DESIGN AND CONSTRUCTION OF WATER LEAKAGE DETECTOR

BY

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DEPARTMENT OF ELECTRICAL/COMPUTER ENGINEERING, SCHOOL OF ENGINEERING AND ENGINEERING TECHNOLOGY, FEDERAL UNIVERSITY OF TECHNOLOGY, MINNA

NOVEMBER, 2008

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A PROJECT REPORT SUBMITTED IN PARTIAL FULFILMENT OF THE REQUIREMENTS FOR THE AWARD OF BACHELOR OF ENGINEERING (B.ENG) DEGREE IN THE DEPARTMENT OF ELECTRICAL/COMPUTER ENGINEERING, SCHOOL OF ENGINEERING AND ENGINEERING TECHNOLOGY, FEDERAL UNIVERSITY OF TECHNOLOGY, MINNA.

NOVEMBER, 2008

DEDICATION

This piece of work is dedicated to Almighty Allah for his mercy, guidance and protection and to all who have in one way or the other contributed positively to my attainment of education up to this level, other well wishers and humanity at large.

DECLARATION

I Umar N. Mohammed, declare that this work was done by me and has never been presented elsewhere for the award of a degree. I also honor her by relinquish the copy right to the Federal University of Technology Minna.

UMAR N MOHAMMED

14/11/08

Signature and date

MR H. OHIZE

13/11/08

Signature and date

DR. Y: A. ADEDIRAN

Signature and date

External Examiner

Signature and date

ACKNOWLEDGEMENT

My parents, Alhaji & Hajiya. M.G. Umar, you are simply magicians! What did I ask for that was not provided classically!

My siblings: Murjanatu, Abdulmutalib, Zubaida, Aishat, Zainab, Abdulmalik will never know how inspiration they were.

I wish to thank the family of Alhaji Dahiru Abubakar most especially Abubakar D. Abubakar. The family of Mr. & Mrs. Oborafor for their love, support and encouragement.

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Finally, I would like to express my profound gratitude to ALLAH for his immeasurable blessings and mercy throughout my pursuit.

ABSTRACT

This project is design and constructed as a water leakage detector which is an instrument that indicates the level as well leakage of water .Water leakage detection is noticed or seen base on the variation of the resistance. A float made of wood on the surface of the water is attached to a variable resistor. As the water reduces the float draws down the slide contact and the changes in resistance is shown on a seven segment display. This is achieved by using a special form of a variable resistor called potentiometer. It has three terminals. Two terminals are connected to the opposite sides of the resistive element and the third connects to a sliding contact that can be adjusted as a voltage divided. The idea was borne out of the need to have knowledge of the quantity of water in a tank and to avoid water leakage in a tank or other water storage vessels.

The project was carried out using commonly available and inexpensive components and the result obtained were satisfactory.

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CHAPTER ONE

1.1 INTRODUCTION

Digital leakage detector indicates leakage In a vessel whenever it happens. Example, in a water reservoir. Water leakage detection is noticed or seen base on the variation of the resistance. A float made of wood on the surface of the water is attached to a variable resistor. As the water reduces the float draws down the slide contact and the changes in resistance is shown on a seven segment display. This is achieved by using a special form of a variable resistor called potentiometer. It has three terminals. Two terminals are connected to the opposite sides of the resistive element and the third connects to a sliding contact that can be adjusted as a voltage divided.

Water storage is a critical aspect of obtaining water security. So that water can be made available at all times, because the unavailability of water will cause discomfort and obstruction of industrial processes

The distribution and control of various liquid at a certain flow rate and pressure undoubtedly calls for more attention. To end the use of sensitive equipment would be necessary to monitor different quantities such as size, flow rate, pressure, temperature, viscosity, leakage, density, volume, etc

DETECTOR TYPES

Proximity detector senses the approach of a metallic machine part either by a magnetic or high-Frequency electromagnetic field. Simple proximity detector use a permanent magnet to actuate a sealed switch mechanism whenever the machine part gets close (typically 1 inch or less). More complex proximity switches work like a metal detector, energizing a coil of wire with a high-frequency current, and electronically monitoring the magnitude of that current. If a metallic part (not necessarily magnetic) gets close enough to the coil, the current will increase, and trip the monitoring circuit. The symbol shown here for the proximity switch is of the electronic variety, as indicated by the diamond-shaped box surrounding the switch. A non-electronic proximity switch would use the same symbol as the lever-actuated limit switch.

Another form of proximity switch is the optical switch, comprised of a light source and photocell. Machine position is detected by either the interruption or reflection of a light beam. Optical switches are also useful in safety applications, where beams of light can be used to detect personnel entry into a dangerous area.

In many industrial processes, it is necessary to monitor various physical quantities with detector. Such detector can be used to sound alarms, indicating that a process variable has exceeded normal parameters, or they can be used to shut down processes or equipment if those variables have reached dangerous or destructive levels. There are many different types of process detector

Speed detector

These detectors sense the rotary speed of a shaft either by a centrifugal weight mechanism mounted on the shaft, or by some kind of non-contact detection of shaft motion such as optical or magnetic.

Pressure detector

Gas or liquid pressure can be used to actuate a detector mechanism if that pressure is applied to a piston, diaphragm, or bellows, which converts pressure to mechanical force.

Temperature detector

An inexpensive temperature-sensing mechanism is the "bimetallic strip:" a thin strip of two metals, joined back-to-back, each metal having a different rate of thermal expansion. When the strip heats or cools, differing rates of thermal expansion between the two metals causes it to bend. The bending of the strip can then be used to actuate a switch contact mechanism. Other temperature switches use a brass bulb filled with either a liquid or gas, with a tiny tube connecting the bulb to a pressure-sensing switch. As the bulb is heated, the gas or liquid expands, generating a pressure increase which then actuates the switch mechanism.

Liquid level detector

A floating object can be used to actuate a switch mechanism when the liquid level in an tank rises past a certain point. If the liquid is electrically conductive, the liquid itself can be used as a Conductor to bridge between two metal probes inserted into the tank at the required depth. The Conductivity technique is usually implemented with a special design of relay triggered by a small amount of current through the conductive liquid. In most cases it is impractical and dangerous to switch the full load current of the circuit through a liquid Level detector can also be designed to detect the level of solid materials such as wood chips, Grain, coal, or animal feed in a storage silo, bin, or hopper. A common design for this application is a small paddle wheel, inserted into the bin at the desired height, which is slowly turned by a small electric motor. When the solid material fills the bin to that height, the material prevents the paddle wheel from turning. The torque response of the small motor than trips the switch mechanism. Another design uses a "tuning fork" shaped metal prong, inserted into the bin from the outside at the desired height. The fork is vibrated at its resonant frequency by an electronic circuit and magnet/electromagnet coil assembly. When the bin fills to that height, the solid material dampens the vibration of the fork, the change in vibration amplitude and/or frequency detected by the electronic circuit.

Liquid flow detector

Inserted into a pipe, a flow switch will detect any gas or liquid flow rate in excess of certain threshold, usually with a small paddle or vane which is pushed by the flow. Other flow switches are constructed as differential pressure switches, measuring the pressure drop across a restriction built into the pipe.

Another type of level switch, suitable for liquid or solid material detection, is the nuclear switch. Composed of a radioactive source material and a radiation detector, the two are mounted across the diameter of a storage vessel for either solid or liquid material. Any height of material beyond the level of the source/detector arrangement will attenuate the strength of radiation reaching the Detector. This decrease in radiation at the detector can be used to trigger a relay mechanism to provide a switch contact for measurement, alarm point, or even control of the vessel level.

1.2 AIMS/OBJECTIVE AND MOTIVATION

Analysis of the aims/objectives and motivation of this project "Design and Construction of a Water leakage detector"

A. The major aim of this project is to build and construct a functional electronic circuit device that is capable of interpreting electronic signal from probes which are inserted in any liquid container so that it detects leakage in the vessel and can b monitored on digital electronic readout (display)

B. To demonstrate the relevance of Electrical and Computer Engineering as the basic component of Civilization

THE BLOCK DIAGRAM OF WATER LEAKAGE DETECTOR

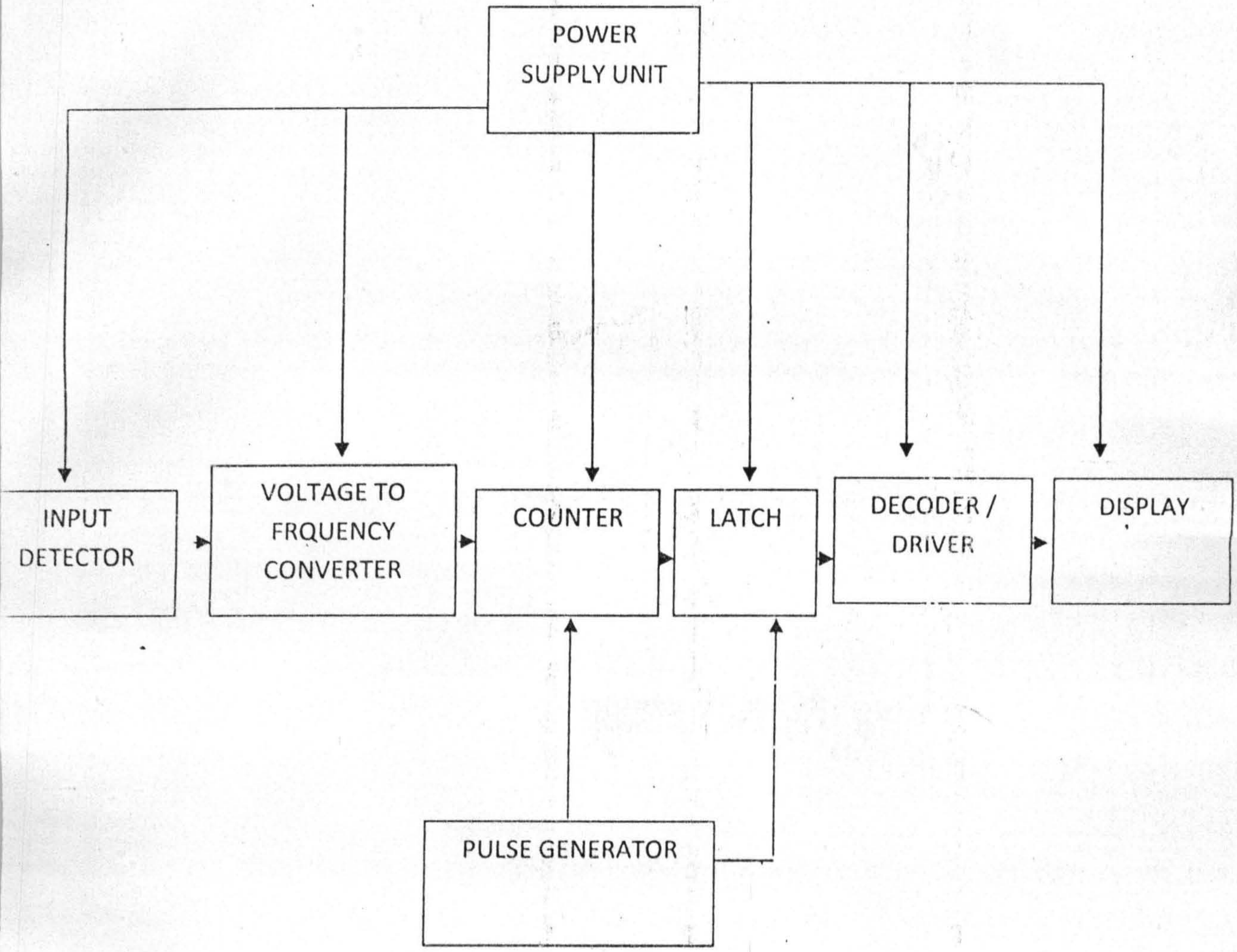


FIG1.1 BLOCK DIAGRAM OF A WATER LEAKAGE DETECTOR

1.3 PROJECT LAYOUT

Chapter one: This chapter gives the general overview of the project, the general introduction of the project; aims, objective and motivation of this project are also contained in this chapter.

Chapter two: Contains the literature review that highlights previous work on this project and areas of application.

Chapter three: This chapter focuses on project construction, testing procedures employed to achieve the final project. It further elaborates on the timing circuit, design calculation, project casting, system coupling and illustration of package construction.

Chapter four: This contains testing of results as well as the difficulties encountered in course of construction and testing.

Chapter five: This chapter contains the conclusion and recommendation with reference which list books and material consulted and appendices that consist of the final circuit diagram of the project.

CHAPTER TWO

2.1 LITERATURE REVIEW

Liquids refer to the second state of matter. The others are solid and gaseous states. Liquids are a condensed state of matter and are intermediate between gases and solids in their properties. They are fluids like gases, but normally have much higher densities, similar to those of the solids. Unlike solids, they flow when subjected to moderate shearing force.

A level could be seen as a height of liquid in their container or as an instrument. When being considered as an instrument it can be used to measure the horizontality in liquids and gases. The ancient Egyptians level consisted of an isosceles "A"shaped piece with a plumb bob hung from its apex. The only rival of the A-level until the 17^{th} century was a simplified form of the Muslim astrolable suspended from its ring with its sighting piece clamped at 90degree to its vertical diameter, it produces a horizontal line of sight. Despite the description by Hero of Alexander of water made of two glass cylinders connected by a tube, the first such instrument was used by Italian astronomers Giovanni Riccioli about 1630.This instrument was popular even after bubble level, which is a sealed glass tube containing water and a small air bubble, was invented in France by Melchise'dech. The venot about 1655, water was later replaced by alcohol or other spirits to prevent freezing.

In order to obtain the level of a liquid, various methods have been employed in time past starting from ancient eye level measurement, where the liquid is placed in a transparent container and the eye is placed at the line of best horizontality and at that point measurement is taken as the level of liquid. This is however prone to a lot or errors mostly arising from the observer. It therefore prompted the need for a more reliable method of detecting the level and controlling the liquid flow.

The past 100 years have witnessed the emergence of various methods of water level measurement (detection) as a result of the improvement in technology witnessed within this period. The ordinary dipstick is a simple device used for measuring liquid level. It consist of a metal baron with a scale is etched and fixed to a known position in the liquid containing vessel, removing the instrument from the vessel make a level measurement and reading how far up the scale the liquid has been wet.

Feedback occurs in system whose input has link to the output for the purpose of checkmating the operation of system itself. it simply provides an easy technique for controlling the action of the system without altering any element of the system itself. It could be positive or negative and has a wide application, which includes, computer controlled assembly.line, self-regulatory action of the servomechanism, etc.

A servomechanism is a device that responds to the discrepancy between the actual value of variable and the pre-determined ideal value of position. This deviation is expressed as a small electrical current. This current is amplified and then triggers an appropriate self-connecting response. Also in 1788, the Scottish Engineer James Watt developed the fly ball governor based on the feedback principle to control the speed of a steam engine.

The Russian Polzunov I invented the first historical feedback system for liquid level control in 1765.It was tested with water as the liquid. The system was used to control the value of water that covers the water inlet in a boiler and floats are used to determine the water level. Several other approaches towards controlling liquid flow in a tank have since been developed

Leakage detection and control of liquid level using float switch has been in existence for a very long time. These float switches are used in industries where water level needs to be detected and controlled.

Measuring the level of a float on the source of a liquid by means of a suitable transducer, is another method for liquid level detection (measured). The system using a potentiometer is very common and well known for monitoring the level of oil in motor vehicle fuel tanks, an alternate system is the float and tape gauge, where a tape is attached to pulley situated vertically above the float and at its other end a counterweight or a negative-rate counter spring is attached. The amount of rotation of the pulley measured by either a synchro a potentiometer is proportioned to the liquid level.

In the optical dipstick method, light from a source is reflected from a mirror and it passes round a chambered end of the dipstick and enters a light detector after reflection by a second mirror. the instrument can be moved up and down and its position is measured and hence the liquid level

Pressure measuring devices used for water leakage detection utilize the principle that the hydrostatic pressure due to a liquid is directly proportional to its depth and hence the level of its surface. In open topped vessels on covered ones that vented to the atmosphere, the level of liquid is measured using an appropriate pressure transducer inserted at the bottom of the vessel. The liquid level is then related to the measured pressured according to $h=p/\rho g$ where ρ= density of the liquid and g= acceleration due to gravity.

The improvement in technology in the semiconductor industry to the development of the operational amplifiers were develop initially for use in performing arithmetic operations such as addition, subtraction, multiplication, and division. Later it was discovered that operational amplifiers could be used for other purposes other than performing arithmetic operations, one of such use is as a difference amplifier or differential amplifiers to amplify the voltage difference at its two inputs, as well as for comparison of voltages as a comparator, comparing reference voltage, without any feedback the operational amplifier is used as a comparator.

CHAPTER THREE

3.1 DESIGN AND CONSTRUCTION

This chapter gives the theoretical background necessary for the design and implementation of water leakage detection.

The advent of modern water leakage detection is arm at improving productivity, proving safety protection, cost reduction and technological advancement in arresting natural or human disaster.

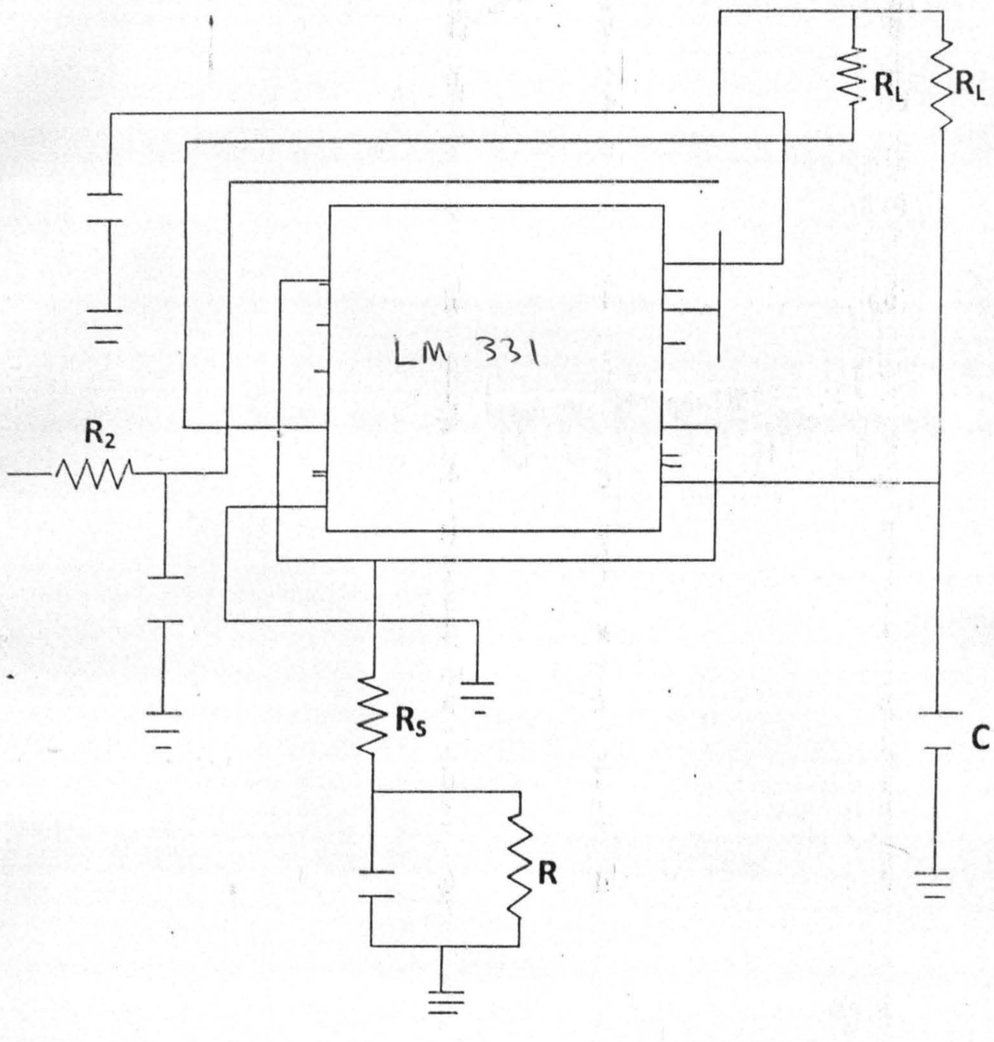
This project is design and constructed as a water leakage detector which is an instrument that indicates the level as well leakage of water .Water leakage detection is noticed or seen base on the variation of the resistance. A float made of wood on the surface of the water is attached to a variable resistor. As the water reduces the float draws down the slide contact and the changes in resistance is shown on a seven segment display. This is achieved by using a special form of a variable resistor called potentiometer. It has three terminals. Two terminals are connected to the opposite sides of the resistive element and the third connects to a sliding contact that can be adjusted as a voltage divided. The idea was borne out of the need to have knowledge of the quantity of water in a tank and to avoid water leakage in a tank or other water storage vessels.

3.2 ANALOG TO DIGITAL CONVERTER (ADC)

The purpose of the analog to digital converter is essentially to convert the analog voltage input into binary counts. The technology applied for this is voltage to frequency conversion techniques. DC voltage is converted into a pulse train whose frequency is proportional to input voltage. The LM 331 IC is used in this design. It is designed for good linearity. Its circuit description is as shown below.

Voltage to frequency co nverter.

A simplified block diagram of the LM 331 is shown below



BLOCK DIAGRAM OF THE LM 331

It consist of switched current source, input comparator and a 1 short timer. The voltage comparator compairs a positive input voltage V1, at pin 7 to the voltage Vx at pin 6. If the V1 is greater the comparator will trigger the short timer. The output of the timer will turn ON both the frequency output transistor and the switched current source for a period t=1.1R1C1. During this period, the current I will flow out of the switched current source and provide a fixed amount of charge Q=Ixt into the comparator C1. At the end of the timing period, the current will turn OFF.

3.3 BCD to 7 Segment Decoder/Driver (7447)

The 7447 is used as the 7 segment decoder in this design. It converts the BCD data into the format suitable for producing decimal digits on a common anode light emitting diode (LED). The 7 segment display was chosen because it is one of the simplest and most popular methods for displaying numeric digits. By controlling the current through each LED, some segments will be lit and others will be dark so that the desired character pattern will be generated.

A BCD to 7 segment decoder/driver is used to take a four bit-BCD input and provide the outputs that will pass current through the appropriate segments is more complicated than the logic of other decoders.

The figure below shows a BCD to 7 segment decoder driver being used to drive a 7 segment LED readout. The LEDs are connected through current limiting resistors to the appropriate outputs of the decoder/driver. The decoder/driver has active low outputs which are open collector driver transistors that can sink a fairly large current because LED read outs may require only 10 to 40mA per segment. A logic table linking the 4-bit inputs to the LED is given in Table 21.

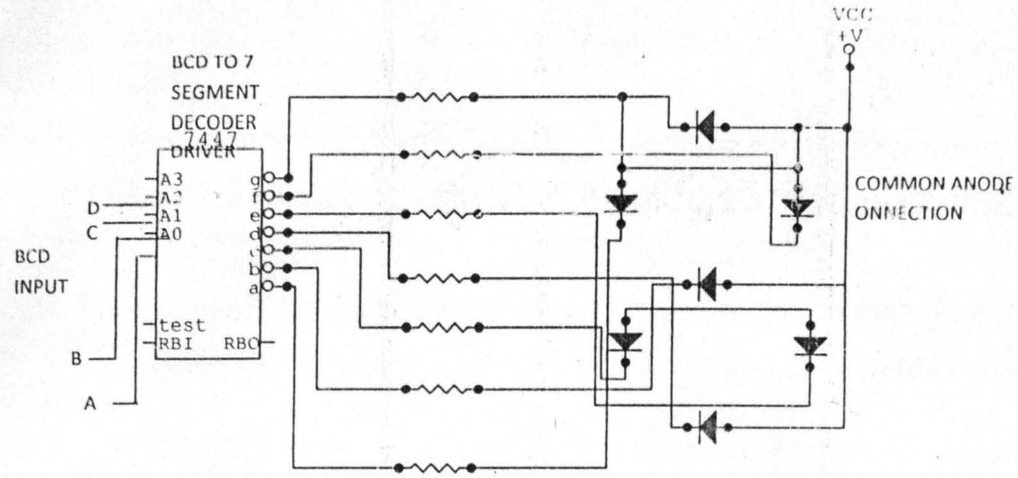


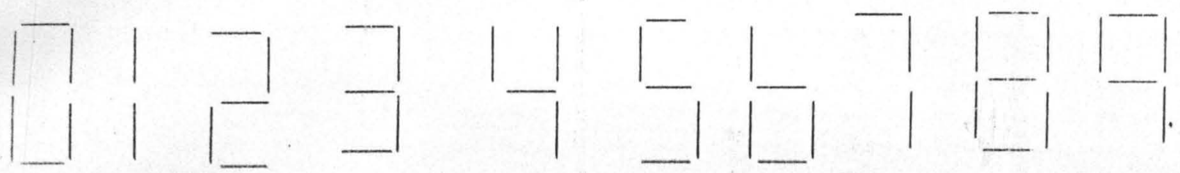
Fig 2.11 BCD to Seven Segment Divider Circuit Driver

TABLE 2.2 Common Anode Seven Segment Display

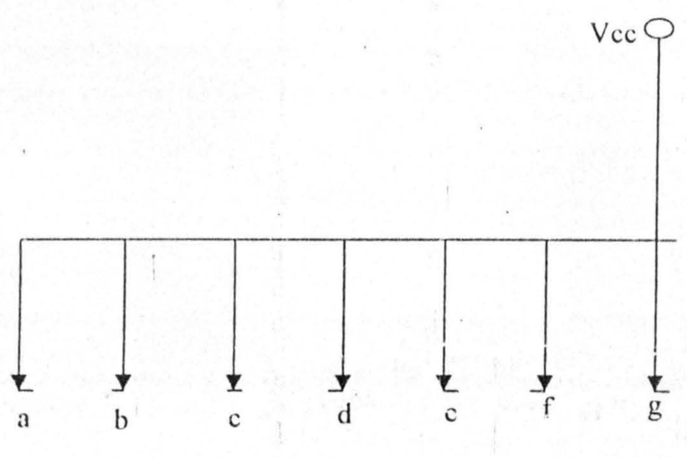
INPUT				OUTPUT						
D	C	B	A	A	B	C	D	E	F	G
0	0	0	0	1	1	1	1	1	1	0
0	0	0	1	0	1	1	0	0	0	0
0	0	1	0	1	1	0	1	1	0	1
0	0	1	1	1	1	1	1	0	0	1
0	1	0	0	0	1	1	0	0	1	1
0	1	0	1	1	0	1	1	0	1	1
0	1	1	0	0	0	1	1	1	1	1
0	1	1	1	1	1	1	0	0	0	0
1	0	0	0	1	1	1	1	1	1	1
1	0	0	1	1	1	1	0	0	1	1

3.4 SEVEN SEGMENT DISPLAY

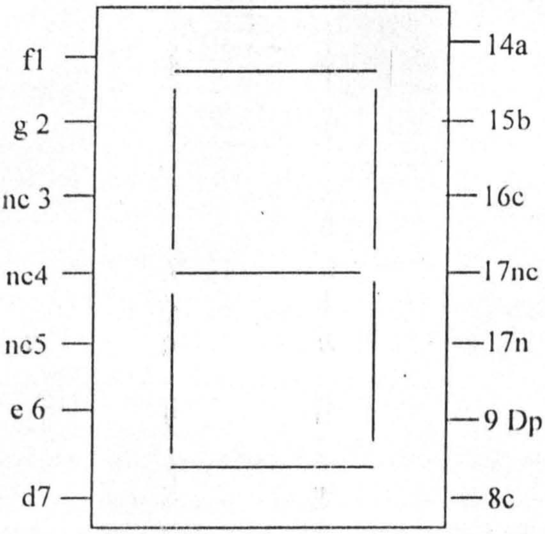
This is a very common output device used to display decimal numbers in the seven segment display. It is labeled "a" through "g". when segment a, b and c is lit, a decimal 7 is displayed. The typical LED in a 7 segment display can be accepted only about 1.7 to 2.1V across its terminal when its lit, so a limiting resistor is incorporated to reduce the amount of current flowing.



The shape of each decimal digit.



Common Anode Seven Segments Display Configuration.



Segment identification of the Seven Segment Display.

The Decoder/Driver (7447)

The design incorporated a BCD to decimal decoder/drivers. The 7447 common anode accepts a positive logic binary coded decimal input and converts it to the proper pattern to light a 7 segment display. This is a common anode decoder driver that decodes a 4-bit binary number and gives the proper logic output to display the decimal equivalent digit number on a 7 segment display. A low output is intended to light the segment.

CONNECTION DIAGRAM

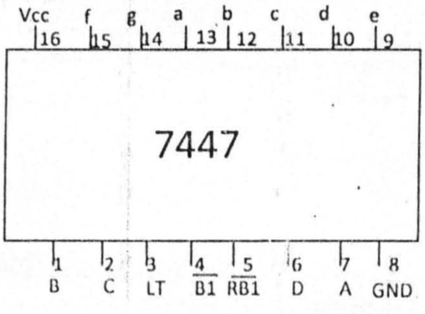


FIG 3.8 Pin Configuration of a 7447

OPERATING SPECIFICATION

Supply Voltage, Vcc	5V
Input Voltage	5V
I_{OH}	-200μA.
I_{OL}	10mA
Input Current	1mA
V_{OH}	2.4
V_{OL}	0.4V(maximum)
Operating Temperature	0°C-70°C
Supply Voltage	3-30V
Current per Segment	5V
Power Dissipation	700mA

CIRCUIT DIAGRAM CONNECTION

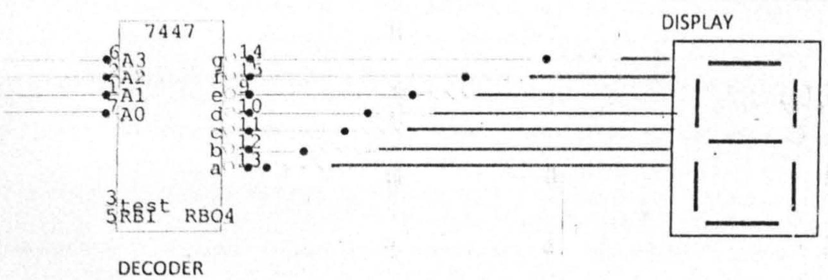


FIG 3.9 Circuit Diagram of BCD 7-Segment Decoder Driver with Common Anode Display

The resistor value R used could be gotten as follows. The voltage drop across the LED is given by.

$$5 - 0.7 - 4.3V$$

$$but$$

$$V_{ON} = 2.4$$

$$I_{OL} = 10mA$$

$$R = \frac{V}{I} = \frac{4.3 - 2.4}{10 \times 10^{-3}}$$

$$= 190\Omega$$

So a resistor of 220Ω was chosen for the implementation.

3.5 POWER SUPPLY

It is the most basic and necessary system in electronics. Its function is to convert the readily available AC supply 230V and 50Hz into a specific DC voltage.

The power supply source consist of a step down transformer, rectifier filtering capacitor and a regulator that gives a constant voltage required to drive the system.

The first stage of power supply unit design involves the stepping down of the 240V Ac mains from the main supply to about 15Volts AC with the aid of 240v/15, 1000mA transformer whose current capacity is enough to drive the entire circuit. The transformer is an electrical device that provide physical isolation between the 240v AC mains and the part of the circuit the only link is by means of magnetic flux, thus eliminating the risk of electric shock. The secondary rating of the transformer is the rms value that is Vrms = 15V

The peak voltage is given by

$$V_{peak} = \sqrt{2} \times V_{rms}$$

$= \sqrt{2} \times 5$

= 18.97V

$Vdc = \frac{2}{\pi} \times V_{peak}$

$= {}^{2}/_{\pi} \times 18.97V$

= 13.8v

Voutput = Vrms – 2vo

= 15 – (2x0.7)

= 13.6v

Where V = Voltage drop across diode

A bridge rectifier of SA is chosen for its capacity to carry a load up to 2A. the bridge rectifier basically convert the alternating current to a unidirectional direct current. The basic purpose of a DC filter is to produce a smooth power flow devoid of ripples.

A capacitor is chosen for this.

The capacitor value was chosen on the bases that its value can hold the peak to peak voltage ripple at approximately 10% of the peak voltage.

V ripple ${}^{10}/_{100}$ x V peak

0.1 x 18.97

= 1897v

Also V ripple = $^{1}/_{43FC}$

Where

F = Frequency……in…..Hertz

I = Current…….in….Ampere

C = Capacitance

C $^{1}/_{43 \times F \times Vr}$

= $^{2}/_{42 \times 50 \times 1.897}$

C = 2.9868mf = 2986uf

For safe design a capacitor value of 3300uf was chosen. Voltage Regulator is an electronic circuit designed to provide a predetermined DC voltage as well as minimize its variation due to variation in load current, temperature and load voltage for the voltage purpose of this project 7805 was chosen.

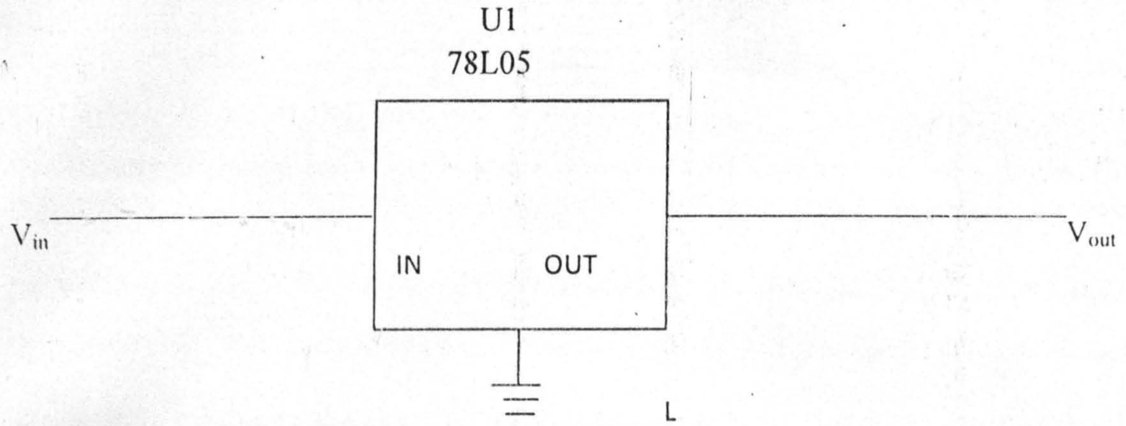
The voltage regulator has the following specifications

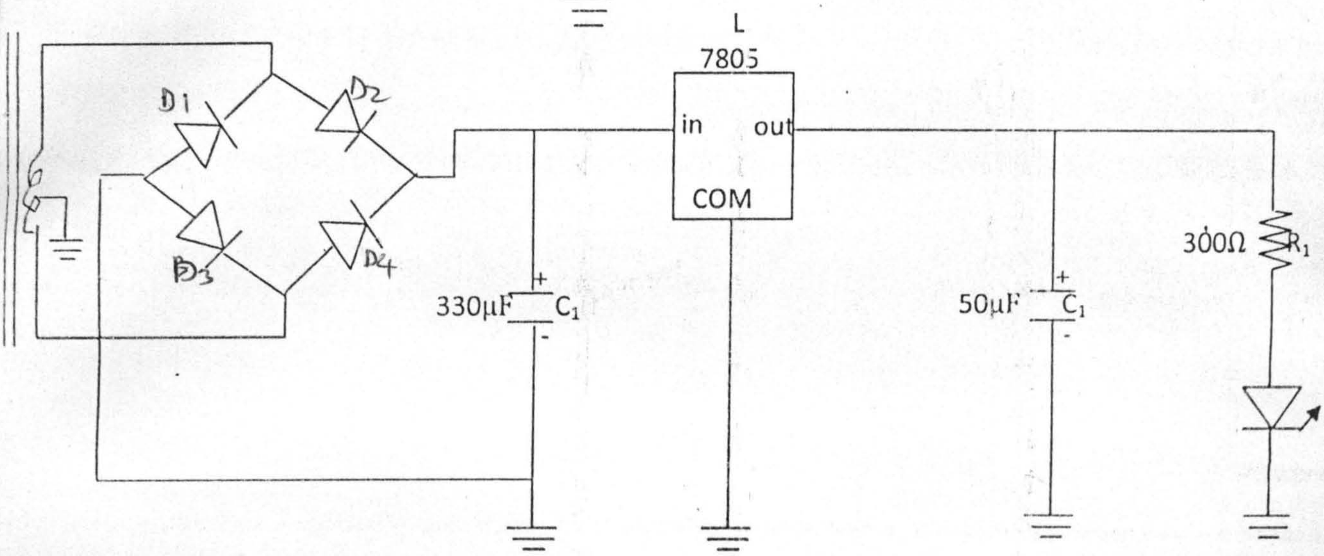
Input voltage 7.5v – 35v

Output voltage 15v

Operating temperature range 0.125°C

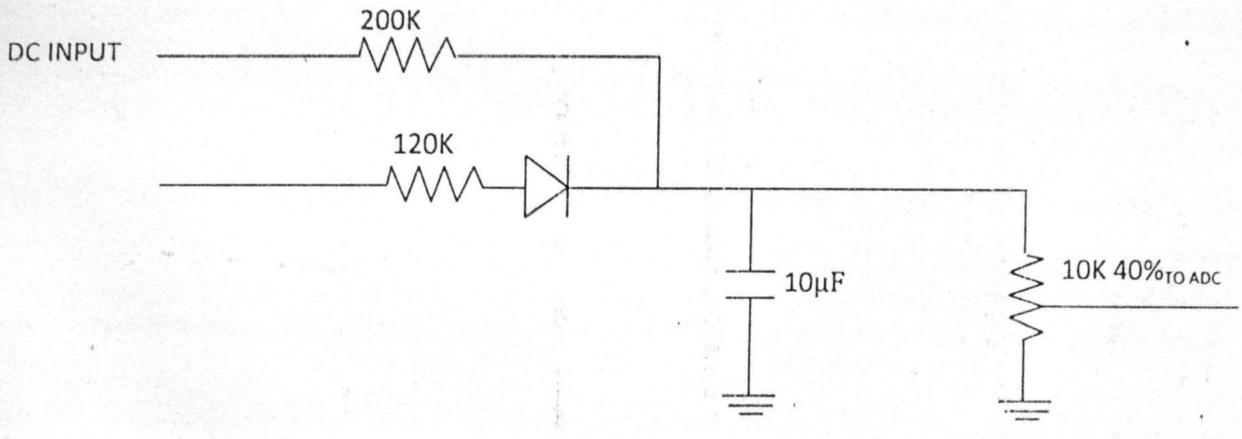
Output current max 1A





Circuit Diagram of the Power Supply

INPUT PROJECTION



The Circuit diagram of input projection

The main aim of the input protection is to be able to give over load projection to the digital water level detector by scaly down the voltage to an acceptable level. On Ac scale a resistor of 220kΩ was used for this while on Dc scale a resistor of 220kΩ was used for that purpose.

3.6 THE WATER LEAKAGE DETECTION UNIT

The water leakage detection unit uses float on the surface of the water to get the level of the water.

. A float made of wood on the surface of the water is attached to a variable resistor. As the water reduces the float draws down the slide contact and the changes in resistance is shown on a seven segment display. This is achieved by using a special form of a variable resistor called potentiometer. It has three terminals. Two terminals are connected to the opposite sides of the resistive element and the third connects to a sliding contact that can be adjusted as a voltage divided.

3.7 THE VOLTAGE AMPLIFIER UNIT

The Voltage Difference Amplifier have low inputs terminals and one output terminal, the output voltage being proportional to the difference in voltage between two input. Difference amplifiers amplify the voltage difference between two inputs each input influences the output voltage in opposite ways.

An increasingly positive voltage in the positive input tends to drive output voltage more positive and an increasingly positive voltage in the negative input tends to drive the output voltage more negative. Likewise an increasingly negative voltage in the positive input tends to drive the output voltage more negative as well and an increasingly negative voltage on the negative input tends to drive the output voltage positive.

It is because of the relationship between input and polarities that the negative input is commonly referred to as the inverting input and the positive input as the non-inverting input. Difference amplifiers are also used to compare two quantities to know which is greater (by the polarity of the output voltage).

In the digital water level detector design, in the difference amplifier unit, a reference voltage is applied to the inverting input and the voltage value corresponding to the low, middle and high water (at the probes) is applied to the non-inverting input of the difference amplifier. The output voltage of the difference amplifier serves as input to the non-inverting of three op-amps configured as comparators.

The difference amplifier works on the requirement that $R_2/R_1 = R_4/R_3 = A$

Where A = gain of the difference amplifier

The output voltage is defined by the following equation

$V_{out} = A\ (V_{non\ inverting} - V_{inverting})$

$V_{out} = A\ (V_2 - V_1)$

In the digital water level design a gain of 22 is desired. A = 22

$A = R_2/R_1 = R_4/R_3 = 22$

$R_2 = AR_1$

Let R_1 = 10kΩm $R_2 = 22R_1 = 22\ (10x10^3) = 220k\Omega$

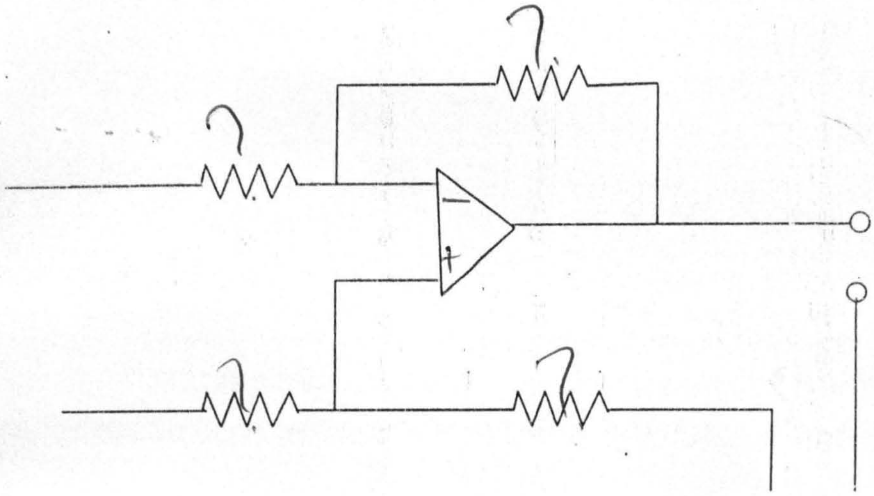
$R_2 = 220k\Omega$

Also R4 = AR^3

Let $R^3 = 10k\Omega$

$R_4 = 22\ (10\ k\Omega) = 220\ k\Omega L$

The Circuit diagram of the difference amplifier unit is shown below



Voltage Difference Amplifier Circuit Diagram

3.8 THE OUTPUT UNIT

The output device used in this project is a seven segment display to show the volume of water left in the vessel in order to avoid the possibility of water overfiliing the tank and spilling away.

3.9 CONSTRUCTION DETAILS

The entire circuit was divided into different sections for easy troubleshooting and construction, each of these units are soldered on different veroboards.

3.9.1 CONSTRUCTION OF THE POWER SUPPLY UNIT AND THE SEVEN SEGMENT DISPLAY

A switch was connected to the primary of the 12v transformer for the control of the AC power supply to the transformer, the secondary of the transformer was then connected to the bridge rectifier circuit formed by connecting four IN4001 diodes, the 220µF/50v capacitor was then connected between the output of the bridge rectifier and ground. The input pin of the 12v voltage regulator was then connected to the output supply after the capacitor and then second terminal Pin connected to the ground terminal, the output voltage was then obtained by, connecting a wire to the third terminal of the voltage regulator, a 0.01µF was then connected on a common line on the Veroboard, to obtained the 12v DC output voltage.

On the same veroboard, the seven segment display was mounted with all its components i.e. I.Cs, connecting wires e.t.c.

3.9.2. CONSTRUCTION OF THE WATER LEAKAGE UNIT

The water leakage unit was constructed using a plastic container on which an iron was use to connect or join the surface of the container to create a hanger in which a clipped variable resistor will hang on the surface of the water.

A float made of wood was used to determine the level of water in the container, and the float was clipped to the sliding contact of the variable resistor

A controlled opening was made at the base of the plastic container and a pipe was attached to it to act as the leakage unit.

3.9.3 CONSTRUCTION OF THE DIFFERENCE AMPLIFIER/VOLTAGE COMPARATOR

These units were connected on a single veroboard to avoid any likelihood of any broken connections and for easy troubleshooting.

The difference amplifier was connected by connecting 220KΩ and 10KΩ resistor to obtain the desired gain. The 220KΩ resistor was connected to the pin 2 (non-inverting) input of the difference amplifier to be configured.

Connecting Pin 1 to Pin 2 using a 220KΩ resistor formed a feedback path. The output of the difference amplifier (Pin 1) was then connected to Pin 12 which was also connected to pin 10 and 5 the non-inverting input of the three comparators. A reference voltage was obtained as input to the inverting input of the three comparators by forming a voltage Divider using a 680Ω, 220K Ω and 1KΩ resistors. The potentiometer terminals are connected to the output of the comparators via pins 7,8 and 14 the comparator outputs using a 1KΩ resistor connected to the anodes of the comparators, the cathode are connected to the respective points.

3.10 CONSTRUCTION TOOLS AND MATERIALS

The tools and materials as well as instructions used during the testing and construction of the project are briefly described below.

i. The breadboard: This is a temporary board for circuit testing with tiny sockets that allows for Electronic Components (i.e. resistors, capacitors, ICs e.t.c.) to be easily plugged on, remove freely without damaging the component. The breadboard is meant for pre-construction testing of circuit and sub circuit before components are soldered on the veroboard.

ii. The Veroboard: This is a perforated board on which electrical components can be inserted and soldered permanently. It is used for permanent construction of the project of the photo type from the circuit diagram.

iii. Wires and Connectors: Wires are used during the testing stage of the projects on the breadboard to connect components together as well as the different sub units of the circuit as well as during the soldering of the components on the veroboard. The type of wire used is the Copper wire.

iv. Wire Cutters/Strippers: These tools were used to cut wire to the desire size required before use as well as to strip off insulation of the wire in order to expose the conductor for proper and neat soldering.

v. Soldering lead: This is a metal (Lead) wire of low melting point. It is used to electrically connect components and wires in fixed position on the veroboard.

vi. Lead sicker: This is used to sick up excess molten lead form the veroboard to prevent short circuit (bridging) or undesirable electrical connections.

vii. Soldering Iron: This is a low power heating element typically 40watts. It provides the heat needed to melt the lead, so that it can be used for connection of the component permanently on the veroboard. It is usually connected to the AC mains.

viii. Socket: This is a device used to hold ICs in position, the ICs socket is first soldered on the veroboard, before the IC chip is fixed on it, to prevent the heat on the soldering iron from destroying the IC, which is very sensitive to heat.

ix. Analogue/digital multimeter: These were devices (instruments) used for measurement of electrical quantities such as resistors, voltage and current, there are also capable of being used to test circuit section for continuity. The digital multimeter gives a digital output digital of measured quantities while analogue meters gives an indication of the value of measured quantities on a scale, the value of which is read on the position of the pointer on the scale.

CHAPTER FOUR

4.1 TEST, RESULTS AND DISCUSSION

THE DISPLAY UNIT

The display unit was first isolated and powered to test for accuracy. it was observed that all displays were at 000.0 that is without Appling any voltage.

Measuring the output voltage after testing the power supply unit and it was found to be acceptable 9.1volts. The entire circuit was then tested by topping the container with water, with the float made of wood on the surface of the water clipped to the variable resistor, and then an opening was made at the base of the container. Water leakage detection is noticed or seen base on the variation of the resistance. As the water reduces the float draws down the slide contact and the changes in resistance was shown on a seven segment display.

4.2 CONSTRUCTION PRECAUTION:

1. All soldered joints (points) are tested for continuity so as to avoid unnecessary open circuits.
2. All the excess load time removed to avoid (short circuits) on the boards.
3. Polarities of the electrolytic capacitors were properly checked to be positioned before connecting (soldering) in the veroboard.
4. ICs were mounted on IC sockets to avoid over heating then during soldering by soldering the IC sockets first on the veroboard.
5. Excessive heating of the components were avoided so that they do not burn by making the soldering process to a component very brief.

4.3 PROBLEMS ENCOUNTERED

1. When the project was first tested, the response was not satisfactory, as I test the variable resistor found out the two terminals were not connected properly, so I had to switch the two terminals, as expected the seven segments gave the desire output.
2. The initial stage of soldering was characterized by some mistakes, such as overflow of molten load but with time this difficulty was over come.

CHAPTER FIVE

5.1.1 CONCLUSION

From the results of the test carried out after the construction of the project the leakage detector was able to detect when there is a leakage in the system by adjusting the variable resistances of the circuit thereby showing the various resistances at each level of the vessel by displaying them on a seven segment display

In summary, the aim and objectives of the project have been achieved satisfactory despite all odds encountered and resolved during the design and construction phase.

The device will be useful in homes, in the industries, hospitals, schools and dam sites to provide knowledge at the water quantity available for use.

The high efficiency and performance of the machine defends the detailed analysis given in this project report that the durability and workability of the device is not in doubt, neither its economic viability nor its value.

5.1.2 RECOMMENDATIONS

- The bulk of the power demanded of the water leakage detector was consumed by the seven segment display, so a liquid crystal display should be used instead of a seven segment display to minimize power consumption.
- Further research study was carried out in the suitability of infra red signal where the visible line of sight between the transmitter and receiver is observed by the water level and thus the generation & electrical signal to appropriate decoding circuits.

- Particular interest in the choice of infra red signal transmission is based on the fact that in accessible area like swamping areas a heavy construction site could make do with wireless (infra-red) signal transmission of data carrying state from the reservoir to the decoding circuits and hence to the display window
- The device could be taken as a case study and be built into a bigger device with larger variable resistance and dimensions

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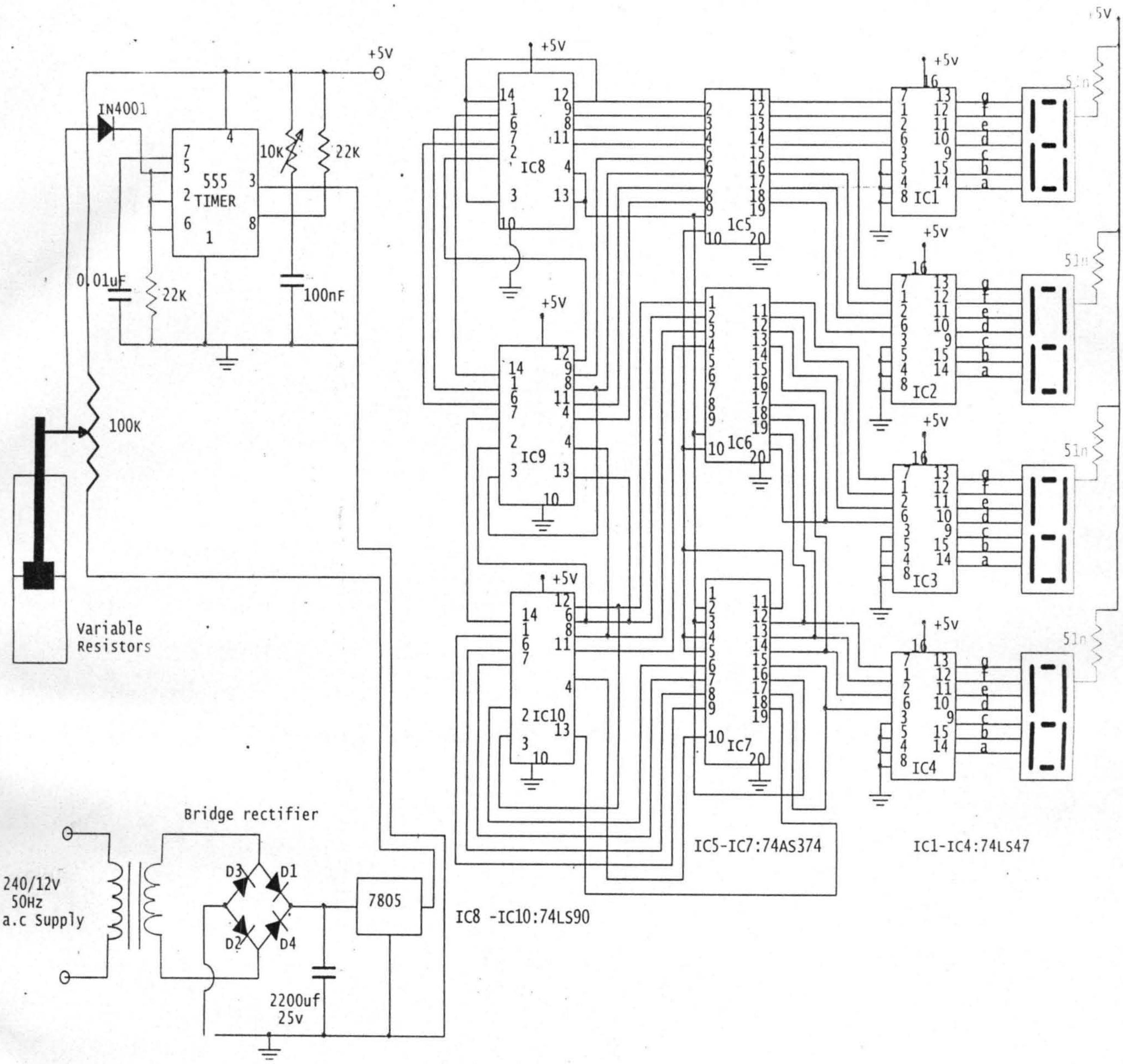

Circuit Diagram of a water leakage detector