AUTOMATIC SOLAR POWER FOR FEEDING SYSTEM FOR AQUAPHONIC FARMING

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Report submitted in partial fulfillment of the requirements

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EXAMINERS APPROVAL DOCUMENT

UNIVERSITI MALAYSIA PAHANG
FACULTY OF MECHANICAL ENGINEERING

I certify that report entitled ‘Automatic Solar Power For Feeding System For Aquaphonic Farming’ is written by Muhamad Firdaus Bin Zaini with matric number MH09063. I have examined the final copy of this report and in my opinion, it is fully adequate in terms of language standard, and report formatting requirement for the award of the degree of Bachelor in Mechanical Engineering with Automotive Engineering. I herewith recommend that it be accepted in fulfillment of the requirements for the degree of Bachelor Engineering.

_____

Prof. Dato Dr. Rosli Bin Abu Bakar

Date:

SUPERVISOR'S DECLARATION

I hereby declare I have checked this report, which written by Muhamad Firdaus Bin Zaini with matric number MH09063, and in my opinion, this report project is adequate in terms of scopes and quality for the award of the degree of Bachelor of Mechanical Engineering with Automotive Engineering.

_____

Supervisor: Prof. Dr. IR. HJ. Yusoff Bin Ali

Date:

STUDENT'S DECLARATION

I hereby declare that the work in this report is my own, except for quotations and summaries which have been duly acknowledged. The report has not been accepted for any other Degree and is not concurrently submitted for award of other degree.

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Muhamad Firdaus Bin Zaini,

MH09063

Date:

To my beloved parent Mr. Zaini bin Hitam and Mdm. Azizah binti Hassan,
my beloved siblings Suzilawaty, Khairul Anuar, and Mohd Hafizuddin
and my beloved friens.
For their support and motivation that they gave while working on this thesis.

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Then, my deepest appreciation and thank to JP Faculty of Mechanical Engineering for their cooperation while I am conducting this project at the laboratory.

Last but not least for my beloved family and all my beloved friends who helped and inspired me to finish this project.

ABSTRACT

The objectives of this thesis are to design and fabricate a low cost and longer life span automatic fish feeder. Besides that, another objective of this project is to use the programmable interface controller (PIC) as a controller to control the machine. This automatic fish feeder is designed to dispense food into the aquarium at a particular time each day. The components for the developed machine can be divided into two types which are automation blocks and mechanical parts. Automation blocks components includes a DC motor, limit switch, relays and a PIC controller. The mechanical parts include auger bit and also the mechanical structure of the machine. An automatic device to feed fish at predetermined amounts of food and time. Fish feeder combines mechanical and electrical system to control fish feeding activity. This device consists of pellet tank, distributor and a stand. The dispensed food will be controlled by a motor which situated under the tank. A propeller design that differs by angle of force applied to spread the food, will distribute the pellet onto tank. A control system attached to this device allows the fish to be fed at predetermined food amount and time. Timer is used to control the motor which run the auger bit and propeller to increase functional efficiency. In this project, concepts are generated through the research on the existing patents to improve its limitations. A rotational movement of auger bit cause the food container rotates and dispenses the food from a small hole. The fish feeder is successfully fabricated and tested. Feeding can be done at predetermined interval of time and accurate amount of food is obtained. Furthermore the waste of fish food in pond is reduced efficiently. Results show that the machine would be able to feed the fish at a certain time range which is being set by the user using the built-in timer in the PIC controller. Besides that, one of the main future developments is to network the whole system which means by combining a few PICs and controlling them from only one control center. As a conclusion, this project is quite successful because it is able to fulfill all of the objectives stated and also performing up to expectation.

ABSTRAK

Objektif tesis ini adalah untuk merekabentuk satu pengumpan ikan automatik yang dapat mengurangkan kos penggunaan dan digunakan dalam jangka masa yang lama. Selain itu, objektif project ini adalah untuk mengaplikasikan programmable interface controller (PIC) sebagai alat kawalan untuk mengawal fungsi-fungsi mesin tersebut. Pemberi makan ikan automatik ini direka untuk membahagikan makanan ke dalam akuarium pada waktu tertentu setiap hari. Komponen-komponen yang diperlukan dalam projek ini boleh dibahagikan kepada dua kumpulan iaitu komponen electrik dan juga komponen mekanikal. Antara komponen-komponen elektrik yang digunakan termasuk motor, suis, relays dan juga PIC controller. Komponen-komponen mekanikal yang digunakan pula adalah seperti mata auger dan juga struktur mekanikal mesin tersebut. Sebuah alat automatik untuk memberi makan ikan pada jumlah dan masa yang tertentu.Pemberi makan ikan menggabungkan sistem mekanikal dan elektrikal untuk aktiviti memberi makan ikan.Alat ini terdiri daripada tangki makanan, penabur dan pemegang. Makanan yang ditabur akan dikawal oleh motor yang terletak di bawah tangki. Rekaan mata auger yang dibezakan oleh sudut daya dikenakan untuk menabur makanan, akan membahagikan makanan ke permukaan air yang dikawal oleh bukaan keluar. Satu sistem kawalan yang diletakkan pada alat ini membolehkan ikan diberi makan pada jumlah makanan dan masa yang tertentu. Penentumasa digunakan untuk mengawal motor yang menggerakkan mata auger bagi meningkat kecekapan berfungsi. Dalam konsep ini mata auger disambungkan dengan bekas makanan oleh aci. Putaran mata auger menyebabkan bekas makanan berputar dan makanan dijatuhkan dari satu lubang kecil. Pemberi makan ikan ini berjaya dihasilkan dan diuji. Pemberian makanan ikan boleh dilakukan pada selang masa tertentu dan jumlah yang tepat. Selanjutnya pembaziran makanan ikan di dalam kolam dapat dikurangkan secara berkesan. Mesin tersebut adalah berupaya untuk memberikan makanan ikan dalam suatu jangka masa yang telah ditetapkan dengan menggunakan timer yang terdapat di dalam PIC. Selain itu, system rangkaian PIC juga patut dikaji agar beberapa PIC dapat dikawal serentak dengan hanya menggunakan sebuah computer. Pada kesimpulannya, projek ini amatlah berjaya kerana semua objectif berjaya dicapai dan mesin prototype yang terhasil berfungsi pada tahap yang memuaskan.

TABLE OF CONTENT

LIST OF FIGURES

LIST OF TABLE

CHAPTER 1

INTRODUCTION

1.1 INTRODUCTION

Automatic fish feeder is one of the technologies that fully control by the electronic gadget. This machine allows the user to dispense the accurate amount of food into the tank at specific time for a particular time each day, hence promising the efficiency and productive in fish farming field in long term. This device fed fish following the time that being set and program in the electronic device that being install and the amount being defined by the user, therefore the over feeding can be overcome. Automatic fish feeder will be run either using electricity through a power cord or battery operated. This automatic fish feeder using plc microcontroller application, offered the user to control the feeding time up to 24 daily feeding cycle just depend on timer that being set in the system and the optimal reset time on the feeder. The amount of the pellet dispense is depend on the length of the feeding cycle adjusted on the feeder itself. Fish feeder usually clamped to the wall over the tank just over the tank. They consist of the hopper which is loaded with the variety of dry food, the motor that rotates the drill bit at regular time or a method of setting the interval between the feeding and the amount of food

dispensed. The rotation speed on the new developed system will determine the amount of pallet that will be dispensed into the tank.

This project involves designing and building a prototype of an automatic fish feeder for cultivation pond usage. This means that the basic concept of the machine is to able to feed the fish at a specific time set and also able to cover the whole pond area which comes in various sizes.

1.2 PROBLEM STATEMENT

The aquaphonic farmer that that uses hand labour to control fish in the pond would prove costly. Fish also like human that only eat a certain quantity at a time. So the feeding time is important for the farmers to give right amount of feeding to the fishes. Any attempt to simplify it by giving with the over amount will results in the excess, uneaten food sinking and contaminating the water. It also will cause the farmer to spend more time to cleaning the filters and the tank. This means that the farmers would always give more attention to the feeding time just to ensure that right quality of feeding. The farmer has to attend timely and sometimes difficult to meet the timing.

To solve this problem, the suggested system is that automatic feeding system powered by solar panel that can be obtain easily and timely.

1.3 OBJECTIVE

The objective of the study is to:

i. Design the automatic feeding system for Fish tank for Aquaphonic system using solar power PV.

ii. Fabrication of the designed feeder.

iii. Use the programmable interface controller (PIC) as a controller to the automatic feeder.

1.4 SCOPES

This project development is limited within the following scopes:

i. To analysis the efficiency of the mechanism used on the automatic fish feeder.

ii. To fabricate the automatic fish feeder by using industrial machine and engineering tool

CHAPTER 2

LITERATURE REVIEW

2.0 INTRODUCTION

The purpose of this chapter is to provide the review of previous invention of automatic fish feeder using solar power PV for aquaphonic farming in many journals from previous. In this chapter also stated the reviews of other components that related with the project and will be useful for the project. The contain of this chapter focus on the fish feeder, solar power PV and Programmable Interface Controller (PIC).

2.1 FISH FEEDER

Fish feeder is a device that controls the delivery of fish food to the water surface in order to feed the fish. Several parameters involved to construct an effective device to complete this feeding task were considered by many of the previous designer such as automatic timed feeder, flexible fish food machine, small size feeder and many more. This thesis is about

inventing the effective feeder to delivered food starting from the tank until the food reach the water surface.

There are few design that being used to feed fish whether in a small or big scale of pond. In aquaculture, the differences and the categories of fish feeder can be divided into two major groups, as follows:

1. Stationary feeding equipment
    - Without supplied energy; demand feeders
    - With supplied energy; automatic feeders
2. Mobile feeding equipment
    - Feeding carts
    - Feeding boats

The classification of feeder for this project is stationary equipment. It is an automatic feeder that use supplied energy from main source to operate and use user input which is time set to execute a schedule task. The electric automatic feeders are controlled by a timer with the length of feeding time and the time interval between two feedings can be adjusted. Besides, a single control unit can be used for one individual feeder or a central control unit can operate more feeders. The stationary term is to show that the position of this device at the tank is flexible. Some other automatic feeder use pneumatic or hydraulic mechanism in the feeder structure to feed the fish. For this type of feeder, the size of the food storage is usually in huge scale and this machine use in large industry of aquaculture.

2.1.1 FEEDER MECHANISM

The feeder consists of two main components, the motor/delivery system and the electronic timer. The delivery system must store sufficient

food for certain time and supply a twice-daily feed of both the correct amount and the correct proportion of large and small pellets. Various systems were considered, including 'hopper' and pellet-ejection methods, but because the pellets are hard and irregular in shape, it was thought that they might jam the mechanism.

A narrower tube could have been used, thus reducing the size, but the tube used was an 'end-of-reel' bargain at a price which could not be refused. The spiral assembly is secured to the motor drive by a single screw which, when released, allows the spiral to move freely to facilitate filling it with food.

All appropriate components used in hardware design stage were assembled to set up the feeding device. This system was simple in construction and operation, also relatively inexpensive, as well as reliable in the period of system operation. The storage that attached at the top stored the pellets and the amount decreased across the time as the motor start running. Pellets in the sphere former will be dispensed at target area based on the motor speed. The shape of the former was designed corresponding to sphere shape ensuring the spreading process more efficient compare to the other shape, especially on the amount of pellets stored. It was proven by math that given the same surface area, sphere outperformed other shape in terms of their volume. Meanwhile, during the operation of dc motor, there were several holes that allowed the pellet to be dispensed into the water. (M. Z. H. Noor, A. K. Hussian, M. F. Saaid, M. S. A. M. Ali, M. Zolkapli, 2012)

2.1.2 TIMER

A facility for threads to schedule tasks for future execution in a background thread. Task may be schedule for one time execution, or for repeated execution at regular intervals. Corresponding to each timer object is a single background thread that is used to execute the timer’s entire task, sequent.

Timer task should complete quickly. If a timer task takes excessive time to complete, it “hogs” the timer’s task execution thread. This can, in turn, delay the execution of subsequent tasks, which may “bunch up” and execute in rapid succession when the offending task finally completes..

Digital timers can achieve higher precision than mechanical timers because they are quartz clocks with special electronics. Integrated circuits have made digital logic so inexpensive that an electronics digital timer is now less expensive than many mechanical and electromechanical timers. However, most timers are now implemented in software. Modern controllers use a programmable logic controller rather than a box full of electromechanical parts. The logic is usually designed as if it were relays, using a special computer language called ladder logic. In PICs timers are usually simulated by the software built into the controller. Each timer is just an entry in a table maintained by the software.

The electronic timer has a battery operated quartz-clock control, which gives both immunity from power cuts and the required accuracy. The rest of the electronics and the delivery motor is mains powered due to energy considerations.

The motor speed directly proportional to the distance travelled by pellet, hence increasing the motor speed will result in longer travel distance.

In the timer case, two types of timers employed in this research. Timer 1 responds to the time entered by user and controls for the feeding time. This timer will activate the motor at specific time requested by user. Timer 1 came with 2 options that allowed the user to set the time second (s) or minute (m). In the other hand, Timer 2 received the desired time delay after each feeding process entered by user. Timer 1 will be activated and repeated each time Timer 2 finished its calculation, and this process will continue until the system shut down. Once input parameters had been completely set up by the user, the motor will start to operate and activate the feeding mechanism, in which pellets dispensed into the pond according to the predefined rotation speed of the motor. Finally, the pellets will be shot

into the marked area of the water surface. (M. Z. H. Noor, A. K. Hussian, M. F. Saaid, M. S. A. M. Ali, M. Zolkapli, 2012)

The system will perform a feed cycle every time the timer rolls over. The user adjustment of feed duration will be used to set the start value for the timer upon rollover. During the feed cycle, the associated output for the feeder will be driven high. This high value will go to the enable pin on the linear regulator, providing power to the feeder. The feeder has its own internal timer, but is not adjustable. However, every time the feeder is powered up, it feeds the system once before starting its timer. This allows the system to apply power to the feeder every time it decides it appropriate based on the timer rollover. (Design Team Six, December 4, 2006)

2.1.3 MOTOR

The function of motor used for this project is to convert electrical energy to mechanical motion from the electric source. This device is broadly classified into two different categories which is direct current (DC) and alternating current (AC). Within these categories are numerous types, each offering different unique abilities that suit them well for specific applications such as this feeder. There are many choices depend on user demands and market price of this component.

Regardless of type, electric motors consist of a stator or stationary field, and a rotor or rotating field which sometimes called armature and operate through the interaction of magnetic flux and electric current to produce rotational speed and torque. In many traction applications where both armature voltage and stator current are needed to control the speed and torque of the motor from no load to full load, the separately excited DC motor is used for its high torque capability at low speed achieved by separately generating a high stator field current and enough armature voltage to produce the required rotor torque current. As torque decrease and speed

increases, the stator field current requirement decreases and the armature voltage increases. Without a load, the speed of the separately excited motor is strictly limited by the armature voltage and stator field current. Separately excited DC motors are the first type of motor to use closed loop control and can also be used in servo systems for control of speed and position.

2.2 SOLAR POWER (PV)

Photovoltaic comes from the words *photo*, meaning light, and *volt*, a measurement of electricity. Sometimes photovoltaic cells are called PV cells or solar cells for short. You are probably familiar with photovoltaic cells. Solar-powered toys, calculators, and roadside telephone call boxes all use solar cells to convert sunlight into electricity. Solar cells are made up of silicon, the same substance that makes up sand. Silicon is the second most common substance on Earth. Solar cells can supply energy to anything that is powered by batteries or electrical power. Electricity is produced when sunlight strikes the solar cell, causing the electrons to move around. The action of the electrons starts an electric current. The conversion of sunlight into electricity takes place silently and instantly. There are no mechanical parts to wear out. (Alexandria December 2003)

Photovoltaic (PV) systems convert sunlight directly to electricity. They work any time the sun is shining, but more electricity is produced when the sunlight is more intense and strikes the PV modules directly (as when rays of sunlight are perpendicular to the PV modules). Solar energy is free, and its supplies are unlimited. It does not pollute or otherwise damage the environment. It cannot be controlled by any one nation or industry. If we can improve the technology to harness the sun's enormous power, we may never face energy shortages again.

The solar panel is composed of solar cells that collect solar radiation and transform it into electrical energy. This part of the system is sometimes

referred to as a solar module or photovoltaic generator. Solar panel arrays can be made by connecting a set of panels in series and/or parallel in order to provide the necessary energy for a given load. The electrical current supplied by a solar panel varies proportionally to the solar radiation. This will vary according to climatologically conditions, the hour of the day, and the time of the year. Several technologies are used in the manufacturing of solar cells. (Govinda R. Timilsina, October 2011)

Basic photovoltaic system consists of four main components which is solar panel, batteries, regulator and the load. The panels are responsible for collecting the energy from the sun and generating electricity from it. The battery stores the electrical energy for the later use. The regulator ensures that panel and battery are working together in an optimal fashion. The load refers to any device that requires electrical power, and is the sum of the consumption of all electrical equipment connected to the system. Something important that should be take note that solar panel and the batteries use the direct current (DC).

The equipment that use the different DC voltage then the one that supplied by the battery, it will need to use a dc/dc converter. For the equipment that use the alternate current (AC), then it need to use a DC/AC converter, also known as inverter. The battery and the equipment will have the range of operational voltage that did not fit with each other, so it will need to include some type of converter.

Solar Inverter converts DC power from battery, charged from PV source, to AC power compatible with the utility and AC loads. This unit consists of solar inverter cum charge controller with intelligent logic which controls the charging of battery from solar or mains or both with solar as priority in sharing mode. This system monitors the battery charging status and accordingly decides to charge the battery either from solar or from mains or both in sharing mode.

The battery stores the energy produced by the panels that is not immediately consumed by the load. This stored energy can then be used

during periods of low solar irradiation. Batteries store electricity in the form of chemical energy. The most common type of batteries used in solar applications are maintenance-free lead-acid batteries, also called recombinant or VRLA (valve regulated lead acid) batteries.

When designing the system, first consideration is realistic estimate of the maximum consumption. Once the installation is in place, the established maximum consumption must be respected in order to avoid frequent power failures

2.3 PROGRAMABLE INTERFACE CONTROLLER (PIC)

The name PIC was originally an acronym for "Programmable Interface Controller". PICs are popular with developers and hobbyists alike due to their low cost, wide availability, large user base, extensive collection of application notes, availability of low cost or free development tools, and serial programming (and re-programming with flash memory) capability. The PIC architecture is distinctively minimalist. It is characterized by the following features with separate code and data spaces (Harvard architecture). Have a small number of fixed length instructions. Most instructions are single cycle execution (4 clock cycles), with single delay cycles upon branches and skips. Has a single accumulator, the use of which (as source operand) is implied (i.e. is not encoded in the opcode). All RAM locations function as registers as both source and/or destination of math and other functions.

To summarize, a microcontroller contains (in one chip) two or more of the following elements in order of importance:

i. Instruction set

ii. RAM

iii. ROM, PROM or EPROM

iv. I/O ports

v. Clock generator

vi. Reset function

vii. Watchdog timer

viii. Serial port

ix. Interrupts

x. Timers

xi. Analog-to-digital converters

xii. Digital-to-analog converters

PIC general instrument as small, fast, inexpensive embedded microcontroller with strong input/output capabilities. The PIC18F877A is CMOS Flash-based 8 bit microcontroller. It packs into 40-pin package with 3 ports for input/output which are Port A, Port B, Port C and Port D. In this project, PIC16F877A will be use. PIC16F877A is in either baseline core or mid-range core devices in the PIC's family core architecture. PIC16F877A also have enhanced core features, eight-level deep stack, and multiple internal and external interrupt sources.

2.3.1 OPEN LOOP SYSTEM

It starts with subsystem called an input transducer, which convert the form of the input to that used by the controller. The controller drives a process or a plant. The input is sometimes called reference, while the output can be called the controlled variable. Other signals, such as disturbances, are shown added to the controller and process outputs via summing junctions, which yield the algebraic sum of their input signals using associated signs.(Azerol hisham bin abd wahab, april 2008)

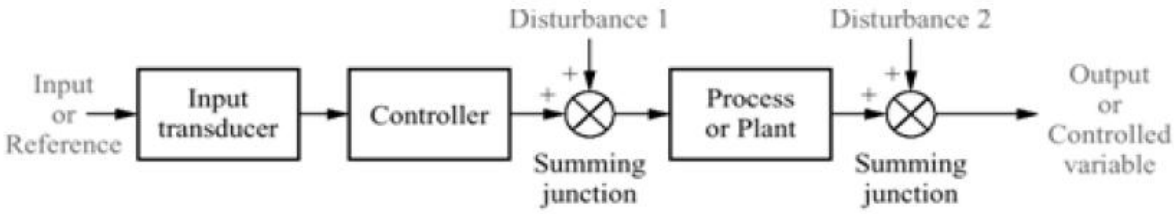


Figure 2.1: Block diagrams of open-loop system

2.3.2 CLOSED-LOOP SYSTEM

The disadvantage of open loop system, namely sensitivity to disturbances and inability to correct for these disturbances, may be overcome in closed loop system. The input transducer converts the form of the input to the form used by the controller. An output transducer, or sensor, measurres the output response and converts it into the form used by the controller. The closed loop system compensates for disturbances by measuring the output response, feeding that measurement back through a feedback path, and comparing that response to the input at the summing junction. If there is any difference between the two responses, the system derives the plant, via the actuating signal, to make correction. If there is no difference, the system does not drive the plant, since the plant's response is already the desired response. (Azerol hisham bin abd wahab, april 2008)

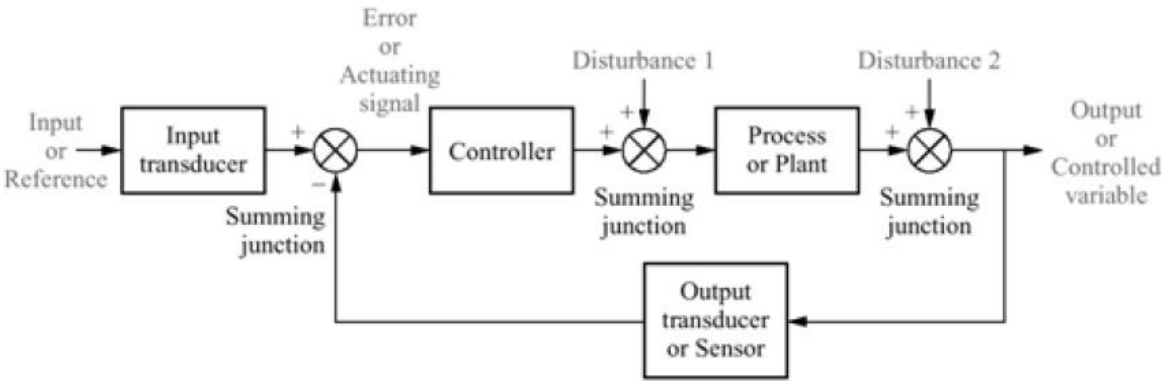


Figure 2.2: Block diagrams of closed loop system

CHAPTER 3

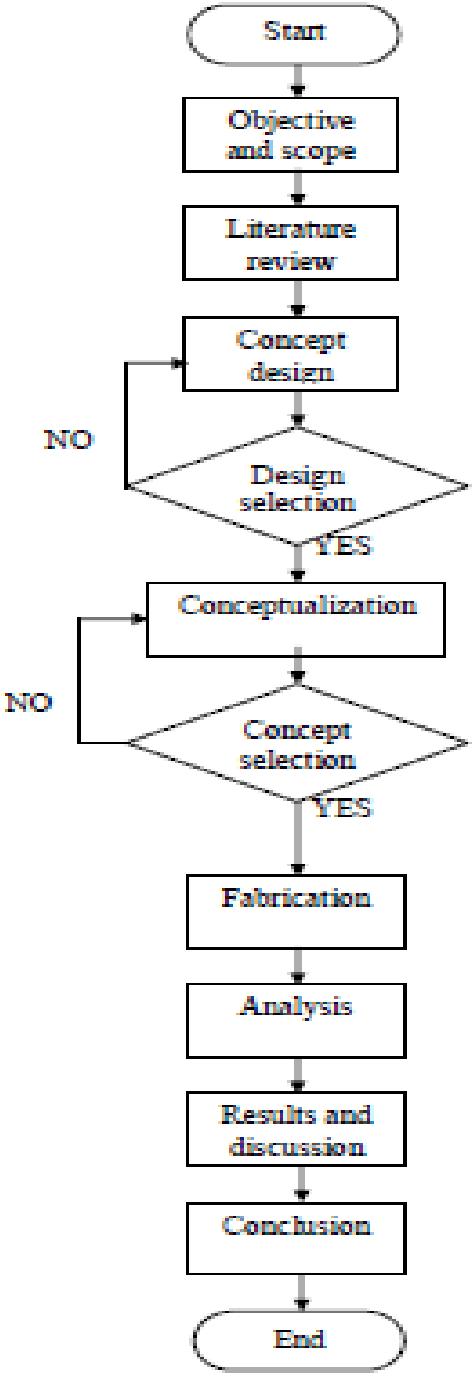
METHODOLOGY

3.1 INTRODUCTION

Methodology process is elaborated more in this chapter where consideration of improvement was important as the design should have the criteria to fulfill the market and costumer need. The control parameters in this paper are the design of pallet distributer and the design arrangement of all component of a feeder. Besides, the suitable or effective cost of the design was also being considered to create good and dependable machine.

This invention more particularly relates to a device for automatically feeding fish predetermined amounts of food at predetermined periods. Certain requirements are associated with feeding fish. The fish must be fed at regular and frequent intervals. Also, at each feeding, the food must be fairly uniformly distributed in measured amounts to minimized spoilage. If too much food is distributed over a small area, much of t will settle on the bottom of the pond holding the fish and will spoil. The invention to provide an automatic feeding device which meets the above feeding requirements thus largely eliminating the need in expensive, experienced labor, thereby reducing the cost of raising fish.

3.2 FLOW CHART



3.3 DESIGN

There is something else that need to fabricate first before start to fabricate the auto fish feeder. Thos fish feeder need to stand at the fish tank where it can be tested. To place the fish tank, there should be a place that suitable which it need to place at the closed place. This because to avoid from raining and a hot day that can affect the fish and tank. So the aquaphonic house being design and fabricate before the auto fish feeder finish. This aquaphonic house not only put the tank and fish feeder, but there is also from other person project that need this aquaphonic house.

The literature review involved studies and collecting information, particularly from previous research. Researcher then reviewed the current issue or development state of automatic feeding system, and made comparison among the researches to identify the flaw of existing systems. Problems or shortcomings were identified and remedies were proposed in hardware and software development stage.

This system wills using power that being supplying by solar. It wills using only one solar panel that will straight supply to the system on the day and using the battery on the night. The battery will be charged on a day for the used when the not in function such in night and raining day. To convert the power source from the solar to the system and battery, it needs the converter or inverter that will convert the direct current (DC) to alternate current (AC). It also needs the circuit that will control the current and voltage that will be supply to the battery and system.

There are several ideas and methods required in order to target the research's main objectives. It include of designing and implementing automatic fish feeder using PIC microcontroller application which encompassed system design, hardware and software development as well as the circuit design. In integration stage, all circuit developed will be combined and integrated with the programming code to initiate the system.

The motor speed directly proportional to the distance travelled by pellet, hence increasing the motor speed will result in longer travel distance. In the timer case, two types of timers employed in this research. Timer 1 responds to the time entered by user and controls for the feeding time.

This timer will activate the motor at specific time requested by user. Timer 1 came with 2 options that allowed the user to set the time second (s) or minute (m). In the other hand, Timer 2 received the desired time delay after each feeding process entered by user. Timer 1 will be activated and repeated each time Timer 2 finished its calculation, and this process will continue until the system shut down. Once input parameters had been completely set up by the user, the motor will start to operate and activate the feeding mechanism, in which pellets dispensed into the pond according to the predefined rotation speed of the motor. Finally, the pellets will be shot into the marked area of the water surface.

3.3.1 DRAWING CONCEPT

There is five type of design that has been done in order to find one of the best. All of the design are making based on electrical system. The design of this Automatic fish feeder comprised of four main parts, namely main controller, pellet storage, stand and spreader. All appropriate components used in hardware design stage were assembled to set up the feeding device. This system was simple in construction and operation, also relatively inexpensive, as well as reliable in the period of system operation. The storage that attached at the top stored the pellets and the amount decreased across the time as the motor start running. Pellets in the sphere former will be dispensed at target area based on the motor speed. The shape of the former was designed corresponding to sphere shape ensuring the spreading process more efficient compare to the other shape, especially on the amount of pellets stored. Meanwhile, during the operation of dc motor, there were several holes that allowed the pellet to be dispensed into the water.

All of the design is shown on the drawing of concept table 1:

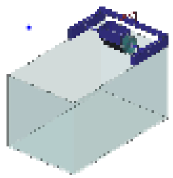
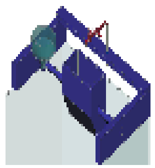
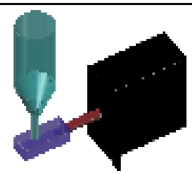
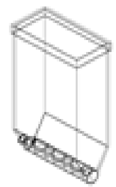
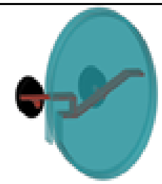
CONCEPT	CONCEPT A	CONCEPT B	CONCEPT C	CONCEPT D	CONCEPT E
DESIGN					
ADVANTAGES	-Low cost -Safe to use -Low maintenance	-Low cost -Safe to use -Low maintenance	-Easy to fabricate -Safe to use	-Efficient -Accurate feeding time -Able to control amount of food	-Accurate feeding time -Can control amount of food
DISADVANTAGES	-Difficult to fabricate -Inaccurate feeding time	-Difficult to fabricate -Inaccurate feeding time -Cannot control amount of food	-Timer too fast -Limited time setting	-Expensive	-Hard to fabricate -High maintenance -Expensive

Table 1: concept of drawing

3.3.2 CONCEPT SELECTION

	DESIGN A	DESIGN B	DESIGN C	DESIGN D	DESIGN E
LOW MANUFACTURING COST	+	+	-	-	-
EASY TO FABRICATE	-	-	+	+	-
ACCURATE FEEDING TIME	-	-	+	+	+
LOW MAINTENANCE	+	+	+	+	-
SAFETY	+	+	+	-	-
DURABILITY	-	-	-	+	-
EASY TO CONTROL AMOUNT OF FOOD	-	-	-	+	-
TOTAL	3	3	4	5	1

Table 2: Concept selection

From the above table, it showed the comparison for five designs that have been done. Based from the table, the high scores is design D. design D give much advantage which is easy to fabricate, accurate feeding time, low maintenance, durability and lastly easy to control amount of food.

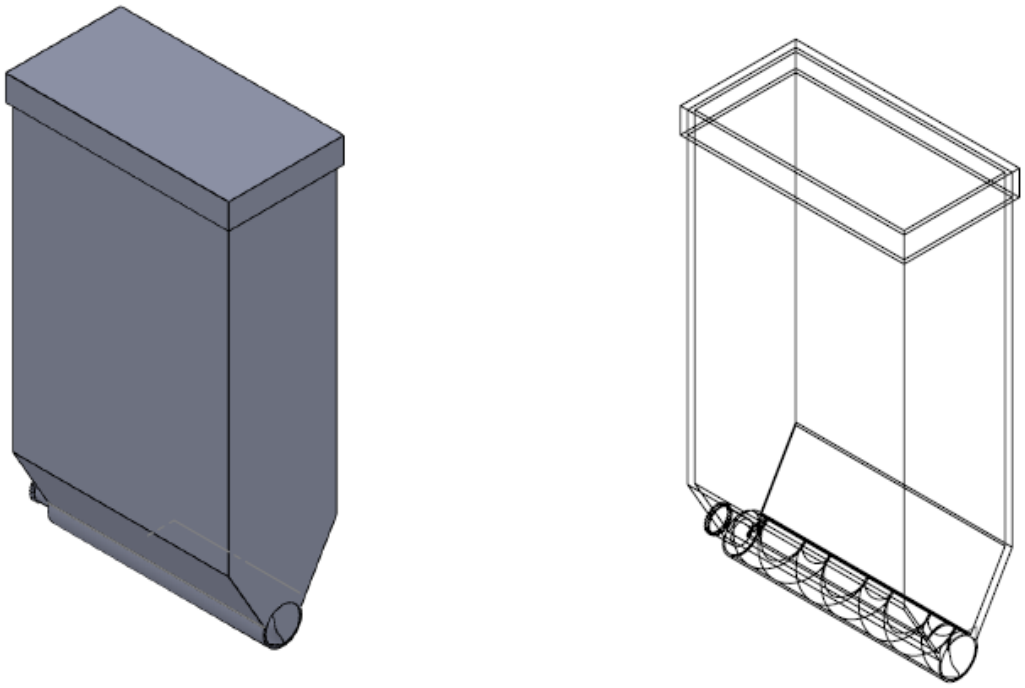


Figure 3.1: Concept D

The figure shows the drawing of the proposed design of the feeder which consist of tank and drill bit. This design considered previous design that have been fabricate so that improvement can be done.

The feeding device of the present invention is constructed to automatically feed fish with measured amounts of food at predetermined periods. The device can be set to feed the fish at times selected by the programmed that have been set. The feeding device is simple in construction and operation, reliable in operation, and relatively inexpensive to purchase and operate.

3.3.3 SPECIFICATION OF FEEDER

- Power supply : 12 V 3Amp
  : Direct Current (DC)
  : Solar panel PV
- Time : set second, minute, hour, day, week, month and year.
- Feeding rate : 0.2 kilogram/ session
  0.4 kilogram /day
- Feeding time : 2 time / day
- Container : 3 kilogram storage
- Feeding system : Using auger bit that rotate and take out the food from the tank
- Size : 150mm X 100mm X 250mm
- Weight : weight feeder without pellet : 2 kilogram
  Weight feeder with pellet : 5 kilogram
- Housing : locate inside Aquphonic house
  Housing for the feeder using sheet metal

3.4 SOLAR CHARGING SYSTEM

There are 3 main components in this project. The first one is the solar module, solar charger (controller) and the third one is the sealed lead battery. The battery used in this project is a 12V 3Ah sealed lead battery. The battery is used to supply electricity to DC motor, PIC circuit and LCD. Solar charger will charge the battery automatically, where it will automatically ON when the sun rises and shut down at down. The circuit uses a 12 volt solar module. Battery charging circuit is used as an input of electrical energy to a rechargeable battery or other electrical cells which have different current levels. In this project, solar module acted as the source of the energy that filling in the form of DC current. A battery charger or a battery charging circuit will conduct an electrical current charging by pushing an electrical current through it. Charging circuit has an assortment of different charge current depending on the type of rechargeable battery.

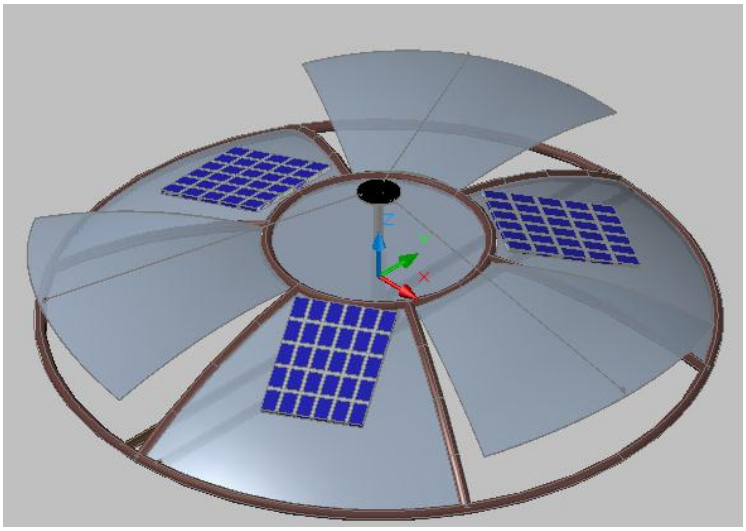


Figure 3.2: Solar panel

Figure 3.2 shows the location of solar panel that will be installed for the aquaphonic usage. There are 3 solar panel will be used to support the

power needed for the aquaphonic house system. This solar panel located at the top of the roof that fix. Each of the solar panel will be connected to different battery with a different used. The first battery will be support the power needed for automatic fish feeder, second for the temperature sensor and lastly is for water pump.

3.5 FABRICATE

3.5.1 MATERIAL AND EQUIPMENT

Material that being used in order to fabricate the aquaphonic house structure are hollow pipe, screw and nut. There is many type of equipment that will be using in order to finish the aquaphonic house structure. The equipment that being using are rolling machine, sheet metal arc welding (SMAW), and cutter.

3.5.1.1 ROLLING MACHINE

Function of the rolling machine is to bend round material from several of size. Different diameter of material will need to change with the different roller. Any mistake of changing the roller that not fix with the material will result a bad shape to the material. The machine consists of three rollers that function to grab and bend the material.

Figure 3.3: Rolling machine

3.5.1.2 CUTTER MACHINE

This machine only use when all the rods has been done being bend. The rod will be cut based from the dimension that state in the design.

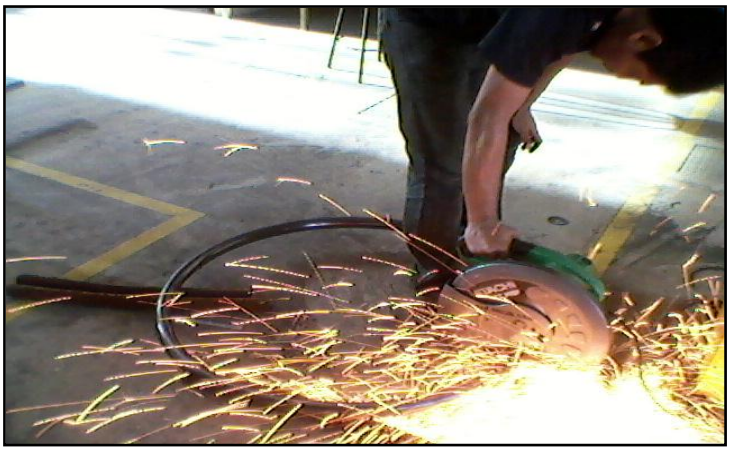


Figure 3.4: Cutting process

3.5.1.3 WELDING MACHINE

Welding machine that being use is sheet metal arc welding (SMAW). At first, we will only doing tap to make the shape according to the design.

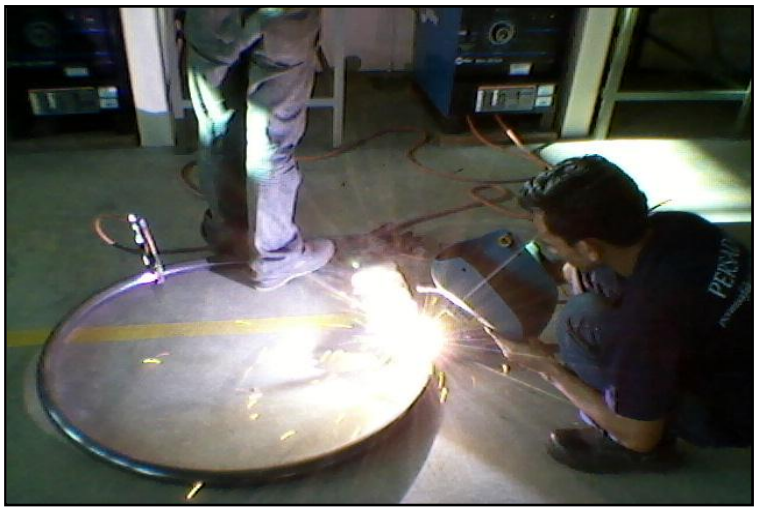


Figure 3.5: Welding process

3.5.2 AQUAPHONIC HOUSE

Aquaphonic house is the place that will place the fish tank and this project which is automatic fish feeder. There is also the other projects that come from others members that will locate inside this aquaphonic house. This house being design in dome shaped because there is others member that made hydroponic project inside it. So with the dome shaped, all the plant will get a square sunlight. This house got a 5m in diameter of the base and 2.5m in height. All the structure being made using hollow pipe because it will going bending process. So the best material that can go the bending process is hollow pipe. In order to bending the rod, we will use the rolling machines that locate at sheet metal lab. The rod will be bending in 3 type of

diameter which is 5m, 3m and lastly 1m. After all the bending process has been done, cutting process will take place. All the part will be cut based on the dimensions that state in the design. The cutting process will be using cutter machine that locate at welding lab. The aquphonic house diagram shown in figure 3.6 :

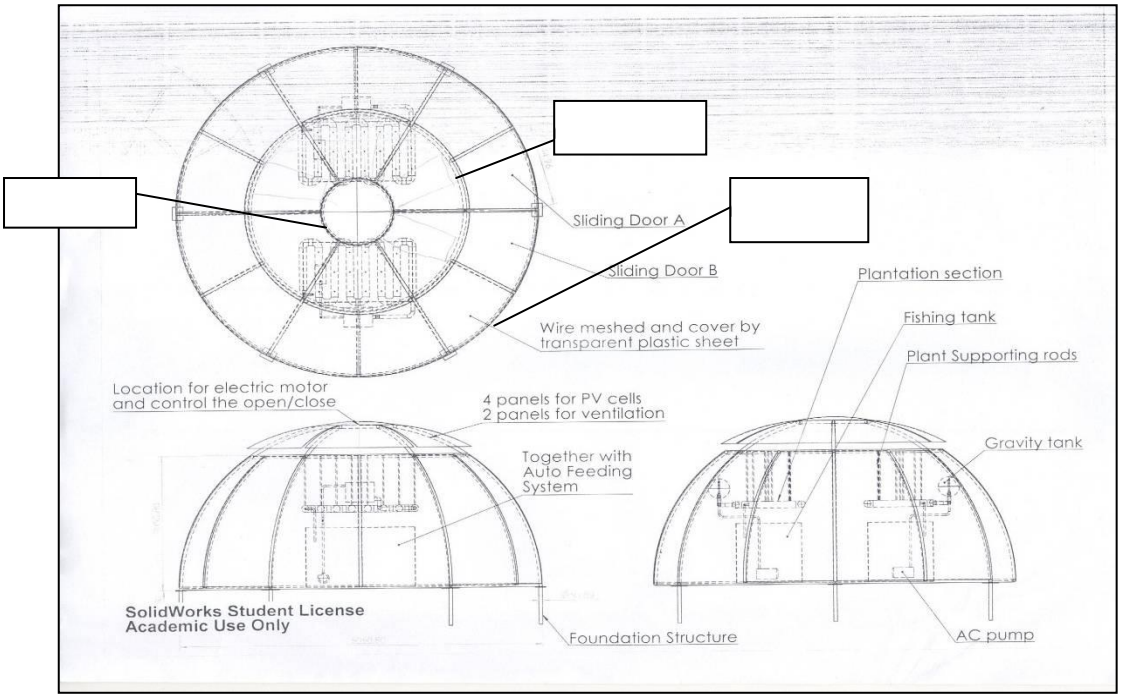


Figure 3.6: Aquaphonic house

3.5.2.1 AQUAPHONIC HOUSE FABRICATE PROCEDURE

Round hollow rod will be use to make the aquaphonic house casing.

Round hollow rod will going bending process using rolling machine. it is to make aquaphonic house shape which is a dome shape.

The round hollow rod being bending in 3 different diameter. The bending rod will be check using jig that have been make.

Figure 3.7: Bending step

After the bending processes have finish. That rod will going for cutting process follow as dimension in the design.

Last process to make the house casing is welding process. In this process all the part will be joining. This is critical part to be made. The joining cannot go wrong and must be strong enough. If any wrong joining that being done, the alternative is only to cut it back.

Aquaphonic housing casing consist of 3 part bending rod. Base and wall is 5m diameter, center is 3m diameter and the upper one is 1m diameter.

Figure 3.8: Chassis assembly

After all the part of casing already assembles, to make the structure long life time, the rod must be coated. So process coating take place.

In order to make sure the structure more stable. Several part of the structure will be fixing to the ground. Several hole being dig to concrete the structure so it will not easily moving if there is a force applied to the structure.

Floor of the housing will be put with something that can give low temperature to the house. So the brick have been chosen and row.

Figure 3.9: Chassis installation

Aluminum has been choosing for the frame. Aluminum did not rust and easier to make shape.

Aluminum that has been cut will be installing to the casing as frame. To install the frame, the aluminum and casing will go drilling process. Rivet process will take place to assembly it.

Wire mesh will be installed to the casing after the entire frame already. Wire mesh will go drilling process to fix it with the frame. Wire mesh being installing to the entire casing wall.

Figure 3.10: Frame installation

Fiber glass will be using to make the other part of the aquaphonic. All the part that will put the water or to make water resistant will be fabricate using fiber glass. This fiber glass being cut follow the shaped and dimensions that have been done in drawing.

Using fiber glass that been cut, the fabrication of plant tank will take place. In order to fabricate the plant tank that have a U shaped, 3 part of the tank will be fabricate separately. The 3 part is 1 base and 2 wall of the tank.

The fabrication of tank continuous with the assembly of 3 parts that have been fabricate before. This 3 part being cut as dimensions in the drawing and the fiber process take place to assembly all the part become one tank.

Figure 3.11: Tank fabrication

Curve of the roof being done using wood to make the roof mould. Brick being put at the lower part of the mould in order to strengthen the mould base.

After the curves have been done to make as the guide to make the curve shaped, the full part will be cover using sand.

Last step to make the roof mould is cover all the part using cement. This is the important part to be done and must be sure that the surface is smooth. Surface that not smooth will affect the roof surfaces.

Figure 3.12: Mold roof

Roof being fabricate using fiber galss. Fiber glass is more easier to fabricate follow the dome shaped of the roof.

The take out process of the fiber glass from the mould will take several times. The mould must be destroying first to take out the fiber glass.

The roofs being cut follow the roof dimension. The dirty at the roof surface being clean using brush.

Figure 3.13: Fiberglass for roof

3.5.3 AUTOMATIC FISH FEEDER

Automatic fish feeder is one of the technologies that fully control by the electronic gadget. This machine allows the user to dispense the accurate amount of food into the tank at specific time for a particular time each day, hence promising the efficiency and productive in fish farming field in long term. This device fed fish following the time that being set and program in the electronic device that being install and the amount being defined by the user, therefore the over feeding can be overcome. Automatic fish feeder will be run either using electricity through a power cord or battery operated. This automatic fish feeder using PIC microcontroller application, offered the user to control the feeding time up to 24 daily feeding cycle just depend on timer that being set in the system and the optimal reset time on the feeder. The amount of the pellet dispense is depend on the length of the feeding cycle adjusted on the feeder itself. Fish feeder usually clamped to the wall over the tank just over the tank. They consist of the hopper which is loaded with the variety of dry food, the motor that rotates the drill bit at regular time or a method of setting the interval between the feeding and the amount of food dispensed. The rotation speed on the new developed system will determine the amount of pallet that will be dispensed into the tank.

The feeder consists of two main components, the motor/delivery system and the electronic timer. The delivery system must store sufficient food for certain time and supply a twice-daily feed of both the correct amount and the correct proportion of large and small pellets. Various systems were considered, including 'hopper' and pellet-ejection methods, but because the pellets are hard and irregular in shape, it was thought that they might jam the mechanism.

A narrower tube could have been used, thus reducing the size, but the tube used was an 'end-of-reel' bargain at a price which could not be refused. The spiral assembly is secured to the motor drive by a single screw which,

when released, allows the spiral to move freely to facilitate filling it with food.

The electronic timer has a battery operated quartz-clock control, which gives both immunity from power cuts and the required accuracy. The rest of the electronics and the delivery motor is mains powered due to energy considerations.

The motor speed directly proportional to the distance travelled by pellet, hence increasing the motor speed will result in longer travel distance.

In the timer case, two types of timers employed in this research. Timer 1 responds to the time entered by user and controls for the feeding time. This timer will activate the motor at specific time requested by user. Timer 1 came with 2 options that allowed the user to set

The time second (s) or minute (m). In the other hand, Timer 2 received the desired time delay after each feeding process entered by user. Timer 1 will be activated and repeated each time Timer 2 finished its calculation, and this process will continue until the system shut down. Once input parameters had been completely set up by the user, the motor will start to operate and activate the feeding mechanism, in which pellets dispensed into the pond according to the predefined rotation speed of the motor. Finally, the pellets will be shot into the marked area of the water surface.

3.5.3.1 FEEDER FABRICATE PROCEDURE

Figure 3.14 shows the model of feeder before the product being fabricated. This model have been done to get the real view of the tank in order to make sure the real product will be make smoothly.

Figure 3.14: Feeder tank model

Figure 3.15 shows sheet metals that have been cut follow the dimension in design. This Sheet metal being cut in part in order to get the accurate dimension. It also easier to assemble with tap welding using metal inert gas (MIG).

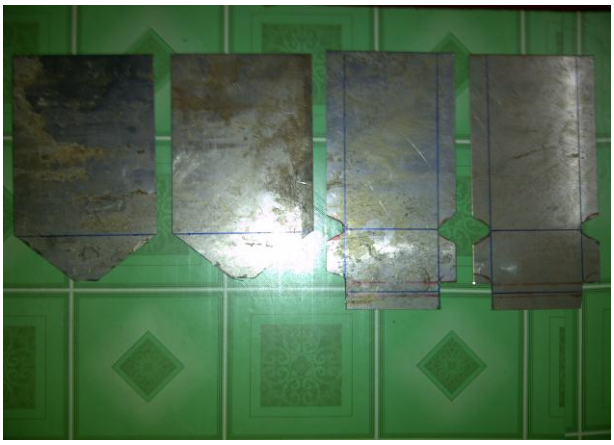


Figure 3.15: Part of tank

Figure 3.16 shows the part of feeder being drill before the tap welding process take place. It will make the assembly between the parts of the tank easier. It also will reduce time to hold the parts in order to get the shape.

Figure 3.16: Assembly of feeder

Figure 3.17 show the feeder tank that completely assembles with the driver chamber and cover. The tank is completely assemble using welding and the feeder tank with the stand being assemble using bolt and nut.

Figure 3.17: Feeder tank

CHAPTER 4

RESULT AND DISCUSSION

4.1 INTRODUCTION

This chapter will discuss about fabrication process and the final result of this development of automatic fish feeder. Most of this device consists of small parts that need to be carefully fabricated so the final dimension of the assembly will not have large tolerance compared to the proposed design.

4.2 FABRICATION

This chapter will discuss about the fabricated model of the fish feeder from components until the assembly. All parts that have been fabricated will be explained in details about its function and purpose that contribute to the effectiveness of feeding. All of the fabrication processes were done in UMP Mechanical Lab under supervisor permission.

Figure 4.1: Automatic fish feeder

Figure 4.1 shows the complete automatic fish feeder. The storage of pallet was made using sheet metal and assembly using metal inert gas (MIG). This kind of welding process used because the sheet metals have a thin thickness. Using welding to assembly the tank storage will make it strong enough and the pallet will not throw away.

Figure 4.1 also shows the steel made stand that can stand the tank at certain height from the ground. MIG process is used to assembly the stand to make sure it strong enough to sustain heavy of the tank and pellet.

Figure 4.2: Aquaphonic house

Figure 4.2 shows the complete aquaphonic house with the dome shape. Three different types of materials being used to make the layer of the wall house. The first inner layer using two inch metal wire mesh in order to make the wall can stand the wind or outside force. The second layer using black wire mesh to filter the sunlight and reduce the temperature of the house. The last layer using plastic to avoid the water from rain straightly enter into the house. Tank of the plant and roof being fabricated using fiber glass because it easier to make shape and good water resistance. Most of the part being assemble using rivet because it easier, strong and reduce cost.

4.3 MECHANISM DESIGN ANALYSIS

There are many type of mechanism design in mechanical engineering application especially in fabricating product. In this project, combinations of several mechanisms are used as the main part of the machine and have its own operation in the machine. Splint movement, rollers are the main mechanisms have been used during fabrication process.

Figure 4.3: Distributing chamber of fish feeder

Figure 4.3 shows the round chamber where pallet will flow through before being distributed in the tank. Round hollow rod being install at the lower parts of the tank that have nearly same diameter with the auger bit. This part will distribute the pallet by the rotating of the auger bit.

Body structural of the tank is the most important part for the machine because with this structural, all assembly of another part will be joining at the main body to complete the fabricating process. To allow that happen, the storage tank must be tough enough to support the function from other part. For the storage tank, first the main body will be design actual like the machine using Solid Work software. The dimension of the storage tank is 150 x 100 x250 mm.

Figure 4.4: Storage tank

Based on the drawing the storage, then the storage tank being fabricated as in the figure 4.4. The material of the main body structural is mild steel 1mm thickness which is common material use. The material being chosen based from it criteria which is light, easy to assemble, easy to make shape and most important is can stand the pallet force.

Figure 4.5: motor and auger bit

Figure 4.5 shows the used of the motor and the auger bit at the distributing chamber. This parts transfer the torque from the motor to rotate the auger bit at a certain speed of rotation. The motor is held by the external tank holder by an adjustable ring. This link can be adjusted in order to take out the motor or to adjust the position of auger bit.

Figure 4.6: feeder side parts

Figure 4.6 shows the motor and the auger bit. The motor and auger bit being fabricated in different part. It will be easier to change the part if needed. The motor and auger bit being assembly using the slot using half inch square hollow metal.

4.4 PROGRAMMABLE INTERFACE CONTROLLER (PIC)

The programming that have been done using PIC was mostly time. The read time that have been program is set in second, minute, hour, week day, day, month and also year. This kind of programming being done because want to make sure the fish feeder smoothly function in 24 hour per day 7 days per week and 365 days per years. The programming that has been done was function 2 sessions per day and 50 seconds per sessions.

Since the controller circuit is controlled by Microcontroller PIC18F877A, the correct and completed codes for the controller loaded and programmed into the Microcontroller PIC18F877A chip. The source code for designing the controller circuit was written in C programming language and compiled using MP Lab software can be seen in appendix.

After the compilation success, the controller circuit is tested virtually using Proteus software. The schematic circuit is designed and draws in Proteus. In Proteus, the 5V power supply and crystal oscillator are automatically connected to the microcontroller. Then *.hex file is downloaded into the PIC in the schematic circuit.

The microchip is the controlling microcontroller which handles all the controlling sequences, such as the interface between a user and the system, making sure the right motors are running in the specified time and position.

A major portion of the software design in this project is the communication between the microchip and motor. All the communications are initiated by the single controller. Once the controller has processed an action selected by the user input, it determines which action was chosen and transmits the information/instructions to the appropriate output/motor. Both read and write on the controller side are implemented in the same subroutine, this routine is in charge of generating the clocks, and sending and receiving the bits of information.

4.5 ELECTRONIC PART AND FUNCTION

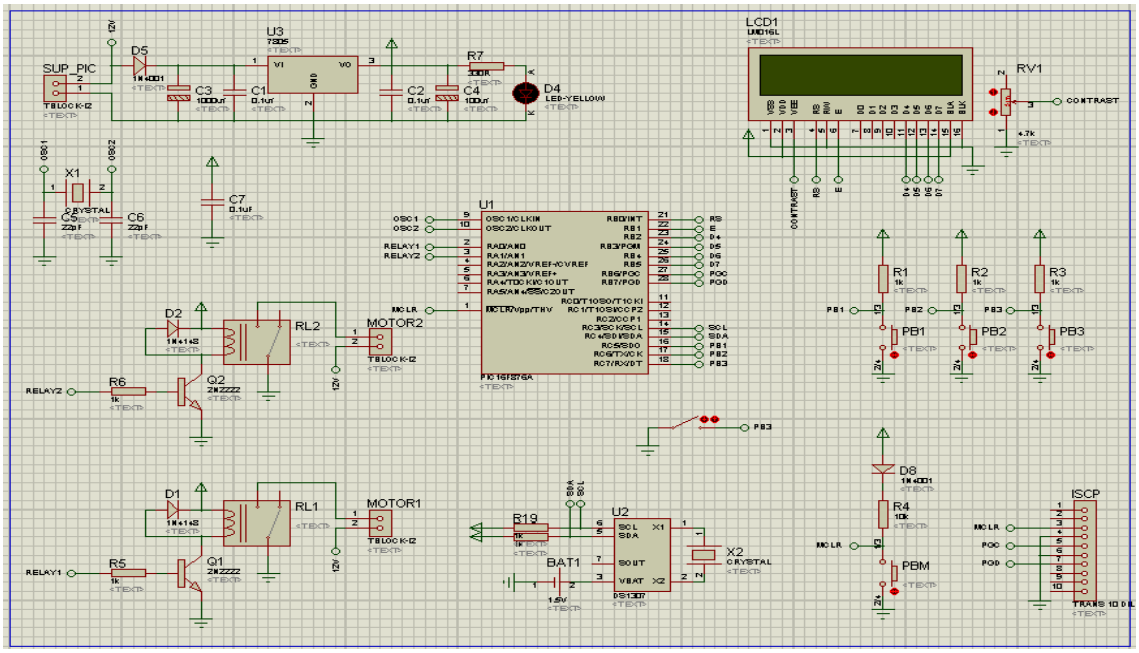


Figure 4.7: Electronic part on the board

Figure 4.7 shows the electronics part that will be installed on the board. There are several important parts that must be choose properly such as the PIC microchip, and the part that will be used to control the clock that follow the real clock. The connection between relay and clock also need the proper part chosen that can make the connection smoothly run.

The correct output of the circuit will be shown by the software virtually. Figure 4.7 shows the result when the controller circuit is tested using Proteus software. After get the correct output from Proteus, the circuit is first tested by using protoboard and then built the circuit.

This design is to modularize the processor environment that has a single controller which takes the control commands from a user and passes the necessary control functions to an appropriate motor to perform the operations. With this design concept, there will be virtually no limit on the number of motor in the system. The limitations in the previous design on a single CPU approach are automatically resolved.

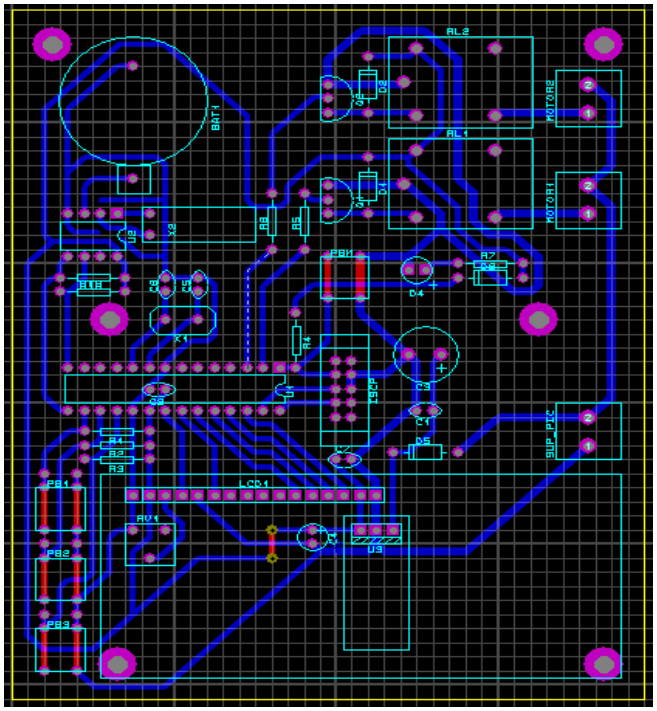


Figure 4.8: Printed Circuit Board (PCB)

Figure 4.8 show the simulation flow of the board that will connect between the electronic parts. This process will make the installation of the electronic part will easier and can reduce mistake. The blue color shows where the flow of current will go and contact with the electronic part. The pink color shows the location of electronic part will be install.

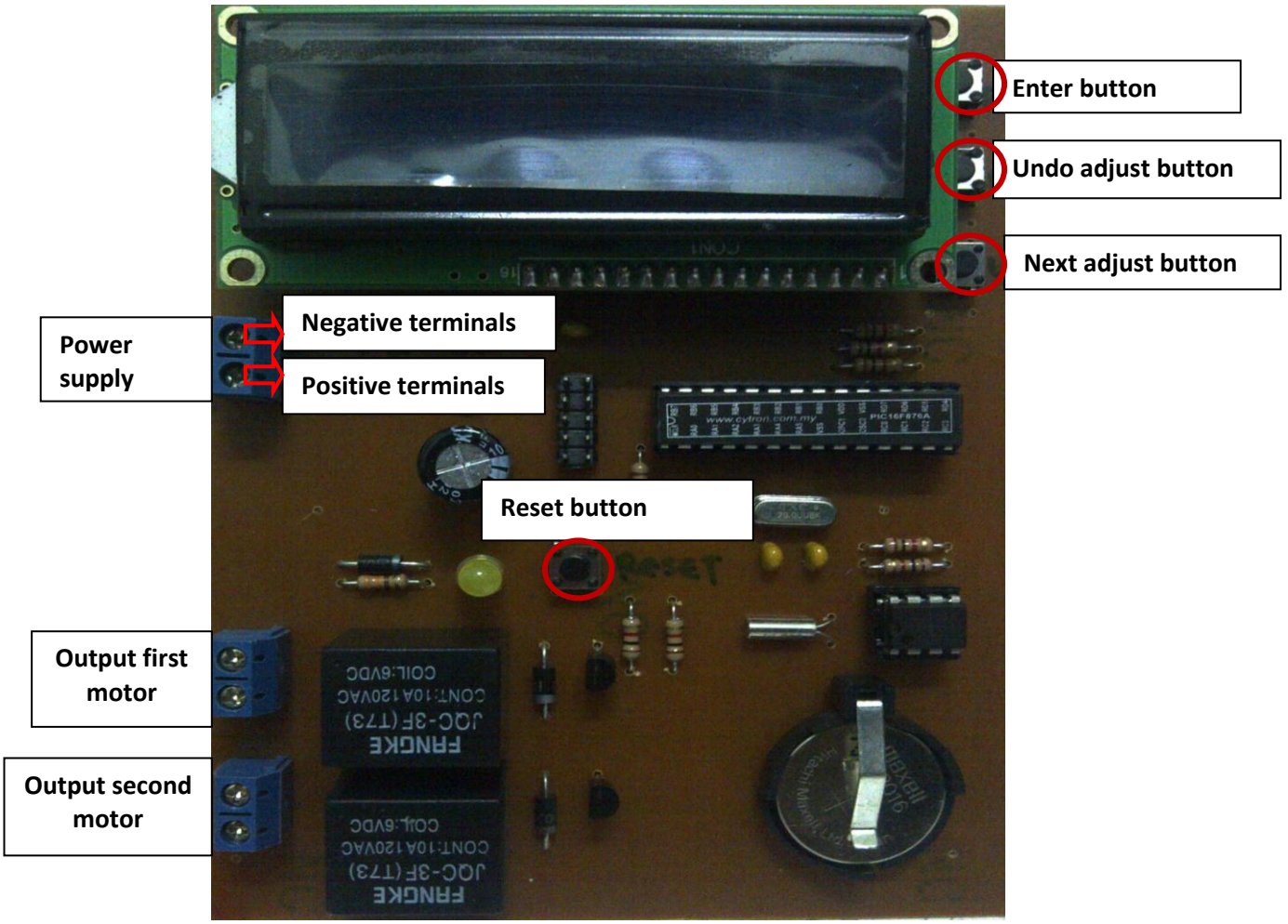


Figure 4.9: Button function

Figure 4.9 shows the function of the button and the place where the input and output power delivery. All the button that being shown will be used to set the time for each session of the feeding time. The function of the button us limited to reset the session time and to create new session time for the feeding. The feeding time for each session is only set in the programming that has been done using PIC.

4.6 DC SERVOMOTOR ANALYSIS

DC motor and auger bit are the main parts of the rotation mechanism machine for distribute pallet to the tank. By adjusting the DC motor the force can be control and the force apply to the DC motor can be calculated using the data below.

Figure 4.10: Direct Current (DC) motor

Calculations of force apply being calculated based on data below:

DC Properties

Model No. : SPG30-300K

Motor Series : low inertia

Power Supply : single phase

Input : 12V, 3Amp

Rated Rotation Speed : 12 RPM

Torque : 1.176 N.m

The angular velocity of DC motor

$$w = \frac{2\pi n}{60}$$

$$= \frac{2\pi(12)}{60}$$

$$= \frac{75.3982}{60}$$

$$= 1.2566 \text{ rad/s}$$

The force apply of DC motor

$$T = Fr$$

$$F = \frac{T}{r}$$

$$= \frac{1.176}{0.006}$$

$$= 196 \text{ N}$$

From the calculation above, the angular velocity provided by DC motor is approximately 1.2566 rad/ s. however, the maximum force provided by DC motor is approximately 196 n with 1.176 N.m torque. From the equation, it indicated that the rotation speed of selected motor was the main factor with influence the angular velocity of DC motor and hence infects the force and torque also. When rotation speed increase, angular velocity will increase.

4.7 MECHANICAL AND MECHANISM FUNCTION

Bolt and nut application is the famous application in the simple machine also the huge machine. The main function of this application is to tighten the parts which have been attached to another part. it easy to use bolt and nut application because we can easy tighten or loosen the part compare to the welding process.

4.8 ANALYSIS

This chapter will discuss about analysis of the fish feeder. The first is pellet distribution. Secondly is analysis of cost analysis.

Since most of the movement structure is made of steel, friction might have been occurred between two contacted surfaces of the components. The possible area of friction to occur is contacted area between the shaft and the hollow round rod shown in figure 4.11.

Figure 4.11: Auger bit and distributed chamber

When friction occurred, the transmitted torque from motor to the propeller through the chain will be reduced as the friction act as a counter of the torque applied by the motor. When this happened, the rotation speed of the propeller also will be reduced. Thus the travelled of the pellet will become less.

Torque= total force x drill bit radius

$\tau = F \times r$ (from motor)

$\tau = \Sigma F \times r$ (transmitted to drill bit)

$\tau = (Fa - Fr) \times r$ where Fa is force applied and Fr is friction force

Force, F = total mass x gravity acceleration.

= 3 kg x 9.81 m/s

= 29.43 N

4.9 SAMPLE CALCULATION

Distributor motor RPM = 12

Pellet velocity, V = πr/30 x RPM

= π (0.019)/30 x 12

= 0.024 m/s

4.9.1 MAXIMUM PELLET CAPACITY

Volume for 1 kg pellet = $\pi r^2 t$

= $\pi (0.019)^2$ 0.09

= 0.00102 m^3

Tank capacity, V1 =length x width x height

= (0.15 x 0.1 x 0.25)

= 0.00375

Maximum pellet in tank = tank capacity, V_1 / volume for 1 kg pellet

$$= \frac{0.00375 m^3}{0.00102\ m^3}$$

= 3.67 kg

4.9.2 PALLET FLOW THROUGH DRIVER CHAMBER

Driver chamber speed = 12 RPM

Pellet driver chamber capacity, $V_2 = \pi r^2 t/4$

$= \pi (0.019)^2 (0.025)/4$

$= 0.000007\ m^3$

Pellet flow rate through drive chamber = pellet drive chamber capacity x drive chamber speed

$= V_2$ x 12 RPM

$= 0.000007\ m^3$ x 12 RPM

$= 0.000084\ m^3$/ minute

$= \frac{3\ kg}{0.00102\ m^3}$ x 0.000084 m3/ minute

= 0.25 kg/ minute

4.9.3 TIME TO COMPLETE FEEDING OVER WEIGHT OF PELLET

Time of feeding, t = pellet flow rate x pellet weight

$$= \frac{0.2kg}{0.25kg/m}$$

= 0.8 minute

= 48 second

4.9.4 FEEDING COST

Feeding cost = $\frac{2\ time}{day}$ x pellet weight x cost for 1 kg pellet

= 2 x 0.4 kg x RM 2.00

= RM 0.8 / day

= RM 24 / 30 days

The feeding activity is to be done twice a day, same with most of pond fish nowadays were fed. The data may different if the assumption was about to change to other value.

The price of the pellet may vary if they were bought from different shop, this price also may vary with time where the price may different in the future and this is upon the current market price.

CHAPTER 5

CONCLUSION

5.1 CONCLUSION

The objective of this project are to design the automatic feeding system for fish tank for aquaphonic system using solar power PV and fabricate the design that have been make using programming interface controller as a controller to the automatic feeder. So the objectives of this project have been achieved. The design of an automatic fish feeder machine for aquaphonic house can give more advantage to the user such as low number of workers and does not need fully time in order to feed fish in a correct schedule. The system is easier because there is the machine that can help the user to schedule time for fed the fish. This automatic fish feeder machine for the aquaphonic farming can give many advantages for entrepreneur to reduce the worker and time for fed the fish as the scheduling. This is because nowadays fish is one of the important foods and got high demand in market, so the fish farmer fed fish with the manual using human power and the weight of the pallet for each pond does not same. It will give a bad result if there is over amount of pallet is giving. It will result in the excess, uneaten food sinking and will contaminating the water. So to get the equal or same amount of pallet in each of the pond the best solution is using automatic fish feeder. Basically, the machine is just a simple machine that using motor that connect with auger bit to operate. Cost to produce the product also not too expensive with the part that need to use the programming is RM 600. Besides that, this machines being done in part, and it is easier for the user to maintenance.

Welding application is the major process in fabricating the machine. The storage tank and stand is fully used welding process to attach between the parts. The joining between the tank and the stand and also the external part such as electronic box using bolt and nut to ease the assembly and service whenever problems occur during feeding has reduce the time of maintenance. For the tank the material used is sheet metal where the shearing, bending and grinding machine have been used to get the shape needed.

5.2 RECOMMENDATION

For future improvement of this feeder to focus on the control system so that this feeder can be control from others place such as using phone activated feeder. Beside, this machine can be improved at the distribution chamber to make the pallet distributed at the large area. The auger bit as the rotation part at the distribution chamber also can be change to another product that can take out food in a large quantity. It can save the electricity used with reduce the feed time.

To achieve high efficiency in the feeder performance, it is important to reduce the friction to allow the smoother rotation. The slot that will grab the auger bit and the motor also important to make sure there is no loosen grab while it run.

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