# DESIGN, CONSTRUCTION AND TESTING OF AN AUTOMATIC FISH FEEDING DEVICE

**BY**

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# DEDICATION

This work is dedicated to God Almighty for his support, guidance and loving kindness over my life throughout my stay at school, my lovely and caring parents Pastor and Pastor Mrs. M.K. Ibrahim for their financial, moral and spiritual support.

# DECLARATION

I IBRAHIM JOSEPH, declare that this work was done by me and has never been presented elsewhere for the award of a degree. I also hereby relinquish the copyright to the Federal University of Technology, Minna.

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# ABSTRACT

This thesis presents the design, construction and demonstration of an Automatic Fish Feeder. This Automatic Fish feeder is designed to dispense a predetermined amount of Fish feed into an aquarium at a specified time each day. The device consists of a cylindrical can, distributing tubes and a stand. The dispensed food will be controlled by the use of a stepper motor which is situated under the canister. A timer control switch is used to control the time at which the motor rotates by a program burned into the microcontroller. The Fish feeder is successfully fabricated and tested. Furthermore the waste of Fish feed in pond is drastically reduced.

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# CHAPTER ONE

# INTRODUCTION

## 1.1 BACKGROUND

Food and feeding are the vital ingredients in aquaculture development, their management being a major challenge in fish rearing. Fish farming is one of the most lucrative and leading businesses in the 21st century. It involves raising fish commercially in tanks, containers or enclosures. The adjustment or quantity of feed delivery to match fish appetite plays a key role to maximize the income of aqua industrialist. Over the years fish farming has been a very lucrative, commonest and major form of business around the world, including Nigeria, but in the last 2-3years, it has diminished due to poor management of feeding. The correct practice or management of fish feeding is majorly centered on how they can return good profit by means of proper feeding, this is a condition a fish farmer must meet. If this condition is not met it can impede the adjustment of food delivery to match variation in fish demand, leading to environmental pollution when overfeeding fish, and retarded growth when underfeeding fish [1].

The effective means of measuring the right proportion or quantity of fish feeds has not yet been fully solved with current technology. The only source that can be used to level the effectiveness of a feeder is from the use of an automatic fish feeder. This can be calculated based on the size of the pond, fish size, and different type of species, largely reducing the financial cost, time consumed, labor, thereby reducing the overall cost of rearing fish.

This project aims at building an automatic fish feeding system for fish pond in order to make fish pond business easier, more lucrative and more effective.

## 1.2 AIMS AND OBJECTIVES

This project is aimed at designing and constructing a simple automatic fish feeder which does the following:

i. Automatically releases a given portion of feed at time intervals within a 24-hour period.
ii. Allows for adjustable timing of intervals for release of portion of feed, so as to serve different fish sizes.
iii. It eases the stress of regular manual feeding
iv. Reduces the overall cost of fish rearing both in terms of finance, staff and time management
v. Eliminates wastage due to over-feeding of fish.

To achieve these, the following objectives are set to be carried out.

i. To design an automatic fish feeder, by the use of a PIC microcontroller
ii. Design of power source, to power the device.
iii. To fabricate a low cost automatic fish feeder

## 1.3 METHODOLOGY

The circuit presented in my project work explains the principle and methods used in automatically feeding of fishes. It would be constructed by the use of a stepper motor which plays a vital role in my project work. The stepper motor would be coupled to ease movement of built structure. It would be controlled by a unipolar stepper motor algorithm programmed in the microcontroller. It would as well be constructed by the use of a PIC microcontroller which would be programmed with sets of instructional codes for interpretation of different timing interval of feeding, and the involvement of a time interval selection switch, to enable easy access and control over timing selection. Conclusively it would be packaged in a well housed case for protection from external harm, such as rain.

## 1.4 SCOPE OF STUDY

The scope of this work entails the design and construction of a device that releases a predetermined amount of fish feed at specified period of time. This was achieved by using a modular approach. The power unit was made up of 230V AC. The timing section was made up of a variable resistor and acts as the input to the PIC microcontroller. The stepper motor unit enables precise movement of the device in degrees.

# CHAPTER TWO

## LITERATURE REVIEW

### 2.1 AQUACULTURE

Aquaculture is the farming activity of freshwater, marine plants and animals; evidently all aqua activity is done inside water, ponds, lakes, oceans e.t.c. Today industrialists take part in this activity by investing a large amount of money in managing, inventing and also marketing the output of fish farming, by the use of friendly, simple and manageable device.

### 2.2 THEORETICAL BACKGROUND

Fishes are cold blooded animals that live in water of relatively different sizes. Over the years they were found in large banks of water, but not long after, man discovered that it could be brought home, and reared in fish ponds, pyramids, enclosures e.t.c. The first fish to be brought indoors was the sea barbel which was kept under guest beds in small tanks made of marble. Introduction of glass panes around the year 1350 allowed Romans to replace one wall of marble tanks, improving their view of the fish. In 1369, the Chinese Emperor, Ho'ngwu, established a porcelain company that produced large porcelain tubs for maintaining goldfish, over time people produced tubs that approached the shape of modern fish bowls used in fish farming practice [2]. Not long after, fish farming practice became a burden to man, in the aspect of management and treatment.

Feeding being the keyword of growth and survival has been the curious aspect pushing man into development of a better fish farming system in order to avoid loss, due to the loss of lives of so many fingerlings. Man in his relentless effort began observing and found out that feeding fishes manually is inadequate, because it brings about inaccuracy in measuring the quantity of their food, which could result in underfeeding (starvation) or overfeeding (pollution). Aqua industrialist then had to get an option which could feed fishes better and as well as gauge the right proportion of the feed to be dispensed in order to avoid underfeeding and overfeeding. This led to the very first invention of fish feeder.

## 2.3 HISTORICAL BACKGROUND

As far back as the 1960's, fish feeders had already been in existence, with the first invention in the year 1962 designed and constructed by Walter E. Malek, at S. Elizabeth. Their main aim was to provide an automatic fish feeder device that automatically dispenses a predetermined amount of fish food from a standard canister into an aquarium at regular time periods and in regular amounts determined by the user. The desirable invention was achieved, useful and effective but had a number of limitations. It is mechanically designed with springs and actuating wheels, instead of a stepper motor or better motoring devices, leading to poor flexibility, movement and waste of materials. Also the timer and dispenser are not coupled together, leading to poor functionality. They are constructed separately, with the dispenser being a synchronous clock motor. After the design and construction, the machine was expensive, too big, not flexible and had poor rotating aids [3]. David C. Smeltzer came out with his own design in 1984 which was thus better than previous invention (1962). His design was centered on constructing an automatic fish feeder mechanism which utilizes water to fill a water container to induce a rotational movement. A predetermined rotation of the water container causes the water container to deliver its contents and cause a rotation of the rotatable arm in an opposite direction. The rotational movement of the rotatable arm induces a vibration movement to cause fish feed to be dispensed from a feed pan with a precise control of the frequency at which food can be dispensed. The major aim of his invention was achieved but had limitations; few of such are the dependent ability on water. i.e. Without water, being filled into a cylindrical container it will not work despite the availability of power supply. That is, if you are away for some days and water finishes from the cylindrical container the machine will stop, leading to loss of lives of fishes and waste of feeds. Fishes are cold blooded animals, but do not eat soaked feed, his design was prone to splashing water on feeds, which resulted in feed waste. Another major problem was the problem of electro-circuit, which could be at great risk to the fishes and conclusively the timing frequency adjustment was not so easy [4]. Not long after another device was invented in the year 1987 by Pitch Ford Jr. He invented an automatic timed feeder as well as pet feeder. The desired objectives were met, with characteristics not too far from previous designs [8]. September 29$^{th,}$ 1992 saw another invention to the development of an automatic fish feeding mechanism, designed and constructed by Momont et al. All objective of the invention were met, but with fewer limitations compared to previous designs. His design was achieved with rotatable mechanical wheels for movement, and as well had complex casing. As age grew with time, several inventions were proposed, designed and accomplished by different inventors, such as: An automatic fish feeder, designed and constructed by Beck in the year September 1$^{st,}$ 1998.Not long after, February 23$^{rd,}$ 1999, David et al constructed his, with similar characteristics as previous designs except for few differences [11].

The late 1990s saw another round of improvements to the design of an automatic fish feeder device designed by Gerald R. Davet and Jean-Paul Davet. The system contains an electrical timing circuit responsible for periodical distribution of food into a hopper to the aquarium. The distribution is accomplished by an electrical motor driving a gear box, the output of the gear box driving a cylinder that has a rough surface. The cylinder in cooperation with a pair of baffles sends a predetermined amount of food into the aquarium or pond during the feeding time interval. The major aim of the design was to reduce food loss due to moisture buildup in the food delivery system. His invention was very useful and effective, but was not much different from the principle surrounding all previous mechanical designs of automatic fish feeder ever constructed [6]. It comprises of an external built fan (big) which could be harmful to the users. Since then, man began looking for way to construct an electrically built automatic fish feeder, rather than big mounted mechanical motor designs. Generally, most previous inventions of automatic fish feeders (as far back 1960) required an external water clock for timing. The water clock was designed in such a way that it would be unharmed by sunlight so it could be used to track time on cloudy days or throughout the night. The water clock were designed in formats of pot liked made of stones, with long slating sides that allowed water to drip down at a constant rate through a small hole in the bottom beneath it. Other versions were bowl or cylindrical shaped containers designed to slowly fill with water coming in at a constant rate. The principles behind some of the water clock were in a way different from other types used in certain inventions, because some were dependent on the amount of water it can retain. After invention of such feeders, the desired objectives were met, it was good, but had limitations. Feeders fabricated with water clock are not precise, because the rate of flow of water is difficult to accurately control, but they are friendly machines because they are not dependent on battery or electric power source. The look and efficiency of the water clock was improved by a Greek physicist and inventor, Ctesibius of Alexandria [9].

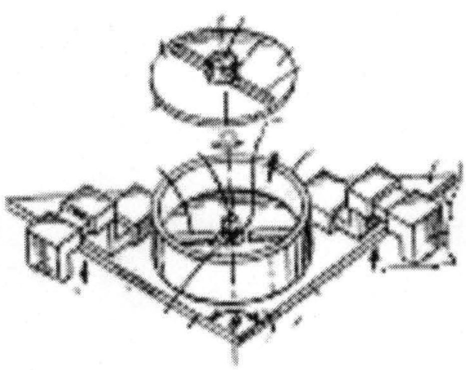
As at far back till date, man has relentlessly not given up. Several inventions have been forwarded but all with big mechanical rotating motors, except for few which emerge in the late

1990s. July $4^{th}$, 2000 saw another round of invention, designed by Halfords Anthony Christopher. The aims and objectives of his design were met; with a better sense of modernization, and a sense of interaction. But one major problem encountered with his design was the opening of the feed hopper, which results to feed waste. A better and most recent one was forwarded in July 2010. It uses a stepper motor. The main aim and objective was to construct an automatic fish feeding device that dispenses the right proportion of feed at different timing. The aims and objectives were achieved with a simple mechanical built structure, a microcontroller, sensor, led, robotic Motors, bifilar motors, multiphase motors and other sophisticated materials e.t.c. An image of a modern Feeder is shown on plate 2.1.The desired objectives were met, with fewer limitations.

The design allows moisture to seep into the food hopper. This can cause clumping, resulting in the failure of the mechanism [5], was expensive, and could not be affordable by average Nigerians.

## 2.4 COMPARISON BETWEEN MODERN AND EARLY FISH FEEDER

Plate 2.1Modern Automatic fish feeder



Early Fish Feeder.Plate 2.2

It is the aim of the present invention to provide an automatic fish feeding device that automatically feeds fishes at a predetermined time interval which can be varied, easy to use, solves the problem of limited pellet distribution area, solves the problem of moisture content being spilt on the food hopper, and conclusively provide an interactive portable fish feeder device for Nigerians that would be less expensive, easy to maintain and would be independent of mechanical wheels as well as water clock. It will be designed by the use of a PIC micro controller, stepper motor (unipolar), LCD, resistors, transistors and capacitors e.t.c.

## 2.5 MODULES

### 2.51 Mechanical Structure

Without a house (case), there will not be safety. The mechanical structure is the housing of all the components and devices coupled. It is shaped in rectangular form, providing protection from water and other external barriers. It is made of good casing with good coating in other to avoid rust. All other units are coupled in this unit.

### 2.52 Stepper Motor Unit

A stepper motor is required to perform precise screw movements (In degrees). It allows for forward and backward movements. The design is aimed at using a unipolar stepper motor. unipolar stepping motors can be controlled using 6 wires and are usually wired with a centre Tap on each of two windings. The centre taps of the windings are typically wired to the positive supply and the two ends of each winding are alternatively grounded to reverse the direction of the field provided by that winding. [7]

## 2.53 Microcontroller Section

Microcontroller is a computer-on-a-chip optimized to control electronic devices. It is designed specifically for specific tasks such as controlling a specific system, in contrast to a general-purpose microprocessor, the kind used in computers [10]. To achieve the design, the PIC microcontroller would be used. PIC is a family of Harvard architecture microcontrollers made by microchip technology. PIC microcontroller is the architecture behind the whole program, surrounding the timing of dispense of food.

## 2.54 Timing Interval Selection Switch

The timing interval selection unit is one of the major units of the design, because without the timing unit, the device would just be a normal device. It is responsible for the ease of variation in time for the release of feed by use of buttons. The state of the switch is noted by the program burned in the PIC. The major aim of the unit is to make things easier, because you can change the time interval from the switch buttons instead of writing a new program. All you need to do is to set a range of time while programming the PIC chip. i.e. The switch acts as an input to the microcontroller this allows for adjustable timing for the release of feed.

## 2.55 Power supply unit

Without power, there system will not function. The Power supply unit is responsible for the supply of power to the various part of the housed device for the effect of functionality. The power supply unit is an ac (Alternating current) entity. The design uses an ac supply because it is more efficient, longer life span and better to use, when it comes to the use of a stepper motor. The design could handle low voltage, medium and as well as high voltages.

# CHAPTER THREE

## 3.1 DESIGN AND IMPLEMENTATION

The design and construction of an automatic fish feeding device is based on the modules that are represented in the block diagram shown in Figure 3.1 below:

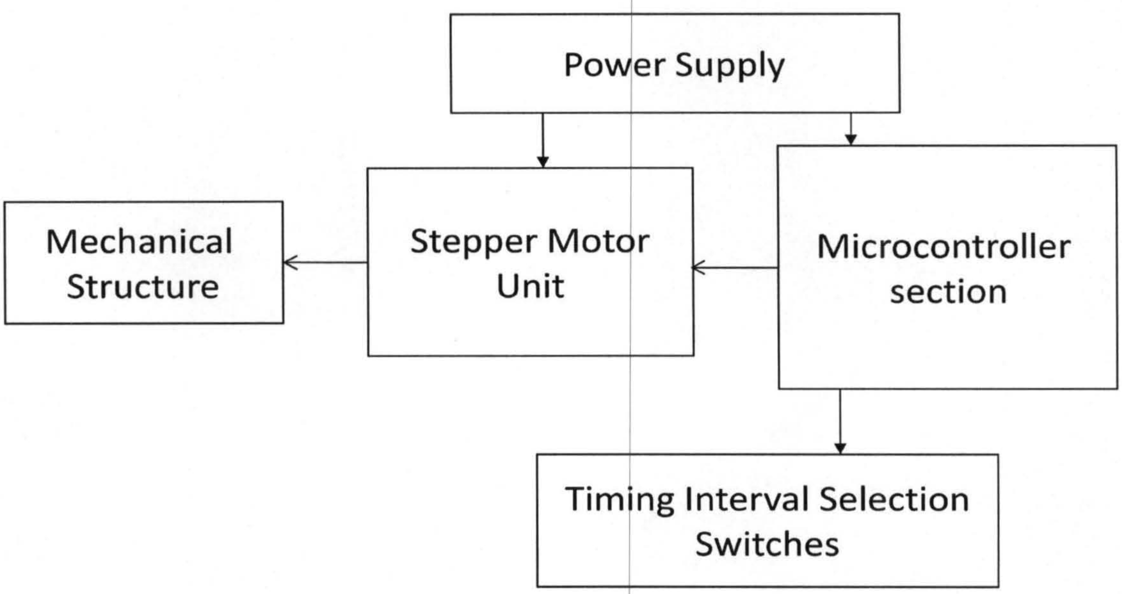



Fig 3.1: Block diagram of an automatic fish feeder

The Automatic fish feeder device comprises of the several modules, thus broken down below.

1. Power Supply Unit
2. Mechanical Unit
3. Stepper Motor Unit
4. Microcontroller Unit
5. Timing Interval Selection Unit

## 3.2 POWER SUPPLY UNIT

Most electronic device and circuit depends on DC power for their operation. Today it is possible to make this power available using dry cell (battery). However as the power required becomes large especially for large items and equipment, dry cells become inadequate. It then becomes necessary to derive the DC power from an AC mains source through a process known as rectification [13]. The block diagram below is a typical D.C power supply system and it incorporates the transformer, rectifier, filter, and regulator.

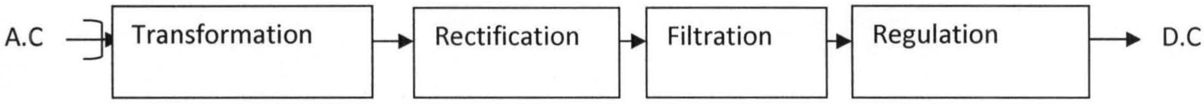



Fig: 3.2 Rectified Power Supply

### 3.2.1 TRANSFORMATION SECTION

A transformer is a static or stationary electrical device by means of which electrical power in one circuit is transformed into electrical power of the same frequency in another circuit through the principle of electromagnetic induction. It however can raise or lower the voltage in a circuit but with a corresponding decrease or increase in current (i.e carried out by the use of a step down or step up transformer) [12].

A transformer is a device that has no moving parts. It basically has two winding of coils/inductors that are magnetically linked, but they have no electrical connection with one another [12]. The primary coil (i.e. first inductor) converts A.C voltage from the power supply (PHCN) to an alternating magnetic field. This supplied voltage is the 240V. This alternating magnetic field hence induces a voltage in the near inductor (i.e. secondary coil) which then causes current to flow in the secondary circuit through the connected loads. This voltage is now the 12V. This phenomenon is known as mutual inductance or transformation or transformer action or transformation. [13].

In practice a transformer always have a finite winding which cause the efficiency to be less than 100% for a sinusoidal input voltage. The flux, Φ varies alternately i.e. $\Phi = \Phi max \times \sin wt$ and the instantaneous voltage in primary is stated in relation to FARADAY'S LAW, which is thus written below as:

$$E = -\frac{d\Phi}{dt} = \omega N \Phi_{max} \times \cos(wt)$$

$$= 2\pi f N \Phi_{max} \times \cos(wt)$$

Where $\omega = 2\pi f$ and $\pi = 3.142$ or $\frac{22}{7}$

The R.M.S value of E is given as:

$$E\ (rms) = \frac{2 \times 3.142 \times F \times N \times \Phi max}{\sqrt{2}} \times 1.11$$

$$= 4.44 FN\Phi max$$

However since the primary and secondary coils have the same flux. The ratio of the secondary voltage and current can thus be derived from the expression:

$$\frac{V2}{V1} = \frac{E2}{E1} = \frac{4.44 \times F \times N2 \times \Phi max}{1.44 \times F \times N1 \times \Phi max}$$

$$\frac{V2}{V1} = \frac{N2}{N1} = K \quad (1)$$

N2 > N1 for a step up transformer => K > 1

N2< N1 for a step down transformer => K < 1

Also for an ideal transformer;

Input VA = output VA or $P_p = P_s$

$I_pV_p = V_sIs$ or $I_s/Ip = V_p/V_s = 1/K$

$$I_s/I_p=V_p/V_s=1/K \quad (2)$$

Transformer power output are usually rated in KVA, where KVA is the apparent power i.e.

K = voltage transformation ratio.

V1 = Primary input voltage

V2 = Secondary output voltage

N1 = Number of primary turns

N2 = Number of secondary turns

PA = apparent power

$V_s$ = secondary voltage

$I_s$ = maximum load current

$$I_s=PA/V_s \quad (3)$$

Exceeding the transformer ratings usually could cause overheating and eventually burnings of the windings.

### 3.2.2 RECTIFICATION

Rectification is the process of conversion from A.C (alternating current) to D.C (direct current) voltage through the use of a rectifier. A rectifier is an electronics device that offers a low resistance to the flow of current in one direction known as the forward bias direction and high resistance to the flow of current in the reverse direction known as reverse bias.

A rectifier may be used to carry out half or full rectification depending on the application. This project is concerned with full wave bridge rectifier. The common type of such rectification makes use of four (4) discrete diodes of IN4001 arranged in a bridge network. They are connected as shown in Figure 3.2.

Diodes D1 and D2 conducts in alternate half cycle of the supply voltage as illustrated in Fig 3.2, while D3 and D4 conduct negative half cycle on alternation. However both conducting path deliver current to the load in the same direction [14].

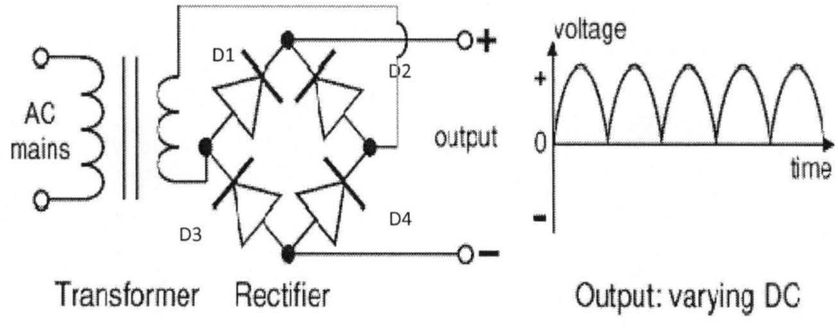



Fig 3.3: Circuit diagram of the Transformer and Rectification Section

### 3.2.3 FILTERING CAPACITOR

A filter capacitor is required to smoothen the pulsating D.C output voltage from the rectifier and produce a constant D.C voltage, because electronics circuits require only a constant source D.C voltage for power operation. The small amount of fluctuations in the filter output voltage is called ripple.

Capacitors are used as shorts to the A.C source, particularly one of very high frequency; hence capacitors would remove any A.C component still contained in the output voltage from the rectifier. The capacitor stores energy during the conduction process and delivers it to the load during the non-conducting period.

The filter capacitor must be large enough in order to store sufficient amount of energy to provide a steady supply of current to the load, otherwise the output will drop as the load continually demands more [14].

The energy stored in the capacitor can be solved in relation to the equation below; we equate the two formulas for the stored energy in a resonant circuit:

$$P = C\,V^2 / 2 \qquad (4)$$

$$P = L\,I^2 / 2$$

Where:

P- stored energy in walts or joules

C -- capacity, in farads

V -- voltage across capacitor, in volts

L -- inductance of motor winding, henrys

I -- current through motor winding

Solving for the minimum size of capacitor required to prevent overvoltage on the switch is fairly easy:

$C > L I^2 / (V_b - V_s)^2$

Where:

$V_b$—the breakdown voltage of the switch

$V_s$ -- the supply voltage

### 3.2.4 REGULATION

Unregulated power supply suffers from the drawbacks that their D.C output volt changes with change in load or input voltage. Regulated power supply can be obtained by using a voltage regulator circuit. A source of regulated D.C power is essential for all communication instruments, computers, or any other electronics system.

A regulator is an electronic control circuit which is capable of providing a nearly constant D.C output voltage even when there are variations in load or input voltage. The change in voltage from no-load to full-load condition is called voltage regulation [13].

The mathematical expression for the voltage regulator is thus illustrated below:

$$\% \text{ regulation} = \frac{Vmax - Vmin}{Vmax} \times 100 \qquad (5)$$

Where

$V_{max}$ = Maximum D.C output

$V_{min}$ = Minimum D.C output voltage [11].

A 7805 voltage regulator IC is chosen for this project which will give a fixed position of 5V D.C at the output. The fixed voltage regulator IC usually comes with three lead terminals (i.e. input, common and output voltage terminals respectively).

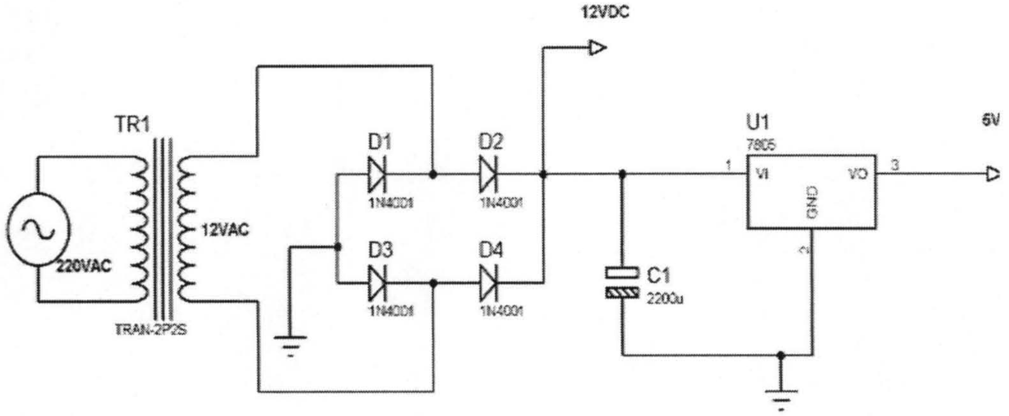



Fig 3.4: Complete circuit diagram of the Power Supply Unit

## 3.3 STEPPER MOTOR UNIT

The section of the stepper motor deals with the basic final stage rotation in degrees for stepping the device into motion. This circuitry is centered on a single issue, switching the current in each motor winding on and off, and controlling its direction. The circuitry discussed in this section is connected directly to the motor windings via the collector of the transistor used and the motor power supply. The circuitry is controlled by a digital system (Microcontroller) that determines when the switches are turned on or off at different times. Stepper motors are classified into several types, based on their design and functionality. The stepper motor used in carrying out this project is a unipolar stepper motor [15].

### 3.3.1 UNIPOLAR STEPPER MOTOR

Motors are of various types, and the use of the various types of motors depends on the nature or design of systems. Basically stepping motors come in two varieties, permanent magnet and variable reluctance. This project is constructed by the use of a unipolar stepping motor. Unipolar stepping motors comprises of the permanent magnet and the hybrid stepping motors with usually five (5) or six (6) wires. The motor usually have a centre tap on each of the two windings. The centre tap of the windings are wired to the power supply terminal. The motor cross section is of 30 degree per step permanent magnet or hybrid motor. The figure bellows shows a rough schematic of the connection and cross section of a unipolar stepper motor [16].

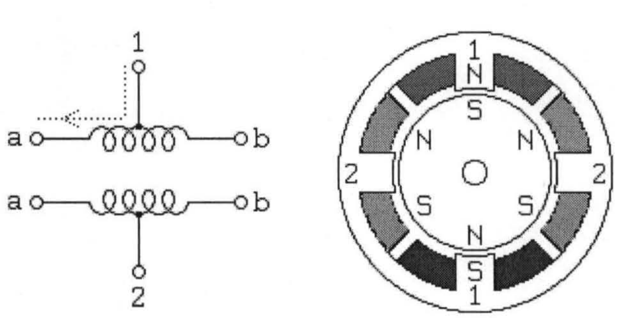



Fig 3.5: Configuration of a unipolar stepper motor

## 3.4 TIME INTERVAL SELECTION UNIT

The time interval selection unit is of very great importance to the design and construction of an automatic fish feeder. This unit can be implemented in various ways; such as by switches, use of variable resistors and digital buttons e.t.c.

Switches are very good, useful and effective when it comes to design. The global world is beginning to make use of switches for implementation, because it makes design to be simple, beautiful and gives it more meaning. Despite the fact it is good, it has some difficulties; such as longer implementation, complexity and more expensive. With all these facts, it is thus necessary to use a variable resistor in place of switches in other to design a cost effective fish feeder.

### 3.4.1 VARIABLE RESISTOR

Variable resistors are very useful and important components in the design of electronic devices. They are used as panel controls or internal adjustments in circuit, often called potentiometer. They are most commonly available in ceramics or plastic resistance elements, with improved characteristics. There are several types of variable resistors. For the design and construction of an automatic fish feeder, it is most appropriate to use resistors with more turns such as a POT-LIN potentiometer with linear track. The figure below shows an example of a POT variable resistor.

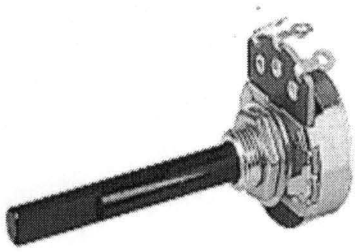


Fig. 3.6 POT-LIN variable resistor

## 3.5 MICROCONTROLLER (PIC 16F876A)

The PIC 16F876A belongs to the mid range family of the PIC microcontroller devices. The program memory contains words, which translate to 8192 of single instructions. This device are available only in 28-pin packages, which also have a program memory byte of 14.3k, Data SRAM bytes of 368, EEPROM bytes of 256, 2 comparators [16] e.t.c.

There are also 33I/O pins that are user configured on a pin-to-pin basis. Some pins are multiplexed with other device functions, such as:

i. External interrupt
ii. Change on PORT B interrupt
iii. Timer 0 clock input

Table 3.1: PIC 16F876A Pin out Description [16]

| NAME | TYPE | NUMBER(PIN) | DESCRITION |
|---|---|---|---|
| MCLR/VPP/THV | INPUT | 1 | Master clear(input) or programming voltage |
| OSC1/CLKIN | INPUT | 9 | Oscillator crystal or external clock input |
| OSC2/CLKOUT | OUTPUT | 10 | Oscillator crystal or external clock output |
| RA0/AN0 | I/O | 2 | RA0:Digital I/O<br>AN0:Analog input 0 |
| RA1/AN1 | I/O | 3 | RA1:Digital I/O<br>AN1:Analog input 1 |
| RA2/AN2/VREF-/CVREF | I/O | 4 | RA2:Digital I/O<br>AN2:Analog input 2<br>VREF-:A/D reference voltage<br>CVREF: Comparator |
| RA3/AN3/VREF+ | I/O | 5 | RA3:Digital I/O |

| | | | |
|---|---|---|---|
| | | | AN3:Analog input 3<br>VREF+:A/D,reference voltage |
| RA4/TOCKI/C1OUT | I/O | 6 | RA4:Digital I/O<br>TOCKI:Timer0 external clock input |
| RA5/AN4/SS/C2OUT | I/O | 7 | |
| RBO/INT | I/O | 21 | RBO: Digital I/O<br>INT: Interrupts |
| RB1 | I/O | 22 | Digital I/O |
| RB2 | I/O | 23 | Digital I/O |
| RB3/PGM | I/O | 24 | Digital I/O & ICSP programming pin |
| RB4 | I/O | 25 | Digital I/O |
| RB5 | I/O | 26 | Digital I/O |
| RB6/PGC | I/O | 27 | In circuit debugger & ISCP program clock |
| RB7/PGD | I/O | 28 | In circuit debugger & ISCP program data |
| RC0/T1OSO/T1CKI | I/O | 11 | T1OSO: Timer 1 oscillator output,T1CKI:Timer 1 external clock input |
| RC1/T1OSI/CCP2 | I/O | 12 | T1OSI:Timer 1 oscillator |

| | | | |
|---|---|---|---|
| | | | input, CCP2:Capture 2 input |
| RC2/CCP1 | I/O | 13 | Capture 1 input |
| RC3/SCK/SCL | I/O | 14 | Synchronous serial clk I/O for SPI & $I^2C$ |
| RC4/SDI/SDA | I/O | 15 | SPI data IN & $I^2C$ data OUT |
| RC5/SDO | I/O | 16 | SPI data OUT |
| RC6/TX/CK | I/O | 17 | USART asynchronous transmit & USART synchronous clock |
| RC7/RX/DT | I/O | 18 | USART asynchronous receive & USART synchronous data |
| VSS | I/O | 20 | Ground reference for logic & I/O pins |
| VDD | I/O | 19 | Positive supply for logic & I/O pins |

## 3.6 LIQUID CRYSTAL DISPLAY (LCD)

A display means an opto-electronic device that can show a number ("numeric display"), a hexadecimal digit, namely 0 – 9 and A – F ("hexadecimal display") or any letter or number ("alphanumeric display"). The dominant display technologies today are LEDs and LCDs. However LCD being the newer technology, with significant advantages for:

i. Battery operated equipment, owing to its very low power dissipation
ii. Equipment for use in high custom shapes and symbols
iii. Displays with many digits or character

The design and construction of an automatic fish feeder would be based on the use of an LCD due to the above listed advantages [17]. The type of LCD used is the 2 x 16LCD.

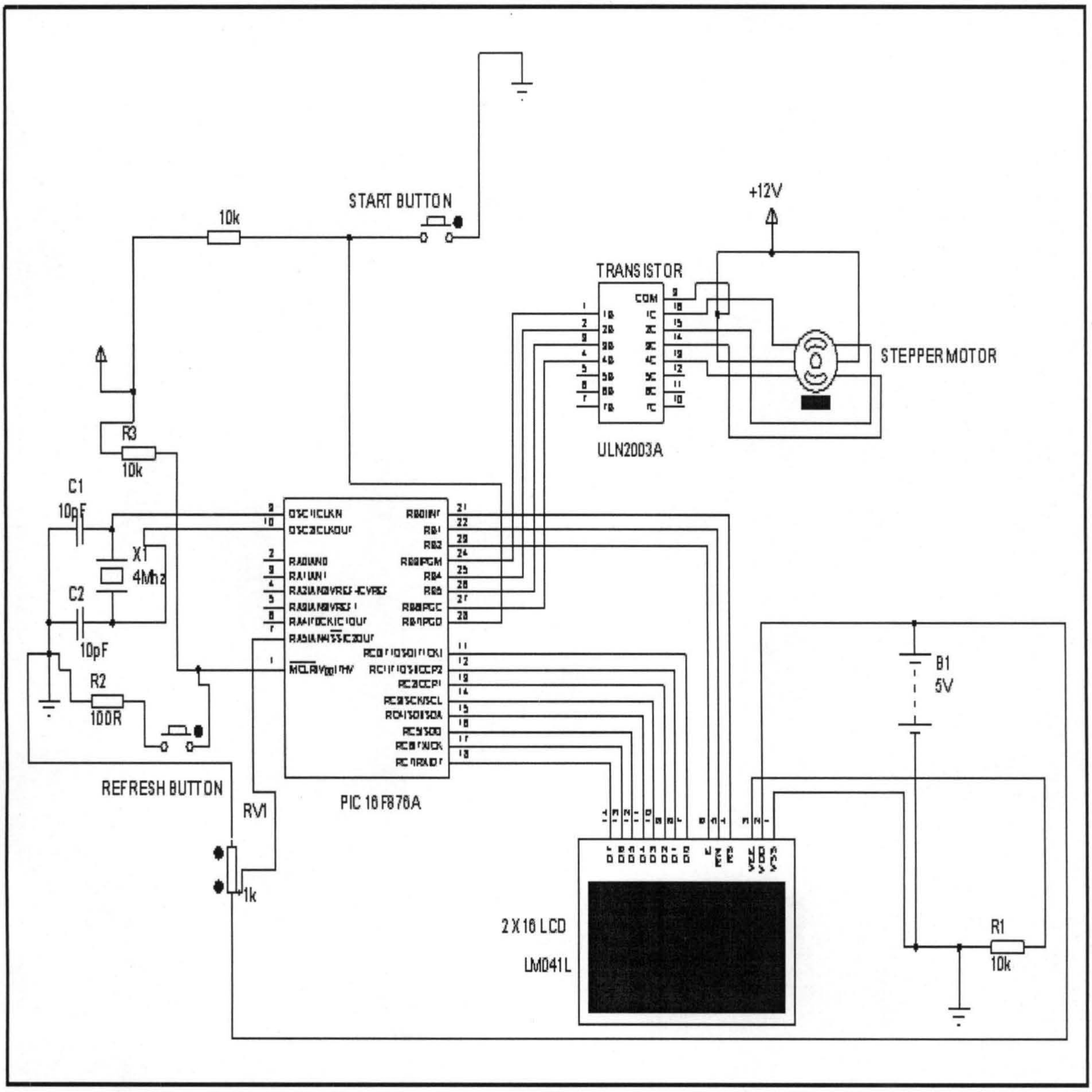



Fig 3.7: Complete Circuit Diagram of an Automatic Fish Feeder

# CHAPTER FOUR

## 4.1 CONSTRUCTION

In this chapter, we are mostly concerned with the construction and testing of the device. After designing the various modules illustrated in the previous chapter, they were assembled on a project board (bread board). After the assembling, the various modules were tested using a 12V DC supply.

## 4.2 TESTING

After construction of each module of the device, it was tested using the steps listed below;

Step 1: To ensure that all the components to be used are functionally operating, they were first tested with a digital multimeter and failed ones replaced before finally soldering them on the veroboard.

Step 2: Immediately after soldering a specific module, the circuit was tested using a digital multimeter, to ensure that there was no leakage at any point along the path.

## 4.3 DISCUSSION OF RESULT

The main reason for testing all the components before usage was to ensure that all the components are in good working condition before soldering. Continuity test was carried out and discovered that the circuit was in perfect working condition.

Simulation of complete circuit of an automatic fish feeder was carried out and result obtained was compared with that obtained from the design itself. The two were slightly different with little discrepancy in values.

## 4.4 PROBLEMS ENCOUNTERED

Few difficulties were encountered while implementing. They include;

i. Unavailability of needed components within minna metropolis. Some could be found in other cities and a few replaced with most convenient and suitable alternative. This result in increase in cost of production.
ii. Needed information was not so easy to find.
iii. Programming of the PIC microcontroller was not so easy, had slight and sensitive problems which I was finally able to debug by assistance from few lecturers
iv. Skill had to be acquired on the job, because it has never being done in Federal University of Technology Minna. This was very advantageous on one hand but hampered the speed of the work
v. Casing of the work took more time than envisaged.

## 4.5 TROUBLESHOOTING

Design and implementation was neat and straight forward to ensure easy and faster means of debugging faults. Such as;

i. If A.C power does not come on, first check the power plug and the rectifier circuit, to verify if there is any fault.

ii. If after powering and there is no proper rotation of stepper motor, first check the four wires of the motor to check if there is leakage. After which you check the two power terminal wires for proper continuity to voltage source.

iii. When the desired time interval fails to display on the LCD. Check the wire connections to check if there is leakage along transmission path.

iv. Always ensure that the time interval selection switch (variable resistor) is handled properly, because it is sensitive.

## 4.6 MATERIALS USED IN THE DESIGN AND CONSTRUCTION

1. Bread board
2. Soldering iron
3. Conducting wire
4. Vero board
5. Wooden case
6. Transistors
7. Regulators
8. Isolator
9. LCD
10. Capacitors
11. Resistors
12. Cylindrical canister
13. PIC 16F876A
14. Unipolar Stepper motor
15. Transformer

16. 12v Load cell

17. Four water pipe tubes

# CHAPTER FIVE

## 5.1 RECOMMENDATIONS

I recommend that a more efficient and reliable motor be used such as a servo motor or any robotic motor. This is to ensure adequate, reliable and efficient rotation. Also a better case should be used to avoid rusting and feed waste, wooden material or a well coated metal plate are recommended. I would also like to recommend that a backup plan should be implemented, to help in situations of power outages.

## 5.2 CONCLUSION

The automatic fish feeder was constructed and the results were obtained with minimal deviations from expectations. The device was realized and performed the desired goals. It delivers fish feeds at specified intervals of time as set by the user, not so expensive, efficient, reliable and eliminates feed wastage.

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# APPENDIX A

## MANUAL FOR THE OPERATION OF THE DEVICE

1. Plug the device to power source
2. Switch on the reset switch
3. Adjust the variable resistor (Time Switch) to the desired time
4. Press the start button
5. The device is now set to work

# APPENDIX B

## PROGRAM IMPLEMENTATION

Define CONF_WORD = 0x3f32

Define CLOCK_FREQUENCY = 4

PORTC = 0

TRISC = 0x00 ‘corresponding data direction register

Dim delay As Byte

TRISB = %1000000 'port b low

Dim counter As Word

Dim reg As Byte

Define ADC_CLOCK = 3 'default value is 3, so not so important to specify (Determines d source 4 ADC clock source)

Define ADC_SAMPLEUS = 20 'default value is 20,likewise this.it sets the desired ADC acquisition time in microseconds (0-255).

Dim an0 As Word 'ADC declaration (ADCIN=ADC Samplues,clock)

Dim an4 As Word

ADCON1 = 0 'ADC

TRISB = %10000000 'make portb output

PORTB = %00000000 'wat it shuld hold

Dim value As Word

Define LCD_LINES = 4

Define LCD_CHARS = 16

Define LCD_BITS = 8 'allowed values are 4 and 8 - the number of data interface lines(Default=4.starting 4mat)

Define LCD_DREG = PORTC 'defines the port where data lines are connected to,default is portB

```
'0 or 4 for 4-bit interface, ignored for 8-bit interface (LCD_DBIT)

Define LCD_RSREG = PORTB  'not necessary cos default is portB

Define LCD_RSBIT = 0  'defines d pin where RS is connected to(default is port3)

Define LCD_EREG = PORTB  'defines d port where E line is connected to,no need cos default is PortB

Define LCD_EBIT = 2  'defines d pin where E is connected to,default is 2

Define LCD_RWREG = PORTB  'set to 0 if not used, 0 is default

Define LCD_RWBIT = 1  'set to 0 if not used, 0 is default

Define LCD_COMMANDUS = 5000  'defines d delay after LCDCMDOUT, default value is 5000

Define LCD_DATAUS = 100  'delay after LCDOUT statement, default value is 100

Define LCD_INITMS = 100  'delay used by LCDINIT, default value is 100(placed b4 any LCDCMDOUT,LCDOUT statement

'the last three Define directives set the values suitable for simulation; they should be omitted for a real device

Dim timval As Word

Dim val As Word

Lcdinit 1  'initialize LCD module; cursor is blinking

        WaitMs 1000

stat:  'loop

startmsg:

        Lcdcmdout LcdClear

        Lcdout "AUTOMATIC"

        Lcdcmdout LcdLine2Home  'set cursor at the beginning of line 2

        Lcdout "FISH FEEDER"  'formatted text for line 2,dint proceed to nxt 4rm here,cos of the time.{Assumes analog input)

wait:
```

```
            Adcin 4, an4  'conversion 4rm analog to digital, nd using d digital value.Base its
argumnt dat d corespndng pin is conf as analog input

            timval = an4

            Gosub display

            WaitMs 100

            timval = 1

If PORTB.7 = 1 Then Goto wait

check:

    Gosub timedelay

For counter = 1 To 7  'stepper motor turns per phase

delay = 100  'delay will begin at 100 ms

WaitMs 500

forward:

PORTB.3 = 1  'turn on Q1

WaitMs delay  'wait for delay ms

PORTB.3 = 0  'turn off Q1

PORTB.4 = 1  'turn on Q2

WaitMs delay  'wait for delay ms

PORTB.4 = 0  'turn off Q2

PORTB.5 = 1  'turn on Q3

WaitMs delay  'wait for delay ms

PORTB.5 = 0  'turn off Q3

PORTB.6 = 1  'turn on Q4

WaitMs delay  'wait for delay ms

PORTB.6 = 0  'turn off Q4
```

```
Next counter
Goto check
End
display:
            Lcdcmdout LcdLine3Home  'set cursor at the beginning of line 2
            Lcdout "BY JOSEPH IBRAX"  'formatted text for line 2
            Lcdcmdout LcdLine4Home  'set cursor at the beginning of line 2
            Lcdout "TIMING: " #timval, "minutes"  'formatted text for line 2
Return
timedelay:
      'create 1 munites delay
      For val = 1 To timval  'timeval carrys much adjustment of time
            WaitMs 6000  'Delay 4 stepper motor rotation
      Next val
Return
readanalog:
      Adcin 4, an4
Return
```