Global Journal of Researches in Engineering: a
Mechanical and Mechanics Engineering
Volume 16 Issue 2 Version 1.0 Year 2016
Type: Double Blind Peer Reviewed International Research Journal
Publisher: Global Journals Inc. (USA)
Online ISSN: 2249-4596 Print ISSN: 0975-5861

Development of Automatic Fish Feeder

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GJRE-A Classification : *FOR Code: 290501*

Strictly as per the compliance and regulations of:

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Abstract- An automatic fish feeder is a device that automatically feed the fish at a predetermined time. In a way, it is to control the fish feeding activity by using a fish feeder that combined the mechanical system and electrical system to form a device instead of manually feeding the fish by hand. Fish owners whom are away for a long time will have trouble knowing the situation of the pond or aquarium. Thus such device is very convenient. At the same time, the environment needs to be monitored. For this paper, I will monitor the environment in term of water temperature. First of all, the device will consist of a motor, stand, fish storage, PLC (Programmable Logic Circuit) and a GSM (Global System for Mobile). The device will feed the fish by dropping the feed from the storage through a hole. The size of the hole is controlled by a piece of block connected to a motor. A timer is used to control the number of feeding time at an interval of time. Plus, there is a feedback system that sense the level of feed left in storage. It will give warning to the user through SMS (Short Messaging Service) so the user will put new feed into the storage. With this, the user or the owner can be away from home with the device monitoring the aquarium condition.

I. Introduction

Food and feeding are the important elements for growth and production, their management being one of the main challenges for aquaculture development, survivability and maintenance. The adjustment of food delivery to ensure the survival of the fish is important for fish owners, whether as pet or aquaculture. Related to economic aspect, especially for highly invested aquaculture project, the control of fish feeding will also determine the survivor of the company involved. However for this paper, I will focus on the fish reared by home owners.

In order to solve this problem, several direct and indirect techniques have been developed. Self-feeders may be used for direct adjustment, whereas indirect methods have also been used based on using automated device to deliver the feed to the fish. Therefore, the aim of the present study is the development of a feeder that can handle good control of fish food feedings.

a) Background

Recently, there has been increase of number of people who kept fish as a pet at their own home. Be it a hobby or for business purposes. Those who do it for business purposes, in statistic, in Asia itself, the production of aquaculture dominate the market, contributing around 91% of the world's total by volume and 82d% by value. Asian countries, such as Thailand, have been the top ten aquaculture producers in the world. The region has the highest variety of cultured species. Asia has also been the highest seafood-consuming region of the world, accounting for two-third of the world's food fish supply, the increase of which mainly came from aquaculture in recent years (Endan, Mazlina, Talib & Yeoh, 2010).

As stated by Endan et al (2010), the fisheries sector in Malaysia has provided direct employment to 89,453 fishermen and 21,504 fish culturists. The consumption of fish in Malaysia is expected to increase by 14% by 2010 and currently, the country is producing 89% of the fish supply for its own consumption. With the marine harvest almost stagnating, the industry is dependent on the aquaculture to cater for the growing demand. Currently, the aquaculture industry contributes to about 13.2% of the total fish produced. Malaysia has the potential to become a major player in the aquaculture industry in Asia Pacific, if more companies enter the sector.

One parameter that involve in a feeder is time management controller that act as main part of a feeder. Many industrialists in aqua field and also fish owner seem to have trouble with this timely operation. Traditional method of feeding fish either for fish in pond, cage or even small lake is by use of man power. For the worker, they sometime face difficulties to do the feedings at the same exact time during some unexpected event especially when raining. If the they continue the job, the only result are not just the pellet ending at the bottom of the pond as waste faster or lead water to pollute, but the main critical problem is the unfed fish. This matter will even grow bigger during raining season and will cost a lot of trouble to the industrialist. This is a very clear example to show how important is timing variation, that determine when is the meal time for the fish. The meal time usually can be change depends on the user coincide with some specific condition such as type of fish, size of the pond, quantity of fish and many other aspect which selected by the programmer or ser to set the time. Moreover, the running period for each feeding also determine by this timer that is also programmed by the user. The feeding device includes means on the control means to vary the length of each predetermined interval. Plus, there is also

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a need for warning for user if the storage reach a low level of fish feed, such as sending SMS to user phone.

At the same time, monitoring the environment of the aquarium is also important in some part of the country. Some places have constant temperature all year round but there are also some places that the temperature will go from extreme to another. Such cases will definite carry huge risk to wards the fish. If such cases occur, the fish will probably die. Thus, there is also need to update such situation via SMS. Same as previously mention situation.

b) Problem Statement

In these modern times, there are many aquarists or fish owners of the home based aquarium leads a busy life especially those who are away on business or vacation. They are often difficult to maintain a regular feeding schedule. However, for the fish survival, the fish require regular care in order to remain healthy. If fish are not constantly fed small amounts of food at regular intervals, there can be significant loss of fish due to starvation. But, at the same time, too much food in the water can easily clog up important filters and cause the owners to spend more time cleaning the aquarium tank. Moreover, monitoring the internal environment such as the temperature of the water is a plus point. There are some aqua life that cannot live if the temperature is too cold or too warm. Thus, they might need to take a certain action by recruiting a reliable helper to ensure that the fish are properly fed and taken care of while they are away.

As such, a device can replace the helper instead. The system of the device must be able to be controlled or adjusted by user according to their demand and needs. As referring to “automatic” word itself, the device or more appropriate, the feeder should be able to be operated without supervision of human at least at certain interval of time. At the same time, the water temperature can also be monitored.

There are many different designs and brands on automatic fish feeders on the market, but there are some limitations on the existing fish feeders need to be improved. Therefore, some improvement or new invention needs to develop to solve these problems. However, when it comes to a total cost of this design, it is a bit expensive as this invention requires higher cost of parts.

Usually modern aquariums have their own automatic fish feeder that used to give food to the fish by following the timer that is set by the user. However, the problem with an automatic fish feeder is that there may be a time a user forgot to resupply the fish feed into the device and there not many feeders that have their own temperature sensor. For this project I need to design the automatic fish feeder with a warning system so the amount of food in the aquarium can be replenished and the water temperature can be monitored at all times.

c) Research Objectives

The aim for this research is to develop fish feeder to automatically dispense flakes twice a day or more according to user interest every day. The system should also able to keep the flakes dry and should monitor the total amount of the flakes. The system should be able to send SMS notification to the owner if the flakes amount goes below preset minimum amount. The system should also monitor the overall environment of the aquarium using different sensors and update the user by SMS communications.

The objectives of this paper are:

1. To design and develop automatic fish feeder for indoor aquarium.
2. To monitor the environment of the aquarium and update the user by sending SMS.
3. To evaluate the performance of the developed mechanism.

d) Research Problems

Here are the research problems that must be overcome in order to complete this research. The questions are:

1. What kind of material is suitable for the feed storage to avoid moisture?
2. How to control the amount of fish feed into the pond or tank?
3. What a kind of sensor is suitable for the warning system?
4. How to create a system so that are able to communicate properly with the GSM for SMS sending?

e) Research Methodology

In order to complete the objectives of this research, the following methodology are used. The first stage is the literature review, in which I study about the previous research about devices made previously, what are their advantage and disadvantages and so on. In second stage, I consider the component used and to optimize cost with the usage due to the wide array of items available in the market. Third, I need to study on how the servo motor works and how to control it. I will also need to study about coding to control the motor properly according to the user input. Then I have also need to learn about controlling the opening area, plus the amount of time it will operate in day. After that I also need to find out what kind of sensor is suitable to warn about low storage. Later, I will need to know how to interface the warning system with the GSM to send a message to the user. Last but not least, I also need integrate all the system together before doing documentation for all the gathered information.

Then the selection of component will be needed to be done and tested by stages. This involves programming the Arduino board with selected components. Each stage will be tested accordingly until the project succeeds. The complete timeline for the

whole project is shown in the project Gant chart as in Appendix A.

II. Literature Review

a) Automatic Fish Feeder Concept

Basically, there is a lot of inventions had been made and been classified as "automatic fish feeder". From those previous designs, a few are chosen due to their criterions which are quite interesting and also useful.

The first design is by David C. Smeltzer which is patented in 4th April 1985. His design is capable of dispensing feed having various sizes of grains over a wide range of dispensing volumes with a high degree of accuracy. The device was able to do this by utilizing an adjustable counterbalance weight which the amount of water required are changeable to produce a dispensing action and simultaneously adjusts the vibration movement made by the fish feeder to differentiate the amount of food given out.

Consequently, both the frequency of feeding and amount can be controlled by the counterbalancing the weight. Furthermore, the number of feeding can also be adjusted by changing the rate flow of the water supply by using a valve and the water supply line, plus an additional water container which is capable of measuring the volume of water supplied to the water container so as to provide an additional degree of accuracy in degree of accuracy insetting the frequency of feeding.

However, as stated by Mohapatra, Sarkar, Sharma and Majhi (2009) and Noor, Hussian, Saaid, Ali and Zolkapli (2012), for most automatic fish feeder, it is not easy to control the amount feed released. Too much will pollute the water in the pond or the tank. Plus, the constant speed to deliver the food pallet limited its usage. At the same time, it is also a waste of food. The size of the device will depend on the location it will be used or install, whether the device is used for normal aquarium or pond. For indoor aquarium, a small device will work well and the outer pond will require a bigger device with a big storage. The size of the storage will determine the number of trips the user needs to do to replenish the feed. Not to mentioned, for most of the time, the cost are proportional the size of the device.

A research conducted by Faridi, Ezri, Saidin and Faizal (2011) has stated that there are two types of automatic fish feeder. There are fixed fish feeder and also mobile fish feeder. From this statement, I can infer these two types have their own usefulness based on the situations. A fixed is useful for owners that have a single pond or and aquarium. On the other hand, mobile feeders are useful to owners who have more than two or more ponds. Faridi et al. (2011) also stated, controlling the feeders will requires high precision programmable logic circuit (PLC) and also efficient.

Furthermore, instead of feeder that are situated in pond, there are also automatic fish feeder feed feeder that are placed on the ocean by installing inside a buoy (James & Stanley, 2006). It is understandable that by placing the feeder inside a buoy on the ocean, by installing a camera, microphone or any other appropriate sensor, oceanic aquamarine life can be easily monitored. As long the ponds are large enough, such fish feeder can be used.

b) Servo Motor

Servo motors have been around for a long time and are utilized in many applications. They are small in size but unlike normal motor, be it AC or DC, these motor pack a big punch and at the same time, very energy-efficient. Due to these features, they can be used to operate radio-controlled or remote-controlled toy cars, robots and airplanes. Servo motors are also used in industrial applications, robotics, in-line manufacturing, pharmaceutics and food services.

Different than normal motor, servo motor can only rotate in a specific angle, whereas a normal motor are able to rotate 360°. In a paper written by Ahmed, Chellali and Zahir (2013), in these recent times, servo will be an important device in industrial application. Plus, this field will require high dynamics on position control. Example of such application are; numerically controlled machinery, robotics, automation and other mechanism where the staring and the stopping functions are quickly and accurate. For robotic application, this motor is used to move the robotic arm to a desired position by means of controllers in the automated manufacturing lines of industries. Special ability of the servo motor is that the rotor construction is made of special material with less weight to decrease inertia of armature but at the same time, it is capable of producing the necessary magnetic flux. The capability of immediately starting and stopping during the on-off conditions increases due to low rotor inertia. Below is the equivalent circuit of DC servo motor:

There is also a brushless DC servo motor. A research by Ku (2006) shows that this type of servo motor is usually involve in an application that require high motion controlled and high speed. It is used in an industry for pick and place for a wide variety of product transfer application. That said, depending the situation at hand that does not require high precision a less precise servo motor is good enough to be implemented.

On the other hand, the servo motor can be controlled in many ways. A research paper proposed by Hao (2012), states, a complex system can be simplified by applying the fuzzy logic to control the servo motor.

For better result, the grey theory was used in order to overcome the disadvantages of the traditional method of computing the torque technique and at the same time, it has similar simple control structure to the PID controller (Rong, Rou & Li, 2001).

c) GSM (Global System for Mobile)

GSM (Global System for Mobile Communication), is a standard developed by the company known as the European Telecommunications Standards Institute (ETSI) to describe the protocols for second generation (2G) digital cellular networks used by mobile phones.

The GSM standard was developed as a replacement for first generation (1G) analog cellular networks and originally described a digital, circuit-switched network optimized for full duplex voice telephony. This was expanded over time to include data communications, first by circuit –switched transport, then packet data transport via GPRS (General Packet Radio Services) and EDGE (Enhanced Data rates for GSM Evolution or EGPRS).

In the paper written by C. D. Oancea (2011), GSM is able to operate in several frequencies. Based on its on its own SIM (Subscriber Identity Module), the known band it can operate are 900MHz, 1800MHz and 2100MHz. This will provide the user and identity in the network with having a unique telephone number for each of them. C.D. Oancea (2011) also states that in order to produce a communication between hand phones and computer, a GSM/GPRS modem is needed. Plus, the communication goes both ways.

In an application that are opposite with the previous mentioned, a paper written by Rozita, Salah Addin, Kok and Mok (2013), the handphones is used to control the home appliance through SMS by going through the GSM.

A signal will need to travel in order to reach its destination. Kazemi, Mosayebi, Etemadi, Boloursaz and Behnia (2012) has written in their research that the data transmission in GSM happen in many channel that are available and it can be compute by using a certain technique or method. Such methods are "Parameter mapping" and "Codebook Optimazation". A paper written by Guifen & Guli (2010) has supported that usage of GSM to for wireless communication especially for cellular phones as it has a lot of advantages and conveniences.

d) Central Processing Unit

In all devices, they must have a unit that will be able to receive all the input, compute all the things need to be calculated such as distance and manipulate the other unit to produce outputs. This usually will be done by a central processing unit (CPU), or also known as the brain for the devices. Without it, the input will not be put into use; the output cannot be control and so on as there is no communication between these units. The microprocessor or microcontroller took the role as the CPU for the devices.

In recent years, for making prototype devices, the microcontroller knows as Arduino is used most of the time. As stated by Masimo (2011), Arduino is a user friendly device with open source software. As it is an open source programe, user all over the world are able to share their knowledge. Furthermore, according to Vicky, Fifki, Ary and Diotra (2013), the Arduino Uno is a microcontroller board based on the ATmega328 which has 16 digital input/output pins, 6 analog inputs and a lot more of other features.

With Arduino, doing the coding for the software is quite simple as it is based on C++ language. Plus it is also cheaper compared to the other available microcontroller. These facts are supported by the research by Luiz, OSvaldo, Marli, Paulo, Leonardo and Fatima (2013).

The practical usage or Arduino as a microcontroller a widely used in many fields such as for lab kits for starters, school competition to nurture future researchers and going up, for robotic configuration. The usage describe previously are written by John & Ioannis (2010), Radhika, Shoba, Terry & Maryam (2013) and also Luiz et al (2013).

For this project, the Arduino is used to program the servo motor. A paper written by Francisco & Vignaud (2013) shows that the Arduino can also be used to control a brushed DC motor all together with the motor driver.

e) Temperature sensor

As implied by its name, it is sensor that measures temperature. For this paper, the temperature here will focus to measuring the temperature in water, such as ponds, lake or ocean. For most cases, this type of temperature is used to monitor the water condition for aquatic life.

In paper written by Chen, Zhong and Cai (2011) has stated that, in moving an ornamental fish, a fish that are sensitive to temperature changes, a temperate sensor is used to monitor the heat from the water as other devices is used to control or cool the water for fish transfer. Fig. 2.10 shows their program flow-chart.

In another, research by Min, Ji and Daoliang (2012), they have state that, in case of a sea cucumber, its growth rate and development are heavily depended on the temperature of the water. From this alone, the factor of water temperature must not be neglected as it can affect the aquatic life.

III. System Design

In this chapter, the project description will be elaborated as well as the design and component selection and justification will be presented. The components for this project will be discussed into two separate categories which are mechanical and electronics.

a) Mechanical Structure

The automatic fish feeder has been designed as such as shown in appendix B.

The material that is required is very simple where the device is mostly constructed by using plastic. This is because the body of the device needs to be highly stable to hold all the electronics components. There are many types of materials can be used to make a robot body, for example, wood, metals, glass and other suitable materials. Each of these components has their own advantages and disadvantages and they normally been selected based on the type of projects. In this project, plastic is selected due to its light weighted and is cheap as shown in the Fig.3.1.

As for the rod used as the limit switch, plastic is preferred to be used as the material. The opening for the feeder is at the bottom of the device.

The below image shows the event when the lead is close and open. As seen, the feed is put inside the storage and it will fall down by gravitational force when the lid is open.

b) Electronics Components

Arduino is an open source physical computing microcontroller board. This device is just needed to connect to the computer with a USB cable to begin uploading the necessary coding. Both of Arduino UNO and MEGA2560 features are shown in the Table 3.2.

Microcontroller	ATmega328	ATmega2560
Operating Voltage	5V	5V
Input Voltage (recommended)	7-12V	7-12V
Input Voltage (limits)	6-20V	6-20V
Digital I/O Pins	14 (of which 6 provide PWM output)	54 (of which 14 provide PWM output
Analog Input Pins	6	6
DC Current per I/O pin	40mA	40mA
DC Current for 3.3V Pin	50mA	50mA
Flash Memory	32 KB (ATmega328) of which 0.5KB used by boot loader	256 KB of which 8 KB used by boot loader
SRAM	2 KB (ATmega328)	8 KB
EEPROM	1 KB (ATmega328)	4 KB
Clock Speed	16 MHz	16 MHz
Price	RM 72.00	RM 168.00

Arduino was selected to be the microcontroller since it is a new component and its features are simpler and complex coding also can be done in such a way that easy to understand. Furthermore, this microcontroller has its own a USB connection, a power jack, an ICSP header and a reset button. Between the two, Arduino Mega is selected due to the high number of digital I/O pins as this project may require more than 16 I/O pins.

i. *Servo Motor*

Different than normal motor, the servo circuitry is built right inside the motor unit and has a positional shaft, which usually is fitted with a gear (as shown below as shown Fig 3.2.). The motor is controlled with an electric signal which controls the shaft movement.

Inside the servo is a simple set-up: a small DC motor, potentiometer and a control circuit. As the motor rotates, the potentiometer's resistance changes, thus the control circuit can precisely regulate how much movement there is and in also which direction to turn.

This is possible due to the motor is attached by gears to the control wheel.

When the shaft of the motor is at the desired position, power supplied to the motor is stopped. If not, the motor is turned in the appropriate direction. The desired position is sent via electrical pulses through the signal wire. The motor's speed is proportional to the difference between its actual position and desired position. So if the motor is near the desired position, it will turn slowly, otherwise it will turn fast. This is called proportional control. This means the motor will only run as hard as necessary to accomplish the task at hand.

Servos are controlled by delivering an electrical pulse of pulse width modulation (PWM) or variable width, through the control wire. There is a minimum pulse, a maximum pulse and a repetition rate. Most servo motors can usually only turn 90 degrees in either direction for a total of 180 degree movement. The motor's neutral position is defined as the position where the servo has the same amount of potential rotation in the both the clockwise or counter-clockwise direction. The PWM sent to the motor determines position of the shaft, and based on the duration of the pulse sent via the control wire; the rotor will turn to the desired position. The servo motor expects to see pulse every 20ms and the length of the pulse will determine how far the motor turns. For example, a 1.5ms pulse will make the motor turn to the 90-degree position. Shorter than 1.5ms moves it to 0 degrees and any longer than 1.5ms will turn the servo to 180 degrees as diagramed below:

When these servos are commanded to move, they will move to the position and hold that position. If

an external force pushes against the servo while the servo is holding a position, the servo will resist from moving out of that position. The maximum amount of force the servo can exert is called the torque rating of the servo. Servos will not hold their position forever though; the position pulse must be repeated to instruct the servo to stay in position.

As describe previously. The position of the servo motor can be controlled by user input using a microcontroller. Below are the movements that are set to move at 45° with 45° increment with the limit at 180° and also the servo motor that is used for this project.

The TG9e is known as a cheap but reliable servo motor. The motor has the same performance as other servo with a 0.10 sec travel time and up to 1.5kg in torque and an ultra-narrow dead bandwidth.

Table 3.2 : Turnigy TG9e Specification

Dimension:	23x12.2x29mm
Torque:	1.5kg/cm (4.8v)
Operating speed:	0.10sec/60 degree 0.09sec/60 degree (6.0V)
Operating voltage:	4.8V
Temperature range:	0-55C
Dead band-width:	7us
Lead Length:	260mm

ii. *GSM*

There are many types of GSM that can be used. Below is another table that shows some of the said items that are considered.

Table 3.3 : Comparison between GSM modules

Sensors	Features
SIM900 GSM/GPRS shield	Size: 7.14 x 6.60 x 0.16 cm Price: RM 220.00 Product Features: • IO ports-RXD, TXD, Free USB to TTL for PC, supports 12000bps-115200bps, Supports AT commands GSM 07.07, 07.05, SIMCOM AT Extended commands • Antenna – SMA connector, comes with GSM 900M/1800M small antenna • Power ports-DC 5V 2A 2.1 mm, BAT/GND connector for external mobile phone battery • SIM Slot – Support 1.8V/3V SIM card • working frequency – EGSM 900 MHz/DCS 1800 Mhz – Auto Dual Band • Size of PCB 59mm*43mm • with ESD Protection • With On/Off button and Power LED indicator • Signal LED Indicator
Mini SIM900A GSM SMS GPRS Module	Size: 0.59 x 0.43 x 0.16 cm Price: RM 150.00 Product Feature • IO ports-RXD, TXD, Free USB to TTL for PC, supports 12000bps-115200bps, Supports AT commands GSM 07.07, 07.05, SIMCOM AT Extended commands • Antenna – SMA connector, comes with GSM 900M/1800M small antenna • Power ports-DC 5V 2A 2.1 mm, BAT/GND connector for external mobile phone battery • SIM Slot – Support 1.8V/3V SIM card • working frequency – EGSM 900 MHz/DCS 1800 Mhz – Auto Dual Band • Size of PCB 59mm*43mm • with ESD Protection • With On/Off button and Power LED indicator • Signal LED Indicator

Based on the previous comparison, the Mini SIM900A GSM SMS GPRS Module is chosen. First factor is due to its lower cost. Plus, the objective for this project is to deliver a SMS when the warning sensor is triggered. At the same time it will also be used to deliver SMS when the temperature is too high.

Matrix keypad is widely use in our daily life. Often, matrix keypad is available in 3x4 or 4x4. In general, matrix keypad is a good substitution to normal push button. This is due to the matrix keypad offers more input to the microcontroller with lesser I/O pins required as compared to buttons. Considering system that needs 16 inputs, this keypad will only requires 8 I/O pins with keypad instead of 16 I/O pins. So I can actually use the extra 8 pins for other functions.

The matrix keypads work by based on Table 3.3 mapping.

Table 3.5 : Mapping of buttons with rows and columns

	Col 0	Col 1	Col 2	Col 3
Row 0	1	2	3	A
Row 1	4	5	6	B
Row 2	7	8	9	C
Row 3	*	0	#	D

A 4x4 matrix keypads consist of 4 rows and 4 columns. On paper, the keypad looks roughly like this:

From the Fig. 3.7, there is a switch connected to each row and column. So, these combinations of rows and columns make up the 16 inputs of a normal pushbutton.

Normally, for a regular pushbutton, the entire switches are open or not connected. Then when I pressed either one of the buttons, the switch will become closed or connected. As a result, between the row and column, connection exists.

Relating with the project microcontroller, I connect the first 4 pins to the column as the INPUT. Meanwhile the other 4 pins are connected to the row as the OUTPUT. The input meant that is the input to the microcontroller while output is the output from the microcontroller. Note that the input to the microcontroller has to connect to pull high resistor, or the internal pull up from Arduino itself can be used.

Here is how it works, the microcontroller send LOW to each row one at a time and check whether there is a LOW signal detected on the column. If there is no button pressed, the microcontroller will scan for the next row and read for LOW signal. Since the column is pull HIGH internally, so no button pressed would return 1 to the microcontroller. When you pressed one of the buttons, now the row and column are connected. The 0 from row would make the column return a 0 to microcontroller.

With the row and column, I can know which button I am pressing.

LCD (Liquid Crystal Display) screen is an electronic display module and find a wide range of applications. A 16x2 LCD display is very basic module and is very commonly used in various devices and circuits. These modules are preferred over seven segments and other multi segment LEDs. The resons being: LCDs are economical; easily programmable; have no limitation of displaying special & even custom characters (unlike in seven segments), animations and so on.

A 16x2 LCD means it can display 16 characters per line and there are 2 such lines. In this LCD each character is displayed in 5x7 pixel matrix. This LCD has two registers, namely, Command and Data.

The command register stores the command instructions given to the LCD. A command is an instruction given to LCD to do a predefined task like initializing it, clearing its screen, setting the cursor position, controlling display etc. The data register stores the data to be displayed on the LCD. The data is the ASCII value of the character to be displayed on the LCD.

Table 3.5 : Pin Description

Pin No	Function	Name
1.	Ground (OV)	Ground
2.	Supply voltage; 5V (4.7V-5.3V)	Vcc
3.	Contrast adjustment; through a variable resistor	VEE
4.	Selects command register when low; and data register when high	Register Select
5.	Low to write to the register; High to read from the register	Read/write
6.	Sends data to data pins when a high to low pulse is given	Enable
7.	8-bit data pins	DB0
8.		DB1
9.		DB2
10.		DB3
11.		DB4
12.		DB5
13.		DB6
14.		DB7
15.	Backlight Vcc (5V)	Led+
16.	Backlight Ground (OV)	Led-

iii. *Sensor (Limit Switch)*

For the warning system, in order to select a correct sensor available in the market, thus I have chosen a component that will act similar to an analog sensor that is the limit switch. A list of features and prices of various types of switch that can be used are considered as shown in the Table 3.1 below.

For this project, after considering all the available switches with their practical uses, plus balancing with their cost, the KW11-3Z limit switch is chosen. Compared to the rest of the switches, although each of them has their own unique uses, however, optimizing the cost while achieving the similar result, the rest of them is omitted. Plus the chosen switches are available easily acquired.

Based on the Fig 3.13, when the feed is full, the rod will not touch the limit switch. However, when the feed level reach a low level, the rod at the outer side will trigger the limit switch which in turn will give a signal or input to the microcontroller.

The limit switch, KW-11-3Z Micro Switches specifications are shown at the table below.

Table 3.7 : Pin Description

Color:	Silver + Black
Material	PA66 material
Voltage:	AC 250V
Current:	5A

iv. *Temperature Sensor*

From the many temperature sensors, I chose the sensor that is waterproof as I will put it in the water for temperature measurement. Below, table 3.8 is the specification of the chosen sensor.

This sensor is a simple 1-wire interface. The DS18B20 provides 9 to 12-bit (configurable) temperature readings over a 1-Wire interface, so that only one wire (and ground) needs to be connected from a central microprocessor.

c) Bills of Materials and Costing

The actual budget of this project is RM 500.00 for the whole complete project. In this FYP 1, some of the component was already acquired from previous project, some are yet to be purchased and the estimated total cost is RM 391.00. The components were selected based on careful research from previous articles and suitable to be used for this project. Do note that this price is only for core components. The miscellaneous items are not included yet. The bills of materials used in this project are shown Appendix B.

V. Conclusion & Future Plan

a) Conclusion

To create an automatic fish feeder device is not an easy task. Plus, adding the sensor for environment monitoring that is the water temperature is new to me. It requires a lot of research and reading. I also have to consider balancing the optimum cost with it practical usage as, in terms of marketing, no customer will want to buy an overpriced product. This will be a challenge to us, because with my limited knowledge, I do not know all the cheapest component that are available in the market that fulfill the requirement and achieved the desirable result.

I already did some literature review to get the idea on the component used to make this device. I also already have my design and also the initial idea on how everything will be put together. I already select the possible components to be used and Insya Allah in the next semester, the project will continue with the creation of the devices.

b) Future Plan

For the next semester, I will work on how to program the Arduino using Arduino IDE, how to code the servo motor at desired interval and desired opening angle, how to use the GMS900 and interface it with the Arduino, how to use the display connected to the keypad, how to connect temperature sensor with its coding and also how to create the overall algorithm. I will also need to prepare for trouble shooting as combining all the coding into one big program will usually cause a lot of error. At the same time, I also need to make sure the device is stable and somewhat robust.

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