine cannot read the note and then rejected the payment.

Lastly, the problems occur when notes or coin stuck in machine. Actually when the coin or the notes inserted not in the right direction, this problem will occur. The only way to remove the notes or coin stuck is called the vending machine company to repair that machine [15].

As conclusion with the current method of payment, there are many problem occurs. So, this project will develop a new system for vending machine that uses prepaid method.

#### **1.4 PROJECT OBJECTIVES**

In the course of completing this project, there are few objectives to be fulfilled. These are:

- i. Design vending machine with prepaid payment system.
- ii. Build the mechanical part of the vending machine.
- iii. Build the electrical part of the vending machine.
- iv. Build the software part of the vending machine.
- v. Assembling and testing the vending machine that uses prepaid system for payment method.

#### **1.5 PROJECT SCOPE**

This development of vending machine project was attached with the prepaid payment system. This project may have a scope that will specific the pathway of this vending machine.

- i. The developed vending machine is only a prototype and not readily functioning as commercial product.
- ii. The develop vending machine is for dispensing small and long lasting product such as pen, pencil, books etc. Item that does not last very long such as food is not considered.
- iii. The number of product can be dispensed is only in small unit, not much than fifteen item.
- iv. The method of payment for this vending machine focusing on using prepaid method, not the others method like using coin and notes.

#### **1.6 PROJECT REPORT ORGANIZATION**

The rest of this report will be organized according to the following chapters:

- i. Chapter two is about literature review and background knowledge and presents vending machine from background knowledge as well as literature review perspectives. The historical progress of the vending machine is presented with special emphasis on the latest development of vending machine.
- ii. Chapter 3 focus on design and methodology. Development of the proposed method of alarm system security is presented. The system design is shown with explanation on why the system and design have been made. Then finally, all elements of the proposed design are built and assembled.
- iii. Chapter 4 is about testing vending machine under 3 case studies. Results of the case studies are presented.
- iv. Chapter 5 is about conclusion. Project conclusion and recommendations for future project works are presented.

#### **CHAPTER 2**

#### LITERATURE REVIEW

#### 2.1 INTRODUCTION

This chapter will explain about the development of the vending machine. This chapter also contain about the previous research on vending machine payment method. In the end of this chapter, the payment method for the vending machine will be discussed.

## 2.2 **DEFINITION**

Definition for vending machine is a coin operated machine for selling merchandise[21].Vending machine provides various product such as snacks, beverages, water, tickets, and others product. Vending machine also no need operator or workers to operated it.

# 2.3 FUNCTIONS

Vending machine has two functions that are selling the product and sell the service to the customers. Vending machine will sell the product that install into the body with different type of product and price. After paying, a product may become available by the machine releasing it at the bottom of the vending machine [10].

For the vending machine that provide service for the main function, the service also may become available after paying with inserted the payment. Example for the services vending machine is Money ATM vending machine [16].

#### 2.4 HISTORY

About 215 B.C, the first vending machine is believed to have been invented in Alexandria, Egypt. The mathematician Hero introduced machine that accepted a coin and then dispensed a fixed amount of holy water. After that, in A.D1076, vending machine was updated by Chinese inventors that developed a coin-operated pencil vendor [1].

Early 1880s, the first modern coin-operated vending machines that dispensing post card were introduced in London, England. The first vending machine in the U.S. was built in 1888 by the Thomas Adams Gum Company. The vending machine dispensed a piece of tutti-frutti gum [17].

In late 1920 and 1930, higher price installed into the vending machine was introduces. Example for the product that been sold in the vending that time is soft drink and nickel-candy. In 1946, coffee vendors were developed and followed by refrigerated sandwich vendors in 1950[6].

Nowadays, many items can be found in vending machine such as clothing, milk, cigarettes, postage stamps, cologne, baseball cards, books, live bait, comic books, and many more. Some hi-tech vending machine can dispense hot foods such as pizza, popcorn, French and burger [1].

## **2.5 TYPE**

There were various types of vending machine today. Some example of the vending machine is soft drink vending machine, phone card vending machine, snack vending machine, ticket vending machine, and beverages vending machine. There were some available vending machines in the market nowadays.



# 2.5.1 Kingston vending machine

Figure 2.1: Kingston vending machine

Source: My Memory Vending Machine (2007)

Kingston has set up vending machines at airports that will dispense a variety of USB flash drives and SD cards .My Memory vending machines will be placed in all major airports, mainline stations and underground stations, with additional hightraffic venues to follow later in the year [18].

#### 2.5.2 Sony vending machine



Figure 2.2: Sony vending machine

Source: Sony Corporation (2006)

These machines will dispense electronics such as Sony PSPs, memory cards, headphones, etc, and media such as UMDs, DVDs and CDs. This hi-tech machine was accommodating around 50 SKUs and 15-inch touch panel. Sony will track product movement with the help of sensors and internet connectivity [2].

### 2.6 METHOD OF PAYMENT

Method of payment for vending machine can be described in 3 method or technique. Many vending machines are capable of making change, and some of the more modern ones accept paper money or credit cards. The method using was coin, using note, and using prepaid as payment.

- Coin operated vending machine.
- Note operated vending machine.
- Prepaid operated vending machine.

#### 2.7 PROBLEM RELATED TO THE PAYMENT

There are 3 major problems with the payment method nowadays. That is tank full with a coin, the notes cannot be read and also the notes or coin always stuck in the machine.

#### 2.7.1 Coin box for vending machine was full.

Firstly, the problem occur with the payment method is having a problem with the coin box. When the coin box is filled, no more coin can be accepted. When the tank is filled, no more coin can be accepted. This will cause no more purchase can be made thus vending machine will stop.

Certain vending machines use a spiral kind of mechanism to separate and to hold the products. When the machine vends, the spiral turns, thus pushing the product forward and falling down to be vended. If the products and the spiral are misaligned, the spiral may turn but not fully release the product. The product will stick in the middle of the vending machine. The vending machine automatically will stop operated when this condition occur.

#### 2.7.2 The notes and coins cannot be read.

Secondly, the problem related to the payment method is notes and coins cannot be read. For vending machine using notes as method payment, the notes must be in good condition. The term of good condition refer to the good shape of the notes, not folded, and original one. When using notes with bad condition such as crumpled and dirty, the vending machine cannot read the note and then rejected the payment. Also some machines may not accept quarters and other coins.

#### 2.7.3 The payment stuck in machine.

Actually when the coin or the notes inserted not in the right direction, this problem will occur. The only way to remove the notes or coin stuck is called the vending machine company to repair that machine. There is, also, the problem of using a coin of a foreign currency which has the same size and shape as the coin accepted by the machine to get cheaper merchandise and some times change that might have more value than the originally inserted foreign coin. Using different coins will make the vending machine having a problem to recognize and lastly the payment will stuck into the machine.

#### 2.8 PREVIOUS SOLUTION FOR PAYMENT METHOD PROBLEM

Before need to give solution to a problem had been occur, firstly we need to come out with previous solution. The previous solution need to be analyzed to get a much better solution. In the previous payment method for vending machine, the technology was high enough to make a payment without using coins or note. From the journal and article that have been found, there was many company had been used card to make a payment. The payment system was upgraded year by a year until nowadays. The list detail of the previous solution for payment method problem was shown in this sub topic in next pages.

#### 2.8.1 Commstar easy reader system (2001)



Figure 2.3: Commstar Reader System

Source: commstarinc (2001)

The Commstar Easy System is design to be attached to vending machine. This reader system can process a product have been purchase without using credit card without using a worker [19].

This reader system has main features such as:

- Accepted all major credit cards.
- Communicates through the bank automatically.
- Interface capability for vending machine to control card operation.
- Multiple machine configuration capability (LAN).
- Can operate without using telephone line.
- Optional hardware interface development.

#### 2.8.2 CardEaseEMV for vending machine (19 January 2004)

CardEaseEMV for vending machine was introduced by Nick McGarvey in 19 January 2004. This smart card technology brings real security to unattended retail devices; furthermore, interoperability between the Visa and MasterCard chip-based credit and debit card schemes takes this security into the world-wide retail market [4].

EMvX is use based on credit call cardEaseEMV certified smart card transaction processing engine. The function of the card also let payment from machine operators upgrade almost under-based payment terminal [8].

This system uses connection between the Visa and Master card. Using CardEaseEMV the system can run in high processing power machine within the existing system. The time development also will be redused by increasing of the power machine. Less time development with allow all kinds of terminal having connection with EMV card payment facilities [4].



#### 2.8.3 Credit card embedded with (RFID) (25 Mac 2005)

Figure 2.4: Credit card embedded with (RFID)

Source: RFID Journal (2005)

Radio-frequency identification (RFID) is an automatic identification method, relying on storing and remotely retrieving data using devices called RFID tags or transponders. An RFID tag is an object that can be applied to or incorporated into a product, animal, or person for the purpose of identification using radio waves.

The RFID enable vending machine accept contact less payment from any credit or debit card carrying the MasterCard PayPass, American Express ExpressPay, Chase blink or Visa Contactless logo.

Credit card embedded with (RFID) for vending machine was introduced in Mac 2005. The system was designed for speed, convenience and security. The cards using was embedded with software to prevent duplication and data theft [5].

#### 2.8.4 MDB conversion kits (November 2005)



Figure 2.5: MDB conversation kits

Source: Vendor Gadget

MDB conversion kits are created for coin changers and bill acceptors. MDB remolds discontinuous plastic component and stockpiles pre-owned parts. Much like a USB port in a PC, MDB provides power and communications with peripheral devices such as card readers, coin mechanisms, bill validators, etc. Almost all of the cashless systems require MDB compliance, as do many of the large denomination bill acceptors and 5-tube coin meshes.

By making the machines MDB capable, they become capable of accepting 1and 5-dollar bills, as well's debit and credit cards. The replacement board will also support a guaranteed vend if a retrofit kit is added [20].

#### 2.8.5 Wireless credit card for vending machine (July 2007)

The latest technology for vending machine payment method is wireless technologies that enable credit card purchases from everywhere only using hand phone or laptop. The wireless credit card for vending machine was introduced in July 2007.

The device, used by customers including Motorola and Reebok, includes a general packet radio service cellular connection. Using this wireless card will solves many problem that occur with using vending machine such as the note issues and also the limited item can be purchase. The items can be purchase from everywhere with unlimited unit. The e-Port and related software also fuel a variety of wireless applications beyond vending [7].

## 2.9 CONCLUSION

As the conclusion from this chapter, the project will develop vending machine with the new payment method. The payment methods that have been proposed in this project are prepaid payment system.

The vending machine will be develop and also with the prepaid payment system. The system will use number operated system as for the vending machine. The coding using PIC Microcontroller will be made to develop the system. The other plan was using parallel port to be a base for the system.

#### **CHAPTER 3**

#### METHODOLOGY

#### **3.1 INTRODUCTION**

The direction for methodology process is the elaboration from literature review. The improvement for new vending machine considered from previous design and system of payment for vending machine. New design of vending machine with prepaid method is considered to fulfill the problem related to payment. The previous design was complicated, expensive, and also difficult to build. So for the improvement, simple ideas using prepaid method have been proposed.

#### **3.2 DESIGN CONCEPT**

Before starting the process of vending machine development, the first important thing need to consider is design. The best design will make the process flow directly according to the system will be used. From the design also, the material need to be used will be decided. In this chapter, the design was based on using plunger as the system. So the design created that the vending machine can used the plunger as it system.

#### **3.3 DRAWING IDEA**

Firstly the designs start with the simple drawing idea. This drawing idea was made only for the body design which is had a different door design. The first drawing idea has a curve look door while the second designs have a flat door design. This drawing idea only just an idea before goes further to the complicated design.



Figure 3.1: First drawing idea

Figure 3.2: Second drawing idea

Compared to each design, the first drawing idea had a best look for the door compared to the second drawing idea. But the weakness of the first drawing is the shaped more complicated to build compared to the second drawing idea. In this project the second drawing idea was chosen for door design base on the material using.

#### 3.4 SOLID WORK DRAWING

After the drawing idea, the detail design for the vending machine was proposed using SOLID WORK drawing. The shaped for the vending machine created in the Solid Work drawing base on the previous second drawing idea. There was 2 design proposed in this project.



Figure 3.3: First design drawing

The first proposed design was using funnel and restaurant door as concept idea to move the soft drink. The plunger will be inserted behind the funnel to remove the soft drink. There was all 4 funnel created in this design to be attached to the vending machine. For this design, the product will be inserted into the funnel. When fan turning, the product will be released onto the support. The concept was taken from the restaurant door which is the door can turning around.



Figure 3.4: Second design drawing

The second design also using plunger as system but the differences from first design with the second design using slot combined with frame idea. The soft drink will be inserted into the frame and will be blocked from remove by plunger. The plunger also is the function to release the soft drink. The plunger will pull out to release the drink and will pull in to stop the water from released. The concept for this design was created base on gravity concept.

#### **3.5 ACCEPTED DESIGN**

Lastly, the first design is used for this project. The first design is easier to build and more dynamic compared to second design. The plunger used in this design also is more stable because of not depends only on the gravity factor like second design. So the change to make an error while released the drink was minimized.

Dimension = height :( 897mm), width: (464mm), depth :( 366mm)



Figure 3.5: Completed design with door

The dimension for the above figure is 897mm for height, 464mm for width and lastly 366mm for depth. The dimension for designing vending does not takes the real dimension like the normal vending machine. The vending machine developed in this project only a prototype. The dimension have been made for the design is suitable for this project because not so big and not so small.

# 3.5.1 Part of body



Figure 3.6: System for funnel



Figure 3.7: Funnel



Figure 3.8: Support



Figure 3.9: Fan

#### **3.6 FABRICATION PROCESS**

After design the body of vending machine and confirm material will be used, the next step is fabrication process. In this fabrication process, first thing need to know is what machine will be used. The machine will be used needs to know firstly because it is an important factor in this project. If the machine need to process the material cannot be used, the process in design the vending machine needs to redesign.

All the body of the vending machine made from acrylic (Polymethyl Methacrylate). Thus the process that involved is:

### **3.6.1** Cutting and shaped the acrylic using laser cutting machine.

The drawing from SOLID WORK is converted into the system that using by the CNC laser cutting machine. Then acrylic will be cutting into the shaped that have been modeling in the SOLID WORK drawing.



Figure 3.10: The CPU that control the laser cutting

The laser cutting machine was controlled using the computer that attached with the program to control the laser cutting. The laser cutting user needs to know how to convert the drawing into the program used by the laser cutting machine. After that the user need to adjust the speed of the laser cutting by adjust the delay in pcline.h . That is important to know the speed because, the different thickness of acrylic having different cutting speed of the laser cutting.



Figure 3.11: Laser cutting tool

Figure 3.12: Compressor

The laser cutting used laser beam as tool to cut the acrylic. Compressor was used in this project and attached to the laser cutting tool to make the cutting process sharper. Thus the cutting will be more accurate and faster. If compressor was not use in this project, the cutting process will be difficult because of the limited power of the machine (30W). The compressor also needs to be set suitable for the thickness of the acrylic. The over pressure from the compressor will make the surface of the cutting acrylic became converged.



Figure 3.13: The process of cutting

The process of the cutting need to be watching carefully to avoid unnecessary thing occur. The user need to adjust the laser cutting height because of the surface not same. All door in the laser cutting lab also need to open, because of the smoke from the acrylic that have been cut was very dangerous to health. The users gladly advise to use mask to avoid smelling the smoke from the cutting process. The papers under acrylic need to be watch because if the power set was larger, the paper may be burn. In this project there was 3 thickness of acrylic have been used. The thickness of the used acrylic is 3mm, 6mm, and 9mm. The different thickness of acrylic has a different strength and to cut it different power and cutting speed need to use.

#### **3.6.2** The electric circuit

After the fabrication of the body for the vending machine, the circuit also needs to build to run the system. The circuit needs to be considering as important thing item to convert program to the system. The component will be used in the circuit need to be considering before build the circuit to run the machine. This is because the wrong component will make the circuit cannot function thus the machine cannot operated.



Figure 3.14: The circuit that have been build

The circuit that been build in this project is base on the parallel port. In this circuit also contain ULN 2803 as a driver, relay to control the plunger and parallel port to connect through PC. The figure above show only 2 relay attached to the circuit, but in this project there was 8 relay used to control 4 plungers.

# 3.6.3 Parallel port



Figure 3.15: Parallel port pc

PC parallel port will connect to the circuit that has been build. The parallel port will read the data from program that has been made into the circuit. Then from the parallel port ULN 2803 will acted as a driver to control the parallel output.



Figure 3.16: ULN 2803



**Figure 3.17:** ULN 2803 pin out

The pin IN 1 to IN 8 was connected to the parallel port cable through the PC and for output leg there were connect to the relay. For the output leg, the output can be read as bellow:

Output 1;  $(2^0 = 1)$ Output 2;  $(2^1 = 2)$ Output 3;  $(2^2 = 4)$ Output 4;  $(2^3 = 8)$ Output 5;  $(2^4 = 16)$ Output 6;  $(2^5 = 32)$ Output 7;  $(2^6 = 64)$ Output 8;  $(2^7 = 128)$ 

#### 3.6.5 Relay



Figure 3.18: Relay picture

Relay used as switch that can connect between two circuits. In this project relay was used to connect a plunger to the circuit. There was 2 plunger used to connect one plunger. First relay will control the positive leg of the plunger while the second plunger will control the negative leg of the plunger.



Figure 3.19: The circuit for relay

#### 3.6.6 Programming

The circuit that was build for the vending machine need program to run it. In this project the C programming was used to control the parallel port. The program build with the system that need to give code to get used the vending machine. While the wrong code was given, the system will blocked the user from used the machine. The program was created to control four funnel with different type of soft drink.

C programming is used to give an order to the machine. C programming that used in this project was C++. The program build was not so complicated and easy to use. The analysis for this project program will be shown in chapter 4 and completed programming in appendix.



#### 3.8 CONCLUSION

As the conclusion in this chapter, the fabrication process will be finished by combining all the fabricate item. The body that has been combined will be assembly to complete the fabrication process. The programming develop will be insert to the circuit so the system can be run. From the methodology, the process will show the result of this project on next chapter.

After all the fabrication in the methodology was done, the next step is to testing the product. The analysis will be made and will be discussed if the were error occur.

#### **CHAPTER 4**

## **RESULT AND DISCUSSIONS**

#### 4.1 INTRODUCTION

After the fabrication process was finished, the next step in this project is to see the result from the methodology which is perfectly done or had weakness. Analysis might be done to obtain the result which is the error occur. If there are weaknesses, the result will be discussed to overcome and make improvement to it.

# 4.2 PART OF BODY

After the laser cutting process, the part of the acrylic that have been shaped need to be combined. The part of acrylic combined by using acrylic glue or also can be combined using 3 second glue. The face of the part will look a little messy but the combine using acrylic glue is strong compared to the silicon glue. The part of the vending machine need to finished combined before can be assembled. The finished combined part was shown bellow.



Figure 4.1: The finished funnel



Figure 4.2: The soft drink in the funnel



Figure 4.3: The finished fan



Figure 4.4: The finished combined support

# 4.3 ASSEMBLY

After all the part was finished combine, the next step is to assembly all the part. The assembly process was using slot and also the same acrylic glue. The finished assembly product was shown bellow.



Figure 4.5: The finished assembly product

## 4.4 PLUNGER

The plungers have been used in this project is CTC plunger. Plunger actually is a part of car. The plunger used in two directions, up and down. In car, plunger was used to locked and open the car's door. When plunger up, the car's door is open and whiles the plunger in down direction, the car is locked. There are many types of plunger also with various load of force can be support. The plunger information detail was stated below.



Figure 4.6: The CTC plunger

Type of plunger = CTC No of plunger used = 4 unit Power of the plunger = 17.65N DC used = 12V



Figure 4.7: The plunger behind the funnel

The plunger was inserted into the funnel of vending machine. For each funnel, the plunger was blocked by the fans that have been made. The plunger has function to hold and released the product from the funnel. The plunger retract to hold the drink and will released the drink if the retract position was change. To know that the plunger can support the soft drink, the analysis has been made. It is important to know the strength and limited load can be support by plunger. The more strength plunger has, the more soft drink can be support.

# 4.4.1 Plunger analysis



Figure 4.8: Fan body diagram

• One soft drink weight = 325 gram

= 3.18N

• 4 soft drink used = 1.3 kilogram

= 12.75N

• Force contributed by plunger = 17.65N

Reaction force:

+ FY = 0; 
$$A_{\rm Y}$$
 - BY = 0  
17.65 N-12.75 N = 4.9 N

From the analysis had been done, there prove that plunger can support the 4 soft drink that insert into the funnel. To low the resistance of the plunger, the funnel can be put into the position not 90 degree. Thus the gravity force will reduce.

## 4.5 SOFTWARE ANALYSIS

The example below is 2 of the product that was program into the C language to take out the product. The whole program will show in the appendix.

<u>Oren</u>

PortOut(888,1); Delay(500); PortOut(888,2); Delay(1000);

# **Lychee**

PortOut(888,4); Delay(500); PortOut(888,8); Delay(1000); The number 888 is for the parallel port. If other numbers substitute it, the program will not running. And the number 1,2,4,8 next to the number 888 is read from ULN 2803. The method to read the number for each leg can be referring to the **3.6.4 ULN 2803**.

Next thing is the delay. The delay functioned as a setting a gap of time between two period. The delay 500 show the was a gap time in 0.5 second and 1000 show a gap time in 1 second. It is important to set the delay because the process need to take time before continue to the next step.

#### 4.6 TESTING USING VENDING MACHINE

After finished with the plunger and system analysis, the system need to been test. To run the program C programming need to compile and run, thus the command will appear. The command will welcome the user to use the vending machine and need code to insert to continue to the next phase. The code is generating with a different numbers to be used.



Figure 4.9: Welcome screen



Figure 4.10: Code insert

The customer with a given prepaid code needs to type it. The prepaid code was generate in the system and will be given to the customer. In this project there was 4 different type of prepaid generate. Different prepaid given to different Department.



Figure 4.11: Correct code insert screen



Figure 4.12: Other correct code insert screen

When the correct code insert, they will invite to choose the drink they want between oren, lychee, vege, or coke. But if the code inserted wrong, the will automatically cannot use the vending machine. The option of the drink will not appear here because of the wrong code inserted. This function will blocked unwanted people using the machine without having permission to use it.



Figure 4.13: Wrong code insert screen



Figure 4.14: Final command

Finally, after choosing the right drink, the drink will be released regarding to the choosing. The drink will be released and the customer can take the drink.

#### **CHAPTER 5**

#### CONCLUSION

#### 5.1 CONCLUSION

After the project finish done and the system also testing, the project finally done. From the plunger analysis had been done, the plunger can support the 4 soft drink and also can be add one more. The plunger strength in this project can support until 5 soft drink in one funnel.

The process in build the body also show that acrylic is suitable to be used as a body for the vending machine. The process to cut and shape the acrylic was not so difficult to use. The body of the vending machine also looks nice and acrylic cannot rusty.

Lastly the prepaid system that use is new system to be used in vending machine. The user can choose which one to use the vending machine by gives the prepaid. The prepaid system can be used in also UMP office by given the prepaid only to the staff. The staff will allow using the vending machine by using the prepaid number.

#### 5.2 **RECOMENDATONS**

For the further study, this project needs to be improved in certain area to make the vending machine more perfected. The first thing need to be consider is the prepaid method, in this project the prepaid only need as password to use the machine. So for further improvement, the first recommend is to make the credit from the prepaid and the credit can be reduce after using the vending machine.

The second thing is the vending machine can be connecting to the internet in term of the balance credit. The balance will be updated with correctly even using the other vending machine.

In this project the scope only focusing in dispensing a limited item. So for improvement, develop a vending machine that cans dispense various items. The items can be substitute anytime for the many use.

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#### **APPENDIX** A

#### **COMPLETE PROGRAMMING**

```
#include "iocpp.h"
#include <stdio.h>
#include <conio.h>
void Oren();
void Lychee();
void Vege();
void Coke();
void main(void)
{
LoadIODLL();
char option;
int a;
printf("----Welcome to my vending machine----\n\n");
printf("----Please insert your code----\n\n");
scanf("%d",&a);
if (a==1098)
printf("----Welcome Departmant A----\n\n");
else if (a=2980)
printf("----Welcome Departmant B----\n\n");
else if (a==3198)
printf("----Welcome Departmant C----\n\n");
else if (a==4098)
printf("----Welcome Departmant D----\n\n");
else
{printf("----not allowed-----\n\n"); return;}
printf("Select your choice of drinks:\n");
printf("1 - Oren 2 - Lychee 3 - Vege 4 - Coke\n");
option=getche();
switch(option)
{
case '1':
printf("-----Wait for your drink----\n\n");
Delay(2000);
Oren();
printf("----Thank you for using the vending machine----\n\a");
```

break;

```
case '2':
printf("-----Wait for your drink----\n\n");
Delay(2000);
Lychee();
printf("----Thank you for using the vending machine----\n\a");
break;
case '3':
printf("-----Wait for your drink----\n\n");
Delay(2000);
Vege();
printf("----Thank you for using the vending machine----\n\a");
break;
case '4':
printf("-----Wait for your drink-----\n\n");
Delay(2000);
Coke();
printf("----Thank you for using the vending machine----\n\a");
break;
ł
UnloadIODLL();
}
void Oren()
{
printf("----Take ur drink----\n\n");
Delay(1000);
PortOut(888,1);
Delay(500);
PortOut(888,2);
Delay(1000);
}
void Lychee()
{
printf("----Take ur drink----\n\n");
Delay(1000);
PortOut(888,4);
Delay(500);
PortOut(888,8);
Delay(1000);
}
void Vege()
{
printf("----Take ur drink----\n\n");
Delay(1000);
PortOut(888,16);
Delay(500);
```

```
PortOut(888,32);
Delay(1000);
}
void Coke()
{
printf("----Take ur drink----\n\n");
Delay(1000);
PortOut(888,64);
Delay(500);
PortOut(888,128);
Delay(1000);
}
```



# **GANT CHART FYP 1**

**APPENDIX B** 





# GANT CHART FYP 2