DESIGN AND CONSTRUCTION OF FINGERLING COUNTING DEVICE

BY

SALIHU MOHAMMED

2007/2/26397EE

A THESIS SUBMITED TO THE DEPARTMENT OF ELECTRICAL/ELECTRONIC ENGINEERING,IN PARTIAL FULFILMENT OF THE REQUIREMENT FOR THE AWARD OF B.ENG. IN ELECTRICAL/ELECTRONICS ENGINEERING, FEDERAL UNIVERSITY OF TECHNOLOGY MINNA, NIGER STATE

NOVEMBER, 2011.

DEDICATION

This project is dedicated to my late father Alhaji Salihu Raji, my mother, my brothers and sisters.

DECLARATION

I, SALIHU MOHAMMED, declare that this work was done by me and has never been presented elsewhere for the award of a degree. I relinguish the copyright to the federal University of Technology. Mnna.

SALIHU MOHAMMED

(Name of Student)

....

(Signature and Date)

ENGR. O .D. AHMED.

(Name of Supervisor)

....

(Signature and Date)

ENGR. A .G. RAJI

(Name of H.O.D)

....

(Signature and Date)

(Name of external supervisor)

....

(Signature and Date)

ACKNOWLEGMENT

For this project, I have enormous appreciation to all who have in one way or the other contributed toward the success of my education carrier and making this report a reality. My thanks go firstly to the Almighty Allah (SWT) for the strength, protection and guidance bestowed on me.

I wish to express my profound gratitude to the following people, my entire family most especially my mother (Mrs. Silifat Salihu), Mr. Salihu ABdulwaheed, Mr. Badamasi Shehu, Mr. Salihu Gambo, Mr. Salihu Musbaudeen, Mr. Abdulrazak Badamasi, Mr. Abdulmajeed, Mr. Abdullateef, Mrs. Fati Ibrahim and their families for the wonderful supports and encouragement.

I am also indebted to my supervisor Engr. O. D. Ahmed and Co-assessor Mr. Salihu Y. Danladi, for their steady and devoted encouragement throughout this project from the basis of my determination to go ahead with this design, and the entire staff of the department in one way or the other contributing to my success in the department, I wish all of them success in life.

Finally, I wish to thank my friends- Raphael Oniwaye, Godwin Onuh, Modamori Sunday and Oyedele Kazeem who stood by me.

ABSTRACT

Convenience is an important issue when fingerlings are being counted and transferred from one pond to another. This project is principally aimed at the design and construction of a microcontroller based digital fingerling counter. The device uses a laser beam light focused on a light dependent resistor (LDR) which is interfaced with microcontroller through a LM555 timer, working on the concept of line of sight, once the beam path is crossed, the microcontroller register a count. The LDR is placed along a channel where the fingerlings are to be passed and cross the beam. The channel is so design in a way that it can permit only one fingerling to pass at a time.

TABLE OF CONTENT

CHAPTER THREE

LIST OF FIGURES

LIST OF TABLE

CHAPTER ONE

1.0 Introduction

Our world today is fast taking to technology which has become a tool for the realization of strategic goals in achieving productivity. Electronics system therefore extends or supplements human facilities and abilities towards achieving their desired goals.

Fish farming is the branch of agricultural science that deals with the rearing or raising of fish commercially in tanks or enclosure usually for sales, production and managements [2]. The fish can be sold when they are at early stage or when they are matured. Fish farming is a relatively new industry in most countries, being from 20-50 years old, but has developed significantly in the last 20 years. It has being due to recent growth in aquaculture, also due to growing human population and diminishing supply of products caught from the wild [1]. Fish farming present many opportunities for development initiatives, it can be implemented with diverse aquatic resources and by the wide range of stakeholders. Until 10 years ago fish culture was intended centrally for home consumption and sales within local communities. It objectives range from food production, income generation, and wild stock enhancement to recreational use [2]. As the hatchery expand, fingerling farmer find it difficult to sell or transfer fingerlings from one pond to another, since error occurs when counting them manually. The design and construction of fingerling counting device is one of the effort of the electrical and electronics engineer in improving the efficiency and general output of fish farming. Focus of this project is to precisely count fingerlings when passing through a channel and thereby display their number.

1.1 Motivation

From the above stated reason in the introduction, when counting fingerlings manually errors always occur along the line, and this affects the output of the fingerling farmer. This also consumes a lot of time and affect the life span of the fingerlings. All these reason has prompted the design of this device in order to have precise count, save time and protected the life of the fingerlings.

1.2 Aims and objectives

The aim of this project is to provide a device that count the number of fingerlings being passing through a single channel. This help to achieve a fairly accurate count. Among the objectives of the projects are:-

1. To explore the used of digital electronics over manual or analogue counting.

2 . To avoid duplication of numbers when counting.

3. To stimulate student interest in the growing field of digital counter.

4. Thereby ensuring the fingerlings farmers are not short changed and reducing human engagement.

1.3 Scope of study

This project shall be limited to the design and construction of fingerlings counting device. Chapter one contains introduction, motivation, aims and objectives and the scope of study, methodology. Chapter two contains literature review, chapter three contains design and construction, chapter four contains testing and result, and finally chapter five contains conclusion and recommendation

1.4 Methodology

The design and construction of fingerlings counter was achieved by using LN555, a high precision timing chip that is control with external resistor and capacitor. LM555 was connected in neither monostable nor astable mode, it was connected against an light dependent resistor [LDR], to monitor the behavior of the LDR and to indicate when the LDR experience darkness .The microcontroller was used to monitor the output of LM555 and increment the count on a liquid crystal display [LCD] to indicate the movement of fingerlings, and it has capability to count from 1-10000000.

CHAPTER TWO

LITERATURE REVIEW

2.0 Theoretical Background

Long before electronics become common, mechanical device were used to count events. These typically consist of series of disk mounted on an axle, with the digit "O" through "9" marked on their edge. The right most moves are increment with each event. Each disk except the left most has a prostration that, after their completion of one revolution, moves the next disk to the left one increment. Such counter were originally used to manufacturing process, but were used later as odometer for bicycle and cars. It is also used in fuel dispenser [6].

In digital electronics, a counter is a device which store and sometimes display the number of times a particular event or process has occurred, often in relation to a clock signal. Counter can be implemented quite easily using register type circuits such as the flip-flop.In a counter, the sequence of state may follow a binary count or any other sequence of state. Counter are found in almost all equipments containing digital systems. Usually, counter circuits are digitally in nature, and count in natural binary [14].

In electronics flip-flop is a circuit that has two stable states and can be used to store state information. The circuit can be made to change state by signal applied to one or more control inputs and would have one or more outputs. A circuit incorporating flip-flops has the attribute of states; its output depends not only on its current inputs but also on it's previous inputs. Such a circuit is described as a sequential logic, where a single input is provided, the circuit changes state every time a flip-flop retain the state after the signal pulse are removed, one type of flip-flop circuit is also called latch. Other types of flip-flop may have inputs that set a particular state, set the opposite state or change state; depending on which inputs is pulsed. Flip-flop are used as data storage for counting of pulses, also used for synchronizing randomly-timed input signal to some reference timing signal [14].

Flip-flop is fundamental building blocks of digital electronics system used in computers, communications; and many other types of systems.

Types of Digital Counters;

i. Decade counter

ii. Up-down counter

iii. Johnson counter

(i) **Decade Counter** :- Decade counter is a kind of counter that count in tens rather than having a binary representation. Each output will go high in turn, starting over after ten outputs have occurred (then all the flip-flop are cleared/reset). These types of circuits find application in multiplexers and demultiplexers or wherever a scanning [14].

(ii) **Up - Down Counter: -** It is a combination of up-counter and down counter counting in straight binary sequences. There is an up-down selector. If this value is kept high, counter increments binary value and if the value is low, the counter starts decrementing the count. The down counters are made by using the complemented inputs to act as a clock for the next flip-flop in the case of Asynchronous counter. An up counter is constructed by linking the Q out of the J-K flip-flop and putting it into a negative edge triggered clock inputs [14].

(iii) **Johnson Counter: -** A Johnson counter is a special case of shift register where the output from the past stage is inverted and feedback as input to the first stage. A pattern of bits equal in length to the shift register thus circulates in indefinitely. These counters are sometimes called **"walking ring"** counters and find specialist application including those singular to the decade counter, digital to analogue conversion [14].

2.1 History of Counting Systems and Numerals

Soon after language develops, it is safe to assume that humans begin counting and that finger and thumb provide nature of abacus .The decimal system is no accident. Ten has been the basis of most counting systems in history. When any sort of record is needed, notches in a stick or a stone are the natural solution. In the earliest surviving traces of a counting system, numbers are built up with a repeated sign for each group of 10 followed by another repeated sign for 1 [14].

2.1.1 Egyptian Numbers: 3000-16000 BC

In Egypt, from about 3000BC, record survive in which 1 is represent by a vertical line and 10 is shown as "^". The Egyptian write from right to left, so the number 23 becomes "III^^". If that look hard to read as 23, glance for comparison at the name of famous figure of our own century-Pope John XXIII. This is essentially the Egyptian system, adapted by Rome and still in occasional use more that 5000 years after its first appearance in human records. The scribes of the Egyptian pharaohs (whose possession are not easily counted) use the system for some very large number [15].

2.1.2 Babylonian Number: 1750 BC

The Babylonians uses a numerical system with 60 as its base. This is extremely unwieldy, since it should be logically required a different sign for every number up to 50 (just as the decimal system does for every number up to 9). Instead, numbers below 60 are expressed in clusters of ten- making the written figure awkward for any arithmetical computation. Through the Babylonian pre-eminence in astronomy, their base of 60 survives even today in the 60 second and minutes of angular measurement, in the 180 degree of a triangle and in the 360 degrees of a circle. Much later, when time can be accurately measured, the same system is adopted for the subdivision of an hour. The Babylonians take one crucial step towards a more effective numerical system. They introduce the place value concept, by which the some digit has a different value according to its place in the sequence. We now take for granted the strange fact that in the number 222 the digit '2' means three quite different things -200, 20, 2- but this idea is new and bold in Babylon. For the Babylonians, with their base of 60, the system is harder to use. For them a number as simple as 222 is the equivalent of 8322 in our system (2 x 60 squared + 2x 60 +2). The place-value system necessarily involves a sign meaning "empty", for occasions where the total in a Column amounts to an exact multiple of 60. If this gap is not kept, all the digits before it will appear to be in the wrong column and will be reduced in the value by a factor of 60 [15].

2.1.3 The Abacus: 1st Millennium BC

In practical arithmetic the merchants have been far ahead of the scribes, for the idea of zero is in use in the market place long before its adoption in written systems. It is an essential element in humanity's most basic counting machine, the Abacus. This method of calculation originally simple furrows drawn on the ground, in which pebbles can be placed, is believed to have been used by Babylonians and Phoenicians from perhaps as early as 1000BC. In a later and more convenient form, still seen in m any parts of the world today, the abacus consist of a frame in which the pebbles are kept in clear rows by being threaded on rods. Zero is represented by any row with no pebbles at the active end of the rod [15].

2.1.4 Roman Numerals: From the 3rd Century BC.

The competed decimal system is so effective that it becomes, eventually, the first example of a fully international method of communication. But its progress towards this dominance is slow. For more than a millennium the numerals most commonly used in Europe are those evolved in Rome from about the 3rd century BC. They remain the standard system throughout the Middle Ages, reinforced by Rome's continuing position at the centre of western civilization and by the use of Latin as the scholarly and legal language [15].

2.1.5 Binary Numbers: 20^{th} Century AD

Our own century has introduced another international language, which most of us use but few are aware of. This is the binary language of computer. When interpreting coded material by means of electricity and complexity merely complicates. So the simplest possible counting system is best, and this means one with lowest possible base – 2 rather than 10. Instead of zero and 9 digits in the decimal system, the binary system only has zero and one. So the binary equivalent of 1, 2, 3, 4, 5, 6, 7, 8, 9, and 10 is 1, 10, 11, 100, 101, 111, 1000.1001, and1010 and so ad infinitum [15].

2.1.6 Past method of counting fingerlings.

Agriculture ponds have been described as a black box. After a pond is stocked the inventory of fingerlings in the pond is unknown until the pond is harvested and drained [1]. Producers often discover that there were fewer fingerlings in the pond than they had thought. This phenomenon of "disappearing fingerlings" has been referred to as the black hole syndrome. Reason for the apparent disappearance of fingerlings includes the inaccurate stocking procedures, predation, cannibalism and undetected disease losses [1]. Regardless of the cause, inaccurate estimate of fingerlings inventory create management problem for fingerlings farmer. Inaccurate inventory estimates may lead to error in decision regarding feeding, harvesting and restocking of ponds. The consequences of these errors may lead to poor feed conversion, poor fingerlings growth and poor pond production rates. Counting of fingerlings through manual method evolved over the years. The different methods and practices from collection or counting of fingerlings are done mostly by trial and error [3]. Over the years, manual method is applied using bear hand to count fingerlings. The whole catches of fingerlings are brought out after capture and are placed in a white plastic basin. A small white bowl is used for counting. The counts are placed in an earthen jar or another plastics container. After counting manually 1000 fingerlings, the fingerlings farmer add 1-10% more to compensate for error in counting or otherwise. The number of fingerlings can also be estimated by water volume displacement or by weight counting with accurate scale [5].Fingerlings are counted each time they are transfer from one container to another and before and after sold. An actual head count is done with the aid of pebbles, shells or any suitable markers. One small pebbles or shells represent one fingerling, while a bigger one would represent one hundred (100) fingerlings [2].

The increasing production of fry of valuable species has motivated the faster and more accurate counting systems and as a result reliable automatic counters for fish fry are available in the market. They are based on a photocell that counts the fish passing in front of it. They are design to keep fry always in water, swimming along a mild water current to the counter where patented nozzle separate the fingerlings to minimize counting error. Their counting capacity is of about 30-35,000 fry/hour with a size range of 0.5-6g.Some method of automatic counting device can also be linked to an automatic grader, and the combinations permit a complete automatic selection process. The advantage of such equipment are fairly good accuracy (98-100) rapidly and reduced disturbance and damage to the fingerlings. The number of personnel required to operate the machine is also less than that required for the more traditional counting session. Their rather high cost can be justified when large amount of fingerlings have to be counted [4].

For long it has seen that all methods employed in counting fingerlings are not accurate enough and also time consuming which can easily result to error. Manual counting of fingerlings one by one, is not only time consuming and tedious, but also requires the necessary skills to transfer fingerlings without mechanical damage or error in counting. Although, automatic counting seen to be the solution for this particular problem, most of the equipment presently available does not fulfill the requirements. Indeed the particle counters based on resistivity detection, have not been design to recover the fingerlings after counting. There are some optical counters designs for dual purposes of counting and also recover the fingerlings [4].

The present methods of counting fingerlings involve filtration by mobile or stationary devices. The bottom topography of the fingerlings ground, wind direction, and tidal fluctuation are the most important consideration in the design and construction of fingerlings counting device. The devices use microcontroller counter to count the number of fingerlings and display it on liquid crystal display (LCD). The devices which can perform the function of counting accurately also cost effectively and reduce time consuming. The device uses light dependent resistor (LDR) to detect the movement of fingerlings through a channel. The diameter of the channel is slightly wider than the dimension of fingerlings to be counted in order to prevent two fingerlings passing through together at a time. The digital counter used has a preset button from 1-1000000.

CHAPTER THREE

3.0 DESIGN AND IMPLEMENTATION

In this chapter, the design of the various units of the system build up is presented; the design is also based on the availability and cost implication of components to be used for the realization of this project.

3. 1 System block diagram.

This shows the interconnectivity of the various units of the counting device, as shown in fig. 3.0

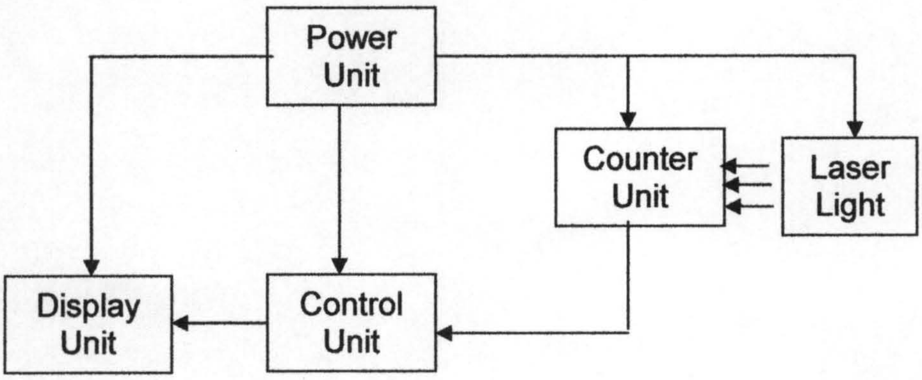

Fig. 3.0 Block diagram system

3.2.0 Power unit

The purpose of stabilize power supply is to keep the direct current (d.c) output constant despite the variation in the alternating current (a.c) supply voltage and d.c load current. A good power source for electronic circuit is battery, and indeed this is the only supply used for portable equipments. It required good knowledge to use the readily available and cheap a.c main supply and convert it to the required d.c, as it was employed in this project which is shown in fig.3.4. Consideration of the power supply as a unit comprises of series of blocks as shown in fig. 3.1

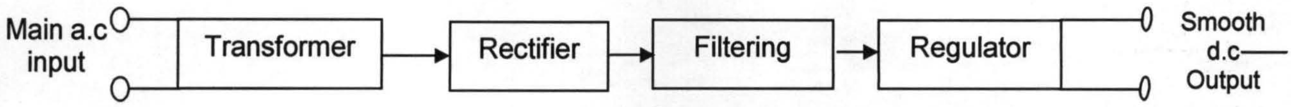

Fig. 3.1 Block diagram of stabilized power supply.

Most electronic devices and circuits require a DC source for their proper operation, and a typical regulator to fix the voltage and make it constant for the load. The power supply unit comprise of the following listed below:

- A step down transformer
- A bridge rectifier
- Filtering capacitors
- Voltage regulators

3.2.1 Step down transformer

A transformer is a device that transfers electrical energy from one circuit to another through inactivity coupled conductors. A varying current in the first or primary winding creates a varying magnetic flux in the transformer's core and thus a varying magnetic field through the secondary winding. This varying magnetic field induces a varying electromotive force (EMF) or voltage in the secondary winding, this effect is called mutual inductions.

If a load is connected to the secondary, an electric current will transferred from the primary circuit through the transformer to the load. In an ideal transformer, the induced voltage in the secondary winding (Vs) is in proportion to the primary winding (Vp), and is given by the ratio of the number of turns in the secondary (Ns) to the number of turns in the primary (Np) as follows [6].

$$\frac{Vs}{Vp} \equiv \frac{Ns}{Np}\text{..................(i)}$$

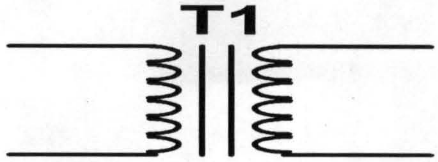

Fig 3.2 Transformer

3.2.2 Bridge rectifier.

In electronics, a diode is two terminal electronic components. A semiconductor diode is the most common type of diode today, is a crystalline piece of semiconductor material connected to two electrical terminals, a vacuum tube with two electrodes, a plate and a cathode. The most common function of a diode is to allow the flow of current in one direction (called the diodes forward direction), while blocking current in the opposite direction (the reverse direction). This unidirectional behavior is called rectification and is used to convert alternating current to direct current [12].

However, diodes can have more complicated behavior than the simple on-off action. Semiconductor diodes do not begin conducting electricity until a certain threshold voltage is present in the forward direction (a state in which the diodes is said to be forward biased). The voltage drop across a forward biased diode varies only a little with the current, and is function of temperature, this effect can be used as a temperature sensor or voltage reference.

Semiconductor diodes have non-linear electrical characteristics, which can be tailed by varying the construction of their P-N junction. These are exploited in special purpose diodes that perform many different functions. For example, diode are used to regulate voltage (zener diode), to protect circuits from high voltage surges (avalanche diode), to electronically tune ratio and TV receivers (varactor diodes), to generate ratio frequency oscillations (tunnel diode, gun diode, IMPATT diode), and to produce light emitting diode.

More so, a bridge rectifier was employed in this power supply which contains four diodes configure for a full bridge rectification to rectify the AC signal coming from the secondary side of the step down transformer to a DC signal [6].

3.2.3 Filtering capacitor

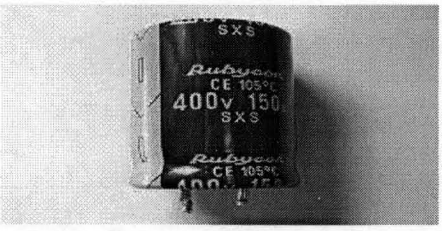

Fig 3.3 Capacitor

A capacitor (formally known as condenser) is a passive electronic component consisting of a pair of conductors separated by a dielectric (insulator), when there is a potential difference (voltage) across the conductors; a static electric field develops across the dielectric, causing positive charge to collect on one plate and negative change on the other plate. Energy is stored in the electrostatic field. An ideal capacitor is characterized by a single constant value, capacitance, measured in farads. This is the ratio of the electric charge on each conductor to the potential difference between them. [9]

Capacitors are widely used in electronic circuits for blocking direct current while allowing alternating current to pass, in filter networks for smoothing the output of power supplies in the resonant circuit diode that tune ratios to particular frequencies and for many other purposes.

The capacitance is greatest when there is a narrow separation between large areas of conductor; hence capacitor conductors are often called "plates" referring to an early means of construction. In practice the dielectric between the plates passes a small amount of leakage current and also has an electric field strength limit, resulting in a breakdown voltage, the conductors and leads intendance an undesired inductance and resistance.[6]

A capacitor consist of two conductors separated by a non-conductive region, the non-conductive region is called the dialectic or sometimes the dielectric medium in simpler terms, the dielectric is just an electrical insulator. Examples of dielectric mediums are glass, air, paper, vacuum and even a semiconductor depletion region chemically identical to the conductors. A capacitor is assumed to be self contained and isolated, with no net electric charge and no influence from any external electric field. These conductors hold equal and opposite charge on the facing surfaces and the dielectric develops an electric field. In SI units, a capacitance of one farad means that one coulomb of charge on each conductor causes a voltage of one volt across the device. The capacitor is a reasonably general model for electric fields within electric circuits. An ideal capacitor is wholly characterized by a constant capacitance C, $C = {}^{Q}/_{V}$ ... ...(ii)

Sometime charge build-up affects the capacitor mechanically, causing its capacitance to vary. In this case, capacitance is defined in terms of incremental charges.

$$C = \frac{dq}{dv} \quad \text{... ... ... (iii)}$$

An electrolytic capacitor of value 2200µF × 9V was employ to filter out the AC ripples.

3.2.4 Voltage regulator

A voltage regulator is an electrical regulator designed to automatically maintain design or may include negative feedback control loops. It may use an electromechanical mechanism or electronic components. Depending on the design, it could be used to regulate one or more AC or DC voltage.

Electronic voltage regulator is found in device such as computer power supplier where they stabilize the DC voltage used by the processor and other elements.

A 7805 voltage regulator was used to regulate it to another fixed 5V to power the microcontroller chip and the entire circuits [9].

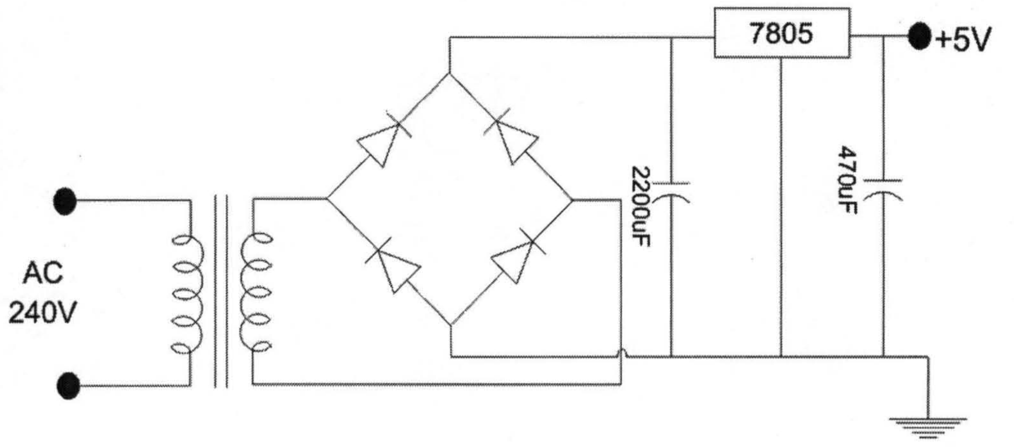

Fig 3.4 Power supply unit

3.3.0 Counter unit

This unit detects the fingerlings when passing through a provided channel and the circuit comprises of several components, such as: light dependent resistor, variable resistor, resistor, diode and the 555 timer Ic, as shown in fig. 3.5

3.3.1 The input component

The major input component in this circuit is a photo conductive device also known as the light dependent resistor (LDR). This device is basically a resistor whose resistance decreases with increasing incident light intensity. A photo resistor is made up of high resistance semi conductor, if light falling on the device has high enough frequency, the photons absorbed by the semi conductor gives valence bond election enough energy to jump into the conduction band. The resulting free election and hole pair partnership conducts electricity thereby lowering the resistance. [7].

3.3.2 Resistor

A resistor is a unit offering a certain definite electrical resistance. It is used in electronics to control the amount of current that flow in a particular part of a circuit, and to serve as circuit elements that limit the current to some desire value. The value of a resistor is known by a combination of color printed on them. The power dissipated by resistive circuit carrying electric current is in form of heat.

Ohm's law state that current flow in a circuit depend on the circuit resistance;

$$E = IR \dots\dots\dots\dots\dots\dots (iv)$$

$$R = \frac{E}{I} \dots\dots\dots\dots\dots\dots (v)$$

Where $I = current$

$E = potential\ difference$

$R = Resistor.$

3.3.3 Variable resistor

A resistor may have one or more fixed tapping points so that the resistance can be changed by moving the connecting wires to different terminals. When continuous adjustment of the resistance value during operation of equipment is required, the sliding resistance tap can be connected to knob accessible to an operator, such device is called a rheostat. A common element in electronics device is a three terminal resistor with continuously adjustable tapping points controlled by rotating of knob. These variable resistors are known as potentiometer when the entire three terminals are present, since they act as a continuously adjustable voltage divider. A common example is a volume control for a radio receiver.

3.3.4 Diode

Diode is a type of two terminal electronics components with a non-linear current-voltage characteristic. The most common function of diode is to allow an electric current to pass in one direction (forward direction), while blocking current in opposite direction (reverse direction). The unidirectional behavior is called rectification and used to convert a.c-d.c and to extract modulation from radio signal in radio receivers.

3.3.5 LM 555 timer

The 555 timer ICs is an integrated circuit (chip) used in a variety of timer, pulse generation and oscillator application. The full part number was NE555, which has been hypothesized that the 555 got its name from the three 5k resistor used within. It is used in this project to compare two inputs on its two pins i.e. 7 and 6/2, and gives output to microcontroller in order to process it. LM 555 timer has 3-mode of operation, which include;

- Astable
- Monostable.
- Bistable mode (Schmitt trigger). [10]

But in this project, it does not operate in any of the three modes, since the counter does not have a fixed time of counting.

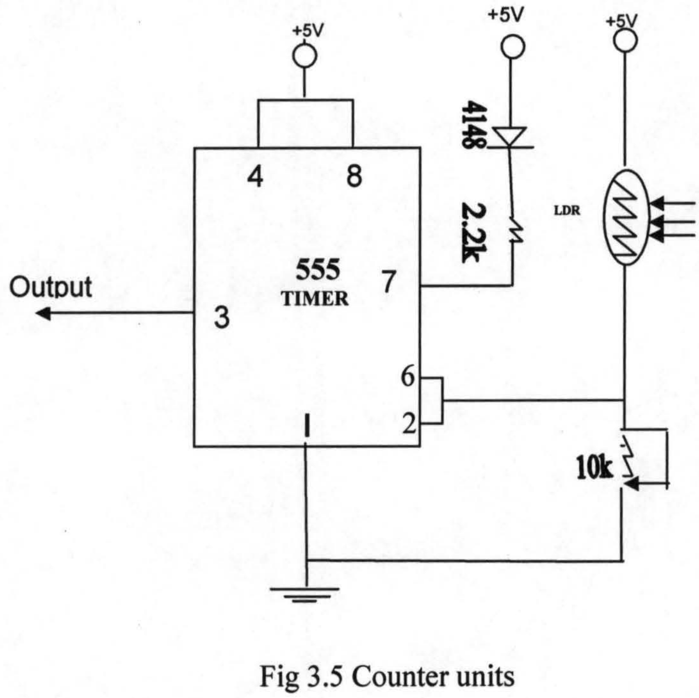

Fig 3.5 Counter units

3.4.0 Control unit

The control unit comprises primarily of an AT89S52 microcontroller (Hardware programmed), and then a clock source sub-unit which basically provides the clock pulse signal and a reset capacitor as shown in fig. 3.7

AT89S52: The AT89S52 is a low-power, high-performance CMOS 8-bit microcontroller with 8K bytes of in-system programmable Flash memory. The device is manufactured using Atmel's high-density nonvolatile memory technology and is compatible with the industry-standard 8051 instruction set and pin out. The on-chip Flash allows the program memory to be reprogrammed in-system or by a conventional nonvolatile memory programmer. By combining a versatile 8-bit CPU with in-system programmable Flash on a monolithic chip, the Atmel AT89S52 is a powerful microcontroller, which provides a highly flexible and cost-effective solution to many embedded control applications. The AT89S52 provides the following standard features: 8K bytes of Flash, 256 bytes of RAM, 32 I/O lines, Watchdog timer, two data pointers, three 16-bit timer/counters, a six-vector two-level interrupt architecture, a full duplex serial port, on-chip oscillator, and clock circuitry. In addition, the AT89S52 is designed with static logic for operation down to zero frequency and supports two software selectable power saving modes. The hardware is driven by a set of program instructions, or software. Once familiar with hardware and software, the user can then apply the microcontroller to the problems easily. The fig 3.6 shows all the input/output pins unique to microcontrollers:

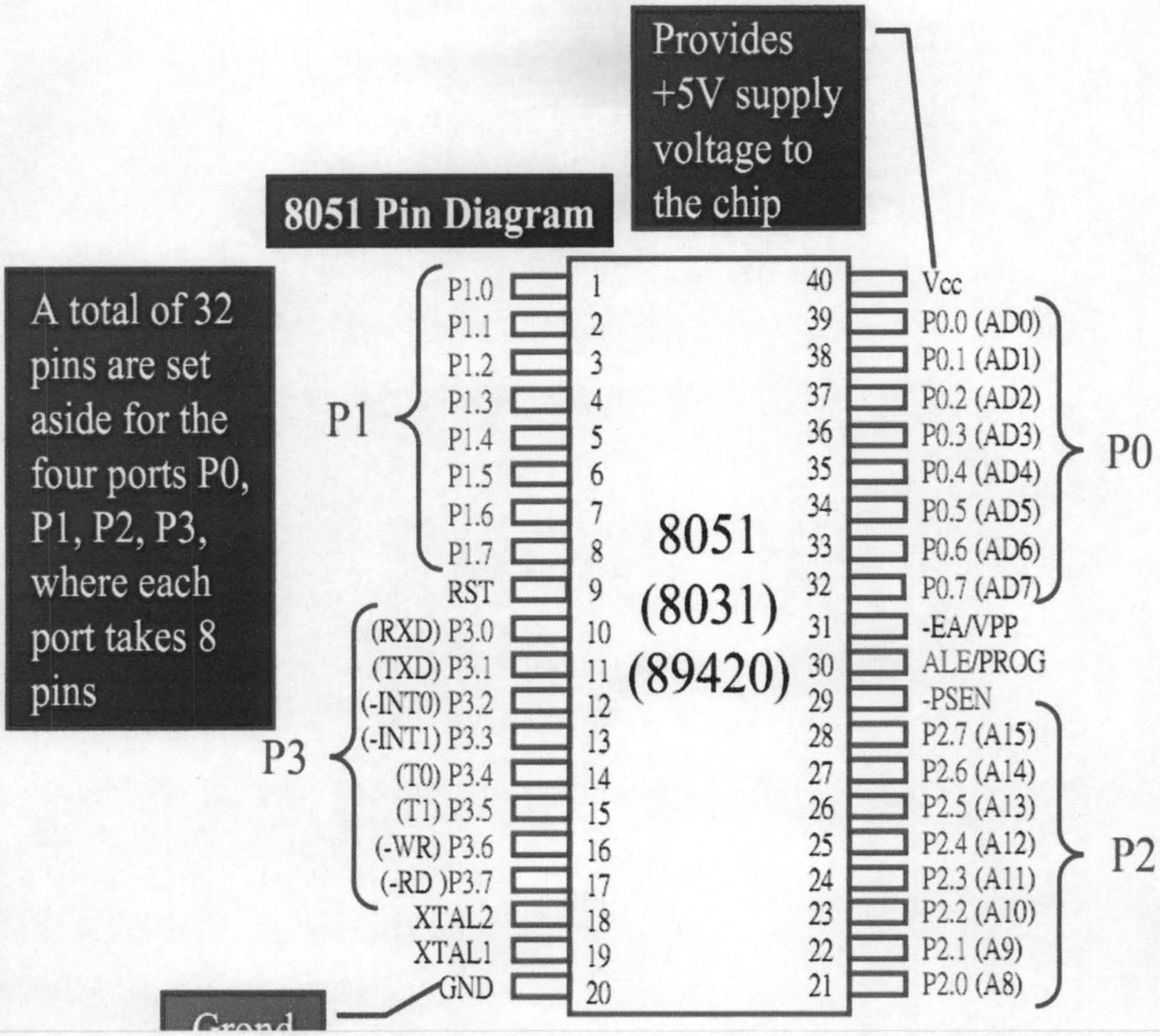

Fig. 3.6 Microcontroller pin configuration.

The following are some of the capabilities of 8051 microcontroller.

- Internal ROM and RAM
- I/O ports with programmable pins
- Timers and counters
- Serial data communication.

The 8051 architecture consists of these specific features:

- 16 bit PC & data pointer (DPTR)
- 8 bit program status word (PSW)
- 8 bit stack pointer (SP)
- Internal ROM 4k
- Internal RAM of 128 bytes.
- 4 register banks, each containing 8 registers
- 80 bits of general purpose data memory
- 32 input/output pins arranged as four 8 bit ports: P0-P3
- Two 16 bit timer/counters: T0-T1
- Two external and three internal interrupt sources Oscillator and clock circuits [11].

3.4.1 Central processing unit

This section serves to control the entire operation on the microcontroller. This unit is divided into two parts; the control unit, cu and arithmetic and logic unit, ALU. The main function of CU is to take instructions from memory and translate the composition of these instructions into simple collection of work processed (decode) and implement instruction sequence in accordance with the steps that have been determined by program (execute).

ALU unit is the part that deals with arithmetic operations like +,- and logic data manipulation such as AND, OR, and comparison [13].

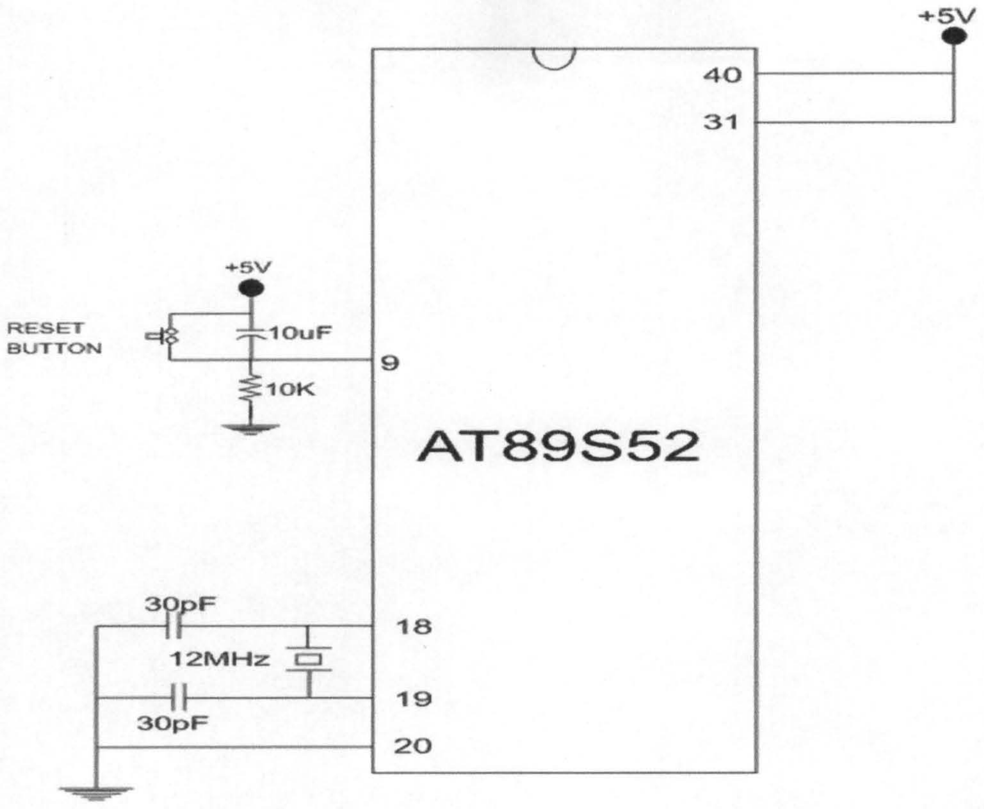

Fig . 3.7 Control unit of the system.

3.4.2 Clock source

The clock source sub-unit is made up of two basic components, two 30PF capacitors and a 12MHz crystal oscillator. This unit generates clock pulses for the microcontroller, so as to enable it execute instruction. The interface between the clock source sub-unit and the microcontroller is shown in fig 3.8

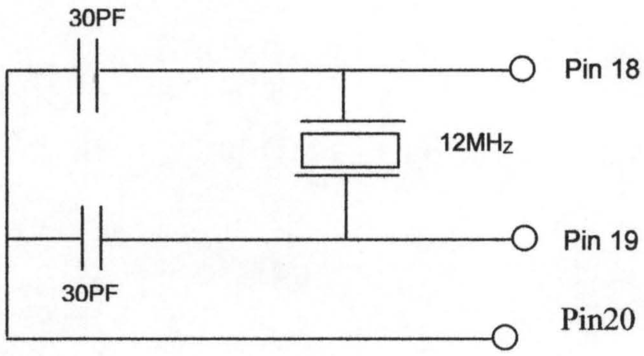

Fig. 3.8 Circuit diagram of clock source and interface schematics.

Pin 18 and 19 are the input and output respectively which can be configured for use as an on-chip oscillator as shown in fig 3.8.Either a quartz crystal or ceramic resonator may be used, in this design, a quartz crystal was used. From data sheet of AT89S52 it is noted that;

C_2 and $C_3 = 30pf \pm 10pf$ for crystals, while $40pf \pm 10pf$ for ceramic resonators.

Therefore, since crystal was used, 30_PF was chosen for both C_2 and C_3.

The $12MH_Z$ oscillator generates $12e^6$ pulses per second [13].

3.4.3 Reset capacitor

For an AT89S52 microcontroller to reset, its pin 9 must be at logic level zero for at least 20ms for most of its register to clear.

It can be seen from the equation below:

$$T = 1.1RC \text{...........} \quad \text{(vi)}$$

$Taking\ R = 10K, C = 10\mu f$

$T = 1.1 * 10 * 10^3 * 10 * 10^{-6}$

$T = 0.11sec > 20ms\ that\ is\ required.$

3.4.4 Soft ware development

Soft ware is a set of instruction for the computer to perform a required task. Since all the input and output function are performed by the hardware, it requires a set of instructions to tell it what to do and how to do it. Single flakes microcontroller 52 family has a specially programming language that is not understood by other types of single flakes. This Programming language known by the name of the assemble language instruction which has 256 device. With the C- language, microcontroller programming is easier, since the c-language format will be automatically converted into assembler language with a hex-file format [11].

3.4.5 Software design

The end product of any good program software design is a program that enables a given microprocessor to perform the task at hand as efficiently as possible. The software used in this project was called KEIL-N- version, it was designed based on several micro controller ranging from ATMEL, PIC, MICROCHIP, INTEL and so on. There are many companies producing microcontroller, but for purpose of this project ATMEL chip was used because of the feature it has, an 8051 family, e.g. AT89S52. This software was used to stimulate the assembly language code to be sure it's free from logic and syntax error after which it will generate an Hex file which was burn on a N-controller chip to perform the operation of which only a processor can read and execute an Hex file, as no human being can read, write or interpret. The burning (written) of Hex file on N- controller chip was done with the aid of device called hardware [11].

This unit is sub divided into two i.e. the software part and the hardware part

3.4.6 Software part

Keil software was used to provide the software development tools for 8051 based microcontrollers. With the keil tools, it was possible to generate a hex file from an assembly language commonly used in embedded applications for virtually every 8051 derivative. The supported microcontrollers are listed in the μ-version; the picture of the software is shown in fig.3.9.

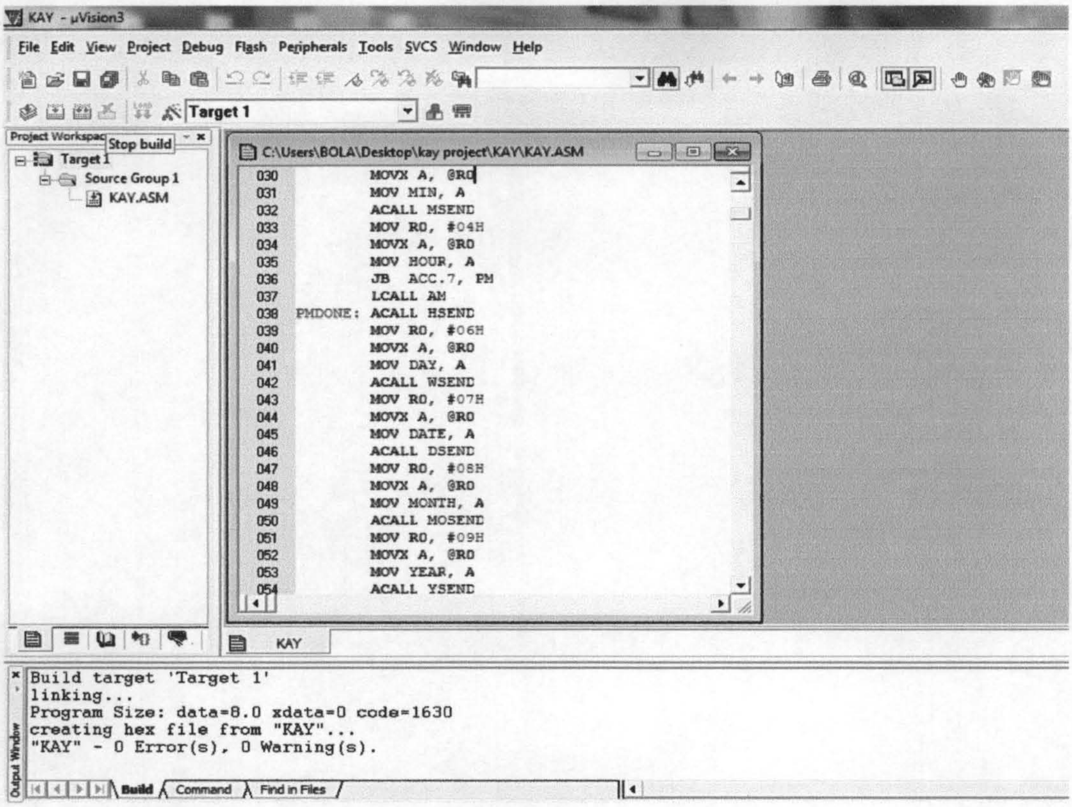

Fig 3.9 Programming software.

The assembly language program written for this project is to monitor the output of LM 555, it increment the count anytime the output of LM 555 goes high and display it on an LCD. See appendix i and ii.

3.4.7 Hardware part

A microcontroller is a single chip that contains the processor (the CPU), non-volatile memory for the program (ROM or flash), volatile memory for input and output (RAM), a clock and an I/O control unit. Also called a "computer on a chip," billions of microcontroller units (MCUs) are embedded each year in a myriad of products from toys to appliances to automobiles. For example, a single vehicle can use 70 or more microcontrollers. The fig.3.1.0 describes a general block diagram of microcontroller [11].

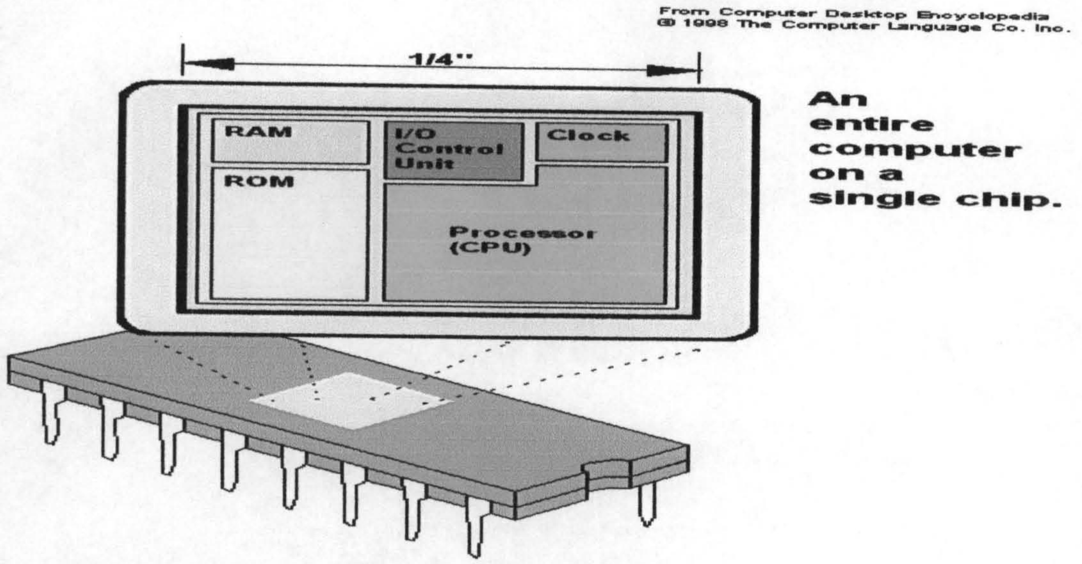

Fig 3.1.0 Block diagram of microcontroller.

3.5.0 Display unit

This unit displays the count of fingerlings passing through a channel. Pin 1, 2, 3, 4, 5, 6, 7, 8, 10 and 11 of a microcontroller are attached to the pin 4, 6, 7, 8, 9, 10, 11, 12, 13, and 14 on a crystal liquid display.

3.5.1 Liquid crystal display

This is an electro-optical amplitude modulator realize as a thin, flat display device made up of many number of color or monochrome pixels arrayed in front of a light source or reflector [8]. It often utilize in battery-powered electric devices because it uses very small amount of electric power. Each pixel of an LCD typically consist of a layer of molecules aligned between two transparent electrodes, and two polarizing filters, the axes of transmission of which are (in most of cases) perpendicular to each other. With no liquid crystal between the polarizing filters, light passing through the first filter would be blocked by the second (crossed) polarizer.

The surfaces of the electrodes that are in contact with the liquid crystal material are treated so as to align the liquid crystal molecules in a particular direction. This treatment typically consists of a thin polymer layer that is unidirectional rubbed using, for example, a typically consists of a thin polymer layer that is unidirectional rubbed using, for example, a cloth.The direction of the liquid crystal alignment is then defined by the direction of rubbing. Electrodes are made of a transparent conductor called Indium Tin Oxide. [8]

The pin function of the LCD is shown in table 1.

Table 1 LCD pin description.

Pin No.	Symbol	Level	Description.
1	Vss	0V	ground
2	Vdd	5.0V	Supply voltage for logic
3	VO	Variable	Operating voltage for LCD
4	RS	H/L	H:DATA,L:Instruction code
5	R/W	H/L	H:Read(MPU-Module)L:Write(MPU-Module)
6	E	H,H -L	Chip enable Signal
7	DB0	H/L	Data bit 0
8	DB1	H/L	Data bit 1
9	DB2	H/L	Data bit 2
10	DB3	H/L	Data bit 3
11	DB4	H/L	Data bit 4
12	DB5	H/L	Data bit 5
13	DB6	H/L	Data bit 6
14	DB7	H/L	Data bit 7
15	A	-	LED +
16	K	-	LED -

COMPLETE CIRCUIT DIAGRAM

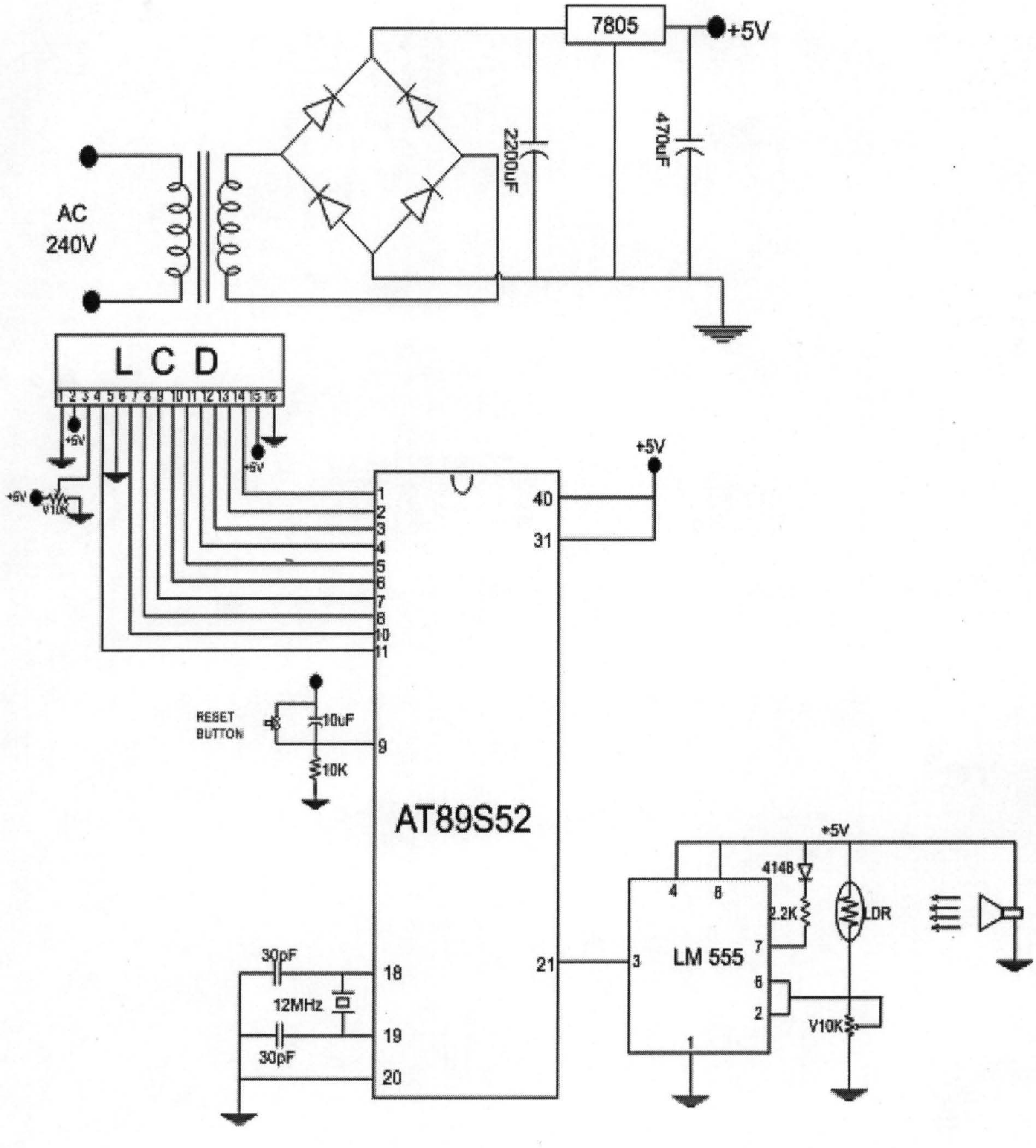

Fig .3.1.1 Circuit diagram

CHAPTER FOUR

CONSTRUCTION, TESTING AND RESULT

4.0 Introduction

This chapter primarily discusses the project construction, precautions taken as well as tests and results obtained and also it correlates the manifests values against the manufacture's specification in order to determine overall system.

4.1 Construction

The circuit was initially constructed on breadboard; this was done to ascertain if any hitches or flaws are in occurrence in the design. This construction was done prior to soldering on a Vero-board which is more of permanents in nature.

4.2 Construction precautions

In the cause of soldering the components on the Vero-board, the following precautions were taken;

1. Excessive heating of components was reduced to its barest minimum, since components are thermally intolerant.
2. Excess lead smears were chiseled off to prevent short circuit occurrence.
3. All points soldered were checked for continuity so as to avoid unnecessary open circuits.

4.3 Testing and results

The two aspects of this project, i.e. the software and hardware phases were developed and tested separately.

An AT89552 is a programmable IC (Integrated circuit). The source code was complied on paper and then test and ran on edsim simulator, after successful simulation, it was interfaced with the microcontroller.

A modularized approach was employed in testing the hardware aspect of this project. The following areas were categorically tested.

1. **Individual Components Test**: Each component was initially tested to ensure their workability.
2. **The Wiring Test:** A surface wiring was used on the Vero-board, by the used of a digital multimeter, open circuits as well as short circuits were checked.
3. **Power Unit Test:** The output from both 9V a.c and 5V voltage regulator was measured and the results are as follows:

Table 2 Measured output voltage.

Output Voltage	Expected Voltage	Measured Voltage
From a.c	12V	12.5V
From regulator	5V	4.94V

In testing for the successful completion of the construction work with two separate mini ponds connected together via channel and placed at a distance apart. When fingerlings pass through the channel, the liquid crystal display, (LCD) displays the count as an output.

CHAPTER FIVE

CONCLUSION AND RECOMMENDATION

5.0 Introduction

The primary focus of this project is a fingerlings counting device, but its area of application is of a wider reach, it could be applied in any where there is only one exit, basically any where a count is needed, though on alteration of the program will be warranted but this only enhances the beauty of electronics, its universality.From the results obtained, it can be conclusively said that the primary aims earlier stated of this project has been both theoretically as well as practically achieved. The limitation of this project, since fingerlings counting device is like any other system that have shortcoming, any unauthorized person can arbitrarily reset leading to a loss of count.

5.1 Recommendation

Possible way to improve the overall system performance, functionality and dynamism of the system by inclusion of an alphanumeric keypad which would enable pass wording of the device. The student should also be grouped in a reasonable number for giant project that even touch the present needs of the department.

REFERENCES

[1]. Alex Bocek, International Center for Aquaculture and environment swingle hall. Auburn university Alabama. 36849-5419.USA pp.52 – 70.

[2]. Publication from United States Department of Agriculture. Grant number: 94-38500-0045 pp.80 - 82.

[3]. A.H, SUTTON;G, MAIN; & RONALD; 1970: An instrument for counting the larvae of the prawn, fingerlings and the Artemia Salina. Laboratory practice; 18. (4) pp. 433-436.

[4]. A. L. Jensen, 1969: An inexpensive automatic counter for fingerlings. pp 239-240.

[5]. L.J. Const. Int. An electronic device for counting nauplii of Artemia Salina. pp.262-.269.

[6]. G.D. Bishop. Electrical electronics system and practice, London: Macmillan press Ltd. (1998). pp.101-103

[7]. B.L. Theraja and A.K. Theraja. A book of electrical technology. By S Chand 2000 pp. 260 - 263

[8]. A. Schuler Charles, Electronics Principles and applications, 5th edition. Mc Graw Hill Companies. (1999) pp 60 - 64

[9]. L. Thomas Floyd, electronics fundamentals, circuits, devices, and application. 7th edition, Pearson Education, Upper Saddle River, New Jersey (2007). pp 52 - 60

[10]. Millan Valarie Architecture and Programming of 8051 microcontroller, online book.

[11]. S.K Bhattacharya & S. Chatterjee. Project in Electrical and Electronics Engineering pp. 452 – 456

[12] Raj Kamal. Concept and Feature of microcontrollers' pp. 44 – 48

[13]. A.K Chhabra & Anokh Singh. Fundamental of Digital Electronics and its applications pp 243 – 244.

[14] J.R.Hurford. The linguistic theory of numerals Cambridge university press, Cambridge 1975.pp 44

[15] T. M. Neibuhr. Ancient Greek Numerals System Ares Publishers ,Chicago 1979. pp98

APPENDIX i

```
ORG 0000H

DATABUS EQU P1s

COUNT EQU P2.0

RS EQU P3.0

EN EQU P3.1

MOV R0, #00H

MOV R1, #00H

MOV R2, #00H

MOV R3, #00H

MOV R4, #00H

MOV R5, #00H


MAIN1:      JNB COUNT, $

            JB COUNT, $

            INC R1

            AJMP AA

AA:

AZERO:      CJNE R1, #01, AONE

            LCALL LINE211

            LCALL W1

            LJMP MAIN1

AONE:       CJNE R1, #02, ATWO

            LCALL LINE211

            LCALL W2
```

```
        LJMP MAIN1
ATWO:   CJNE R1, #03, ATHREE
        LCALL LINE211
        LCALL W3
        LJMP MAIN1
ATHREE: CJNE R1, #04, AFOUR
        LCALL LINE211
        LCALL W4
        LJMP MAIN1
AFOUR:  CJNE R1, #05, AFIVE
        LCALL LINE211
        LCALL W5
        LJMP MAIN1
AFIVE:  CJNE R1, #06, ASIX
        LCALL LINE211
        LCALL W6
        LJMP MAIN1
ASIX: CJNE R1, #07, ASEVEN
        LCALL LINE211
        LCALL W7
        LJMP MAIN1
ASEVEN: CJNE R1, #08, AEIGHT
        LCALL LINE211
        LCALL W8
        LJMP MAIN1
AEIGHT: CJNE R1, #09, ANINE
```

```
        LCALL LINE211
        LCALL W9
        LJMP MAIN1
ANINE:  CJNE R1, #10, BB
        LCALL LINE211
        LCALL W0
        INC R2
BB:
BZERO:  CJNE R2, #01, BONE
        LCALL LINE210
        LCALL W1
        MOV R1, #00H
        LJMP MAIN1
BONE:   CJNE R2, #02, BTWO
        LCALL LINE210
        LCALL W2
        MOV R1, #00H
        LJMP MAIN1
BTWO:   CJNE R2, #03, BTHREE
        LCALL LINE210
        LCALL W3
        MOV R1, #00H
        LJMP MAIN1
BTHREE: CJNE R2, #04, BFOUR
        LCALL LINE210
        LCALL W4
```

```
        MOV R1, #00H
        LJMP MAIN1
BFOUR:  CJNE R2, #05, BFIVE
        LCALL LINE210
        LCALL W5
        MOV R1, #00H
        LJMP MAIN1
BFIVE:  CJNE R2, #06, BSIX
        LCALL LINE210
        LCALL W6
        MOV R1, #00H
        LJMP MAIN1
BSIX: CJNE R2, #07, BSEVEN
        LCALL LINE210
        LCALL W7
        MOV R1, #00H
        LJMP MAIN1
BSEVEN: CJNE R2, #08, BEIGHT
        LCALL LINE210
        LCALL W8
        MOV R1, #00H
        LJMP MAIN1
BEIGHT: CJNE R2, #09, BNINE
        LCALL LINE210
        LCALL W9
        MOV R1, #00H
```

```
        LJMP MAIN1
BNINE:  CJNE R2, #10, CC
        LCALL LINE210
        LCALL W0
        INC R3
CC:
CZERO:  CJNE R3, #01, CONE
        LCALL LINE29
        LCALL W1
        MOV R1, #00H
        MOV R2, #00H
        LJMP MAIN1
CONE:   CJNE R3, #02, CTWO
        LCALL LINE29
        LCALL W2
        MOV R2, #00H
        MOV R1, #00H
        LJMP MAIN1
CTWO:   CJNE R3, #03, CTHREE
        LCALL LINE29
        LCALL W3
        MOV R2, #00H
        MOV R1, #00H
        LJMP MAIN1
CTHREE: CJNE R3, #04, CFOUR
        LCALL LINE29
```

```
        LCALL W4
        MOV R2, #00H
        MOV R1, #00H
        LJMP MAIN1
CFOUR:  CJNE R3, #05, CFIVE
        LCALL LINE29
        LCALL W5
        MOV R2, #00H
        MOV R1, #00H
        LJMP MAIN1
CFIVE:  CJNE R3, #06, CSIX
        LCALL LINE29
        LCALL W6
        MOV R2, #00H
        MOV R1, #00H
        LJMP MAIN1
CSIX: CJNE R3, #07, CSEVEN
        LCALL LINE29
        LCALL W7
        MOV R2, #00H
        MOV R1, #00H
        LJMP MAIN1
CSEVEN: CJNE R3, #08, CEIGHT
        LCALL LINE29
        LCALL W8
        MOV R2, #00H
```

```
        MOV R1, #00H
        LJMP MAIN1
CEIGHT: CJNE R3, #09, CNINE
        LCALL LINE29
        LCALL W9
        MOV R2, #00H
        MOV R1, #00H
        LJMP MAIN1
CNINE:  CJNE R3, #10, DD
        LCALL LINE29
        LCALL W0
        INC R4
DD:
DZERO:  CJNE R4, #01, DONE
        LCALL LINE28
        LCALL W1
        MOV R1, #00H
        MOV R2, #00H
        MOV R3, #00H
        LJMP MAIN1
DONE:   CJNE R4, #02, DTWO
        LCALL LINE28
        LCALL W2
        MOV R2, #00H
        MOV R1, #00H
        MOV R3, #00H
```

```
            LJMP MAIN1
DTWO:       CJNE R4, #03, DTHREE
            LCALL LINE28
            LCALL W3
            MOV R2, #00H
            MOV R1, #00H
            MOV R3, #00H
            LJMP MAIN1
DTHREE:     CJNE R4, #04, DFOUR
            LCALL LINE28
            LCALL W4
            MOV R2, #00H
            MOV R1, #00H
            MOV R3, #00H
            LJMP MAIN1
DFOUR:      CJNE R4, #05, DFIVE
            LCALL LINE28
            LCALL W5
            MOV R2, #00H
            MOV R1, #00H
            MOV R3, #00H
            LJMP MAIN1
DFIVE:      CJNE R4, #06, DSIX
            LCALL LINE28
            LCALL W6
            MOV R2, #00H
```

```
            MOV R1, #00H
            MOV R3, #00H
            LJMP MAIN1
DSIX: CJNE R4, #07, DSEVEN
            LCALL LINE28
            LCALL W7
            MOV R2, #00H
            MOV R1, #00H
            MOV R3, #00H
            LJMP MAIN1
DSEVEN:     CJNE R4, #08, DEIGHT
            LCALL LINE28
            LCALL W8
            MOV R2, #00H
            MOV R1, #00H
            MOV R3, #00H
            LJMP MAIN1
DEIGHT:     CJNE R4, #09, DNINE
            LCALL LINE28
            LCALL W9
            MOV R2, #00H
            MOV R1, #00H
            MOV R3, #00H
            LJMP MAIN1
DNINE:      CJNE R4, #10, EE
            LCALL LINE28
```

```
            LCALL W0
            INC R5
EE:
EZERO:      CJNE R5, #01, EONE
            LCALL LINE27
            LCALL W1
            MOV R1, #00H
            MOV R2, #00H
            MOV R3, #00H
            MOV R4, #00H
            LJMP MAIN1
EONE:CJNE R5, #02, ETWO
            LCALL LINE27
            LCALL W2
            MOV R2, #00H
            MOV R1, #00H
            MOV R3, #00H
            MOV R4, #00H
            LJMP MAIN1
ETWO:       CJNE R5, #03, ETHREE
            LCALL LINE27
            LCALL W3
            MOV R2, #00H
            MOV R1, #00H
            MOV R3, #00H
            MOV R4, #00H
```

```
        LJMP MAIN1
ETHREE: CJNE R5, #04, EFOUR
        LCALL LINE27
        LCALL W4
        MOV R2, #00H
        MOV R1, #00H
        MOV R3, #00H
        MOV R4, #00H
        LJMP MAIN1
EFOUR:  CJNE R5, #05, EFIVE
        LCALL LINE27
        LCALL W5
        MOV R2, #00H
        MOV R1, #00H
        MOV R3, #00H
        MOV R4, #00H
        LJMP MAIN1
EFIVE:  CJNE R5, #06, ESIX
        LCALL LINE27
        LCALL W6
        MOV R2, #00H
        MOV R1, #00H
        MOV R3, #00H
        MOV R4, #00H
        LJMP MAIN1
ESIX: CJNE R5, #07, ESEVEN
```

```
            LCALL LINE27
            LCALL W7
            MOV R2, #00H
            MOV R1, #00H
            MOV R3, #00H
            MOV R4, #00H
            LJMP MAIN1
ESEVEN:     CJNE R5, #08, EEIGHT
            LCALL LINE27
            LCALL W8
            MOV R2, #00H
            MOV R1, #00H
            MOV R3, #00H
            MOV R4, #00H
            LJMP MAIN1
EEIGHT:     CJNE R5, #09, ENINE
            LCALL LINE27
            LCALL W9
            MOV R2, #00H
            MOV R1, #00H
            MOV R3, #00H
            MOV R4, #00H
            LJMP MAIN1
ENINE:      CJNE R5, #10, FF
            LCALL LINE27
            LCALL W0
```

```
        INC R5
FF:
W0:     MOV A, #'0'
        LCALL WRITE
        RET
W1:     MOV A, #'1'
        LCALL WRITE
        RET
W2:     MOV A, #'2'
        LCALL WRITE
        RET
W3:     MOV A, #'3'
        LCALL WRITE
        RET
W4:     MOV A, #'4'
        LCALL WRITE
        RET
W5:     MOV A, #'5'
        LCALL WRITE
        RET
W6:     MOV A, #'6'
        LCALL WRITE
        RET
W7:     MOV A, #'7'
        LCALL WRITE
        RET
```

```
W8:     MOV A, #'8'
        LCALL WRITE
        RET
W9:     MOV A, #'9'
        LCALL WRITE
        RET
BACK4:          RET
READY:          MOV R5, #50
HERE:   MOV R0, #255
                DJNZ R0, $
                DJNZ R5, HERE
                RET

DELAY:          PUSH 00H
                PUSH 01H
                PUSH 02H
                MOV 00H, #30
BOLA2:          MOV 01H, #255
BOLA1:          MOV 02H, #255
                DJNZ 02H, $
                DJNZ 01H, BOLA1
                DJNZ 00H, BOLA2
                POP 02H
                POP 01H
                POP 00H
                RET
```

```
INIT:  DB 38H,0CH,01H,06H,0

WEL:  DB "WELCOME TO FIN. ",0

LINE2CS:DB 0C0H,0

LINE2DS:DB "COUNTING DEVICE",0

LOAD:   DB " LOADING SYSTEM ",0

FILE:  DB "   FILES.....   ",0

COUNTA: DB "COUNTING STARTS ",0

A0000: DB "    0000000    ",0

END
```

APPENDIX ii

FLOW CHART