DESIGN AND CONSTRUCTION OF DIGITAL WATER LEVEL DETECTOR

BY

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

OCTOBER, 2006

DEDICATION

This piece of work is dedicated to almighty God 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.

DECLARATION

I Yusuf Yakubu, declare that this work was done by me and has never been presented else where for the award of a degree. I also her by relinquish the copy right to the Federal University of Technology Minna

YUSUF YAKUBU

Signature and date

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External Examiner

Signature and date

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ABSTRACT

This project is design and constructed at a digital water level detector which is an instrument that indicates the level of the water in a tank low, middle or high level by the displaying of seven sequent and illumination of the appropriate light emitting diode (led).the idea was borne out of the need to have knowledge of the quantity of water in a tank and to avoid water wastage due to spillage or oven flow of water 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 water level detector indicate the level of water in a tank and other water storage vessels, example a water reservoir.

It indicates if the water level is at low, at the middle or at a high level of the water-containing vessels by appropriate light emitting diodes illuminating with digital display, displaying the amount of water at different levels.

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

With the introduction of automation during installation of reservoirs for storage and distribution, reliability is inevitable as compare to the monotonous native of work, boredom and fatigue in human operation (manual operation) which is usually characterized with different inefficiency and deterioration in performance.

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.

At home, knowledge of water level is necessary so that domestic activities such as cooking, washing as well as bathing and other activities require to maintain cleanliness and personal hygiene do not become tedious or even impossible. In the cleanliness and personal hygiene do not become tedious or even impossible. In the industries, it is necessary to maintain certain minimum reserve of water in the storage vessel(s) to take care of erratic water supplies from the public mains, in other to avoid a sudden disruption of manufacturing processes.

In the agricultural sector where a large quantity of water is needed for irrigation purposes it is necessary that a certain reserve of water be maintained in the reservoir at a minimum or maximum level to avoid milting of the plants or flooding of the farm land as well as to provide for the day season farming by controlling the flow of water either into an out of the reservoir.

In the hydro power generating stations where great quantity of water is stored in reservoir in dams and used to generate electricity, knowledge of the level of water in the dam is necessary so that the spillway can be opened for excess water to flow out in other to prevent the drawing of the dam.

In chemical engineering process, the knowledge of liquid is vessel such as the distillation columns, boilers, evaporators, and mixing tanks is very important in process operation, a level which is too high can upset chemical reaction equilibrium, cause damage to equipment or lead to the spillage of hazardous chemicals. A level, which is too low, can equally have bad consequences such as over heating of equipment or complete failure of operation.

Knowledge of water level in a tank is necessary to prevent the incidence of being taken unaware when the tank is empty as well as when the tank is full during filling. A large volume of purified water is wasted due to overfilling of tanks as a result of the inability to known when the tanks is full or any indication of the level of water in the tank.

Digital water level detector is designed with a view to solving the numerous problems associated with manual operation. It is completely aimed at operating automatically independent of any sort of human intervention.

1.2 AIMS AND OBJECTIVES

The aim of the project is to build and construct a functional electronic circuit device that is capable of interpreting electrical signals from probes which are inserted in any liquid container so that the amount or volume content of such vessel can be monitored on digital electronic readout (display).

1.3 PROJECT LAYOUT

Chapter one: This chapter gives the general overview of the project. The general introduction to the project, aims and objectives of the project are also contained in this chapter.

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

Chapter three: This chapter focuses on project construction. Testing, procedure employed to achieve the final product. It further elaborates on the timing circuits, design calculations, project casting, system coupling and illustration of packaged construction.

Chapter four: This chapter contains testing of results as well as discussion of the result, precautions taken and as well as the difficulties encounter in the course of the construction and testing.

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

CHAPTER TWO

2.0 LITERATURE REVIEW

The car list record of water level measurement was the use of the float regulator mechanism in Green in the 300 to 1BC using feedback control. The meter clock invested by Kleisibios used a float regular for measure the level of water in a contamer on which a scale attached is used to take the reading of time.

Russion Pulzunov 1 in 1765 invented the water level float regular using feedback system: the float detects the water level and controls the value that covers the water inlet in the boiler [3].

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 [1, 16].

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 it's other end a counterweight or a negative-rate counter spring is attached. the amount of rotation of the pulley measured by either a synchro or 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 [1,3]

Pressure measuring devices used for water level measurement 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 are 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 [1, 16].

Capacity devices are used for measuring liquid level in such applications as for measuring level in liquid metals (high temperature) corrosive liquids (less than 0.1 micro dm/cm^3), two bare metal capacitor plates in the form of concentric cylinders are immersed in the substance, the liquid behaves as a dielectric between the places according to the depth of the liquid for conducting liquids. same method applies, but the capacitor plates are encapsulated in an insulating materials. the dielectric effect of the insulator is put into consideration. The radiation method utilizes a radiation source and system located in a liquid filled tank. The absorption of both beta rays and gamma rays varies with the amount of liquid level. Caesium – 137 is a gamma ray source which is commonly used for this purpose, the radiation level is measured by the detector. I is related to the length of liquid in the path x, according to the relation

$$I = I_0 e^{-u\rho x}$$

I_0 = intensity of radiation received by the detector in the absence of any liquid.

U = mass absorption coefficient for the liquid

P = mass density of the liquid [1,6]

The principle of vibrating level sensor consists of two piezoelectric oscillators fixed to the side of a hollow tube, which generates flexural vibrations in the tube a its resonant frequency. The resonant frequency of the tube varies according to the depth of its immersion in the liquid. A Phase Locked Loop (PLL) circuit is used to track the changes in resonant frequency and adjust the excitation frequency applied to the tube by the piezoelectric oscillator. Liquid level measurement (detection) is therefore, obtained in terms of the output frequency of the oscillator when the tube is resonating.

The ultrasonic level gauge principle use energy from an ultrasonic source above the liquid reflected back from the liquid surface into an ultrasonic energy detector, measurement of the time at flight allows the liquid level to be inferred. The Stevens ultrasonic level transmitter is solid state device for sensing water level in channels, lakes or streams for input to a data logger on other inventorying unit, analogue output can be configured normal or inversely proportional to the distance form the target or water surface [1, 16].

The seven submersible depth transmitter is a sensing device designed for water level measurement application. Higher range unity is used for grand water, storage tank or other applications. Low range units are I deal for open-channel flow applications, a stain loss steel pressure transducer is used as the primary sensing element, and it measures the water depth by pressure above the unit [1, 16]

The improvement in technology in the semiconductor industry to the development of the operational amplifiers were developed initially for use in performing arithmetic operations such a 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 it's two inputs, as well as for comparison of voltages as a comparator, comparing reference voltage with a varying voltage. without any feedback the operational amplifier is used as a comparator. [4, 5, 10, 14]

CHAPTER THREE

3.1 DESIGN AND CONSTRUCTION

3.1.1 Principles of Operation

The digital water level detector operates based on the principle that the conductivity of water increases with increase in separation distance of the measuring probes, placed at different levels (distances) from the bottom of the water storage vessel (tank).

A reference probe supplied with a fixed value of direct current (D.C) voltage is positioned at the bottom of the water storage vessel and the reference probe serves input to the different amplifier which amplifies the voltage difference between the reference voltage which serves as input to the different amplifier which serves as input to the inverting input and the voltage transducer at the probes positioned above the reference amplifier. The output voltage of the difference amplifier then serves as the input to the non-inverting input of the voltage comparator/window detector with a reference voltage applied to the inverting input of the comparators.

The light emitting diode (LED) illuminates corresponding to the level of water in the tank. If the reference voltage is below the voltage at the non-inverting input of each the three comparator, the LED at the output of the corresponding comparator illuminates. At a low water level in the tank the yellow LED illuminates. when water gets to the mid-level of the tank the green LED illuminates and the red LED illuminates when the water in the tank is at a high level, seven segment display zero when the vessel is empty,display one when water level is low, two is display when water is at the middle and three is display when water is at high level.

3.2 THE POWER SUPPLY UNIT

All electronics devices utilize a direct-current (DC) voltage sources for operation. The main electricity supply is an alternating current at a voltage of 220V A.C. A circuit is therefore required to step down this voltage to the required value as well as to convert it to the Direct Current (DC) voltage form required by electronic devices for operation.

Although batteries provides a cheaper source of direct current voltages, it cannot satisfy the amount of current drawn by most electronic devices for a long time as the battery is quickly drained and thus becomes inefficient, hence an AC to DC conversion is done by the power supply unit to avoid these inadequacies of the battery.

The power supply is made up of transformer, a rectifier (bridge), a filter and a voltage regulator which all function together to transform the alternating current (AC) voltage supply from the main into a regulated DC supply as the output of the supply unit.

Figure 3.1 shows a block diagram of the power supply unit.

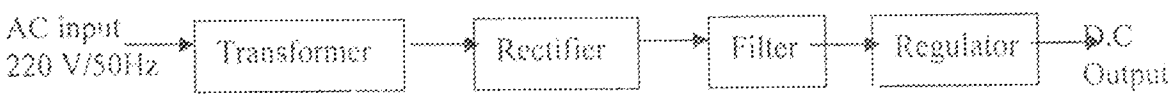

Figure 3.1 power supply unit block diagram.

3.2.1 The Transformer Specification

The first stage of power supply unit design involves the stepping down of the 240V AC mains from the mains supply to about 15 volts AC with the aid of 240v/15v, 1000mA transformer whose current capacity is enough to drive the entire circuit [2]. The transformer is an electrical device that provides physical isolation between the 240v AC main and the rest part of the circuit, the only link is by means of magnetic flux, thus eliminating the risk of electric shock[7].

It consist of two coil the primary winding and the secondary winding.

Figure 3.2 shows the circuit symbol of a transformer.

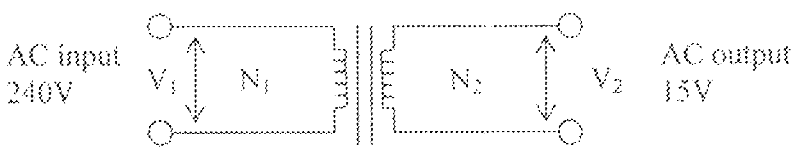

Figure 3.2: Transformer circuit symbol

From the transformer $V_1 = 240V$, $V_2 = 15V$, $I2 = 100mA = 1A$, the frequency of the AC main supply is 50Hz.

The primary and secondary voltages of an ideal transformer are related as follows.

$V_1/V_2 = N_1/N_2 = 240/15 = 16$

Hence the turns ration $N_1:N_2 = 16:1$

In an ideal transformer the magneto motiveforce (mmf) = N_1

$N_1I_1 = N_2I_2$

$$\frac{N_1}{N_2} = \frac{I_2}{I_1} = 16$$

$I_2 = 1000mA = 1A$

$$\frac{I_2}{I_1} = 16$$

$I_2 = 16I_1$

$$I_1 = \frac{I_2}{16} = 0.0625A = 62.5mA$$

Power input = power output

$P_1 = P_2$

$I_1V_1 = I_2V_2$

$62.5 \times 10^{-3} \times 240 = 1000 \times 10^{-3} \times 15 = 15w$

3.2.2 The Rectifier Specifications

The rectifier convert the 15v, AC voltage from the secondary of the transformer into a pulsating DC voltage and the process is called rectification. A full wave bridge recfier circuit is used for rectification [2]. It consist of four IN4001 diodes arranged as shown in figure 3.3 below

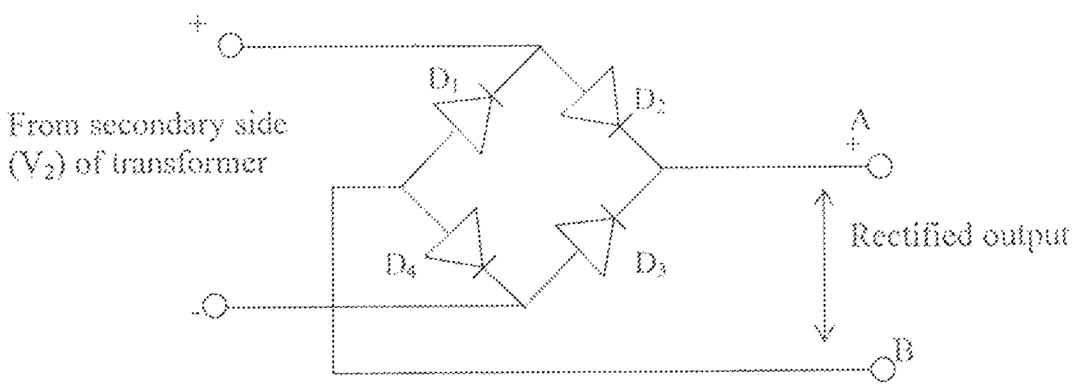

Figure 3.3. Full – Wave Bridge Rectifier Circuit Diagram

During the positive half cycle of the secondary voltage, diode D_2 and D_3 are forward biased, therefore the load voltage has the negative half cycle diodes D_1 and D_4 are forward biased, on either cycle the load voltage has the same polarity because the load current is in the same direction no matter which diodes are conducted. The full secondary voltage appears across the load resistor hence the bridge rectifier is better than the full wave rectifier [17].

The output voltage of the transformer secondary winding V_2

V_2 = 15 volts.

V_2 (peak) = $V_2\sqrt{2} = 15\sqrt{2} = 21.21 volts$

The average DC voltage V_{dc} across terminal AB

$$V_{dc} = \frac{2}{\pi V_2} = \frac{2}{\pi(21.2)}$$

V_{dc} = 0.636V_2 (peak) = 0.636(21.21) = 13.49volts.

3.2.3 The Filter Specification

The filter circuit is to minimize the ripple of the rectifier output. The output voltage wave from of a rectifier is pulsating, it has both DC components and some AC components called ripple, this type of output is not useful for driving electronic circuit.[2]

A circuit that convert a pulsating output from a rectifier into a steady DC level is known as a filter because it smoothens out the pulsations in the output

Capacitive filtering is adopted in the design where a large electrolytic capacitor is connected to the rectifier output. The capacitor charge up during the diode connection period to the peak value and when the rectifier voltage falls below this value the capacitor discharges through the load so that the load receives almost steady voltage.[9]

For a r.m.s. (root mean square) voltage of 15 volts from the transformer secondary terminal.

$V_2(peak) = r.m.s \times \sqrt{2} = 15\sqrt{2} = 21.21volts$

Let the ripple voltage be 20% of this value, dv = 20% of 21.21 = 4.24

$\frac{1}{C} = \frac{dv}{dt}$

$C = \frac{dt}{dv} = \frac{5m/s}{4.24} \quad (where\, dt = 5ms^{-1})$

C = 1179.2μF.

However, a preferred value (standard) value of 2,200μF/50volts was used. The arrangement is shown in figure .4 below.

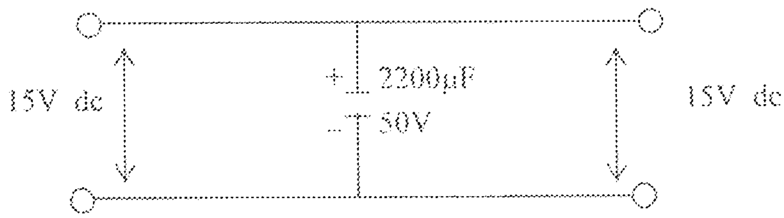

Figure 3.4 Filtering Capacitor Circuit Diagram

3.2.4 The Voltage Regulator Specifications

The output voltage of the filter capacitor varies when the load current or the input voltage varies, this effect is undesirable. In an unregulated power supply, output voltage is never constant. The functions of the voltage regulator is to reduce these variations to zero [2].

A voltage regulator is a circuit that holds an output voltage at a predetermined value regardless of the change in normal voltage or charges in load impedance voltage regulators which comes in a three terminal package. They have one input terminal, one output and a ground terminal.[7]

A voltage regulator requires an input voltage at a minimum of 3 volts above the output voltage, it is designed to deliver, hence the choice of a transformer of 15volts at the secondary terminal for the use of a voltage regulator of 9 volts.

The LM 7809 voltage regulator was used. A capacitor of 0.01µ was connected at the output to filter off any ripples left on the supply line. Figure 3.5 is the complete circuit diagram of the power supply unit.[9]

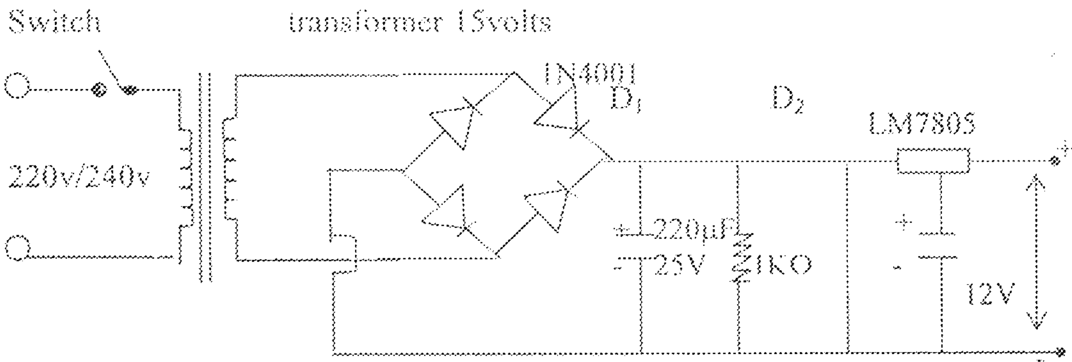

Figure 3.5 power supply unit circuit diagram

3.3 THE WATER DETECTION UNIT

The water detection unit uses aluminium conductors as the probe to convert(transducer) the water level into electrical signal (D.C voltage).

It does this based on the principle that the conductivity of water, which increase with the increase in separation distance of the sensor, probes, from the reference probe.[14]

All aqueous solutions conduct electricity of various degrees, the conductivity of liquids vary with temperature, volume and separations distance of the sensor (measuring) probes. In the water detection unit the common or reference probe positioned at the bottom of the tank is connected to the reference voltage source, the low probe is positioned at the minimum desire water level in the tank and high probe at the maximum desired water level of the tank.[16]

Figure 3.6 shows the arrangement of the probes in the water detection unit.

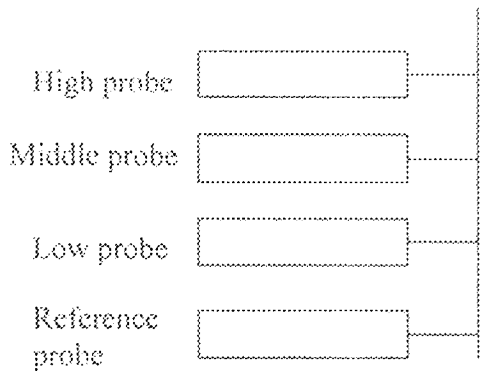

Figure 3.6 Arrangement of the probes in the water Detection Unit

3.4 THE VOLTAGE DIFFERENCE AMPLIFIER UNIT

Difference amplifiers, also known as differential amplifiers 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 differences between two inputs, each input influences the output voltage in opposite ways.[4]

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 on the positive input tends to drive the output voltage negative as well and an increasingly negative voltage on the negative input tends to drive the output voltage positive.[5]

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).[11]

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:

$$\frac{R_2}{R_1} = \frac{R_4}{R_3} = A$$

Where A = gain of the difference amplifier

The output voltage is defined by the following equation

$V_{out} = A$ (Vnon inverting – Vinverting)

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

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

$$A = \frac{R_2}{R_1} = \frac{R_4}{R_3} = 22$$

$R_2 = AR_1$

Let $R_1 = 10k\Omega$m $R_2 = 22R_1 = 22 (10 \times 10^3) = 220k\Omega$

$R_2 = 220k\Omega$

Also $R_4 = AR_3$

Let $R_3 = 10k\Omega$

$R_4 = 22(10k\Omega) = 220k\Omega$ [10]

The circuit diagram of the difference amplifier unit is shown in figure .3.7

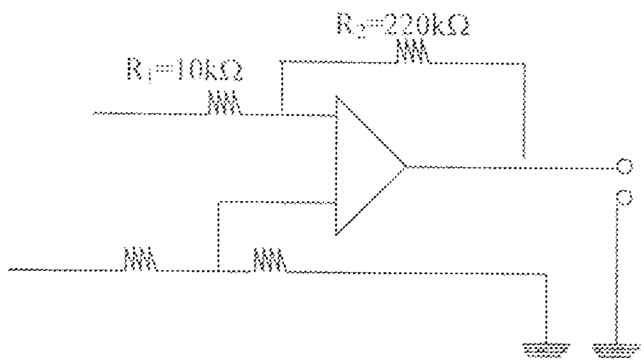

Figure 3.7 Voltage Difference Amplifier Circuit Diagram

3.5 THE OUTPUT UNIT

The output devices used in this project are light emitting diode (LED) to give a visual indication of the water level and seven segment display to show the volume of water left in in the vessel in other to avoid the posiblity of water overfilling the tank and spilling away.

3.5.1 The Light Emitting Diode (LED) Specification

When sufficient voltage is applied to the LED chips across the leads of the LED, electrons can move easily in one direction across the junction, between the P and N regions. Each time an electron recombines with a positive charge, electric potential is converted into electromagnetic energy for each recombination a quantum of electromagnetic energy is emitted in the form of photon of light. [6]

Ordinary diodes are made of silicons, an opaque materials that does not allow light to pass through. LEDS are different, by using elements like gallium, arsenic and phosphorous, a manufacturer can produce LEDs that radiate red, green, orange, amber and white colour. The Led leads are identified with the anode lead being longer than the cathode lead and the cathode lead can be identified with a flat or notch cut on it lead plastic case side. The series resistance value (R) required to limit current flow to the LED can be obtained from the relationship

$$R = \frac{(V_S - V_{LED})}{I}$$

Vs = supply voltage

V_{LED} = LED voltage

I = LED current [13]

In the Digital water level detector, Yellow LED is used to indicate when the water is at low level. The green LED is used to indicate the water is at middle level of the tank. The red LED is used to indicate when the water in the tank is at a high level. At a voltage input to non-inverting input of the comparator slightly higher than the reference voltage of each of the comparartor, the output voltage of the comparator = V_{cc} = 12V [7]

To obtain the value of the current limiting resistor used for each of the LED

$$R = \frac{(V_S - V_{LED})}{I}$$

V_s = 12V, V_{LED} = 1.7V, I = 30mA

$$R_R = \frac{(9-1.7)}{(30\times10^{-3})} = 243.3\Omega$$

To calculate the value of the current limiting resistor value for the yellow LED R_y where V_{LED} = 2.1

$$R_y = \frac{12-2.1}{30\times10^{-3}} = 330\Omega$$

To calculate the value of the current limiting Resistor Value of Green LED R_G

V_S = 12V, V_{LED} = 2.2V, I = 30mA

$$R_G = \frac{12-2.2}{30\times10^{-3}} = 326.67\Omega$$

However, in other to get approximately constant brightness a preferred series of resistor value of 1kΩ was used for all the three LEDs.

3.5 SIGNAL GENERATING UNIT (THE DECODER)

The 4 to 16 decoder (De-multiplexer) has 16 possible output combinations it can accept both high and low input states. By design, the NS7446 logic decoder is build to e activated in the low state (i.e a low input signal turns on an output).

Digital water level detector is designed to respond to low input signal serially as they occur. This means that the next acceptable input signal depends only on the one before or after the present input combination. This is explained better in the table below

Table 1: shows the output displayed

BINARY INPUT COMBINATION	**DECIMAL QUIVALENT**	**VOLUME STATUS**	**VOLUME CONTENT**
0 0 0	0	EMPTY	00
1 0 0	1	LOW	01
1 1 0	2	HALF	05
1 1 1	3	HIGH	10

From the table, it is quite obvious that when the water level is at half capacity it can never jump to high level capacity without passing through the half level neither can it move to empty without passing through the low level accordingly.

It is based on this binary input combinations as selected by the probes that the Decoder sets the decimal equivelent corresponding to the binary input which will further be manipulated by the numeric display driver to yield the appropriate decimal volume content.

3.6 CONSTRUTION TOOLS AND MATERIALS

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

i. the simulation; the circuit diagram was tested on the computer using the circuit maker software for the simulation the output voltage required to illuminate each of the light emitting diodes was measure to know if the value will be sufficient to illuminate the LEDs. the wave form at these out put was also viewed using probes. The circuit diagram functioned as desire.

ii. The breadboard; this is a temporary board for circuit testing with tiny sockets that allow for electronic components (ie resistors, capacitors, ICS etc) to be easily plugged on removed 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

iii. Analogue/digital multimeter: These were devices (instruments) used for measurement of electrical quantities such as resistance, voltage and current there are also capable of being used to test circuit section for continuity. The digital multimeter gives a digital out put display 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.

iv. The Vero board: This is a perforated board on which electric components can be inserted and soldered permanently. It is used for permanent construction of the project of the prototype from the circuit diagram.

v. Wires and connectors: wires are use during the testing stage of the project on the breadboard to connect components together as well s 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.

vi. Sockets: This is a device used to hold ICS in position, the IC socket is first soldered on the veroboard, before the IC chip is fixed on it , to prevent the heat of the soldering iron form destroying the IC, which is very sensitive to heat.

vii. Wire cutters/strippers: These tools are used to cut wires to the desired size required before use as well as to strip off insulation of the wire in other to expose the conductor for proper and neat soldering.

viii. Soldering iron: This is a low power heating element typically 40 watts. It provides the heat needed to melt the lead, so that it can be used for connection of the components permanently on the Vero board. It is usually connected to the Ac mains.

ix. Soldering lead: This is a metal (lead) wire of low meting point. It is used to electrically connect components and wires in fixed position on the Vero board.

x. Lead sucker: This is used to suck up excess molten lead from the Veroboard to prevent short circuit (bridging) or undesirable electrical connections.

3.7 CONSTRUCTION DETAILS

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

3.7.1 Construction of The Power Supply Unit

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 2200µf /50v capacitor was then connected between the output of the bridge rectifier and the ground. The input pin of the 12v voltage regulator was then connected to the output supply after the capacitor and the 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 obtain the 12v Dc output voltage.

3.7.2 Construction of The Water Detection Unit

The water detection unit was (constructed using aluminum conductors, which were cut into four numbers of equal lengths these were the positioned at different height levels passing then through a hole at the height level made on a plastic measuring ruler.

A connecting wire for the reference voltage was then connected to the reference probe placed at the lowest level. The low, middle and high level probe were positioned passing them through the hole made in the ruler at the desire low, mid, and high water level. These three probes were then connected together to makes electrical contact to each of these three probes.

3.7.3 Construction of the Difference Amplifier/Voltage Comparator/ LED Units

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

The difference amplifier was constructed by connecting 220kΩ and 10kΩ resistors to obtain the desire gain. The 220kΩ resistor was connected to the pin2 (non-inverting) input of the difference amplifier to be configured.

Connecting pin1 to pin2 using a 220kΩ resistor formed a feed back path. The output of the difference amplifier (pin1) 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 obtain as input to the inverting input of the three comparators by forming a voltage divider using a 680Ω, 220kΩ and 1kΩ resistors. The LED units 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 cathodes are connected to the respective points.

CHAPTER FOUR

TEST, RESULTS AND DISCUSSION

4.1 TEST AND RESULTS

Meaning the output voltage after testing the power supply unit, and it was found to be acceptable 9.1 volts. The entire circuit was then tested by inserting the probes into a container; water was then gradually poured into the container to increase the value of the water in the container. Alone of the LEDS illuminate before the bucket was filled with water and digital display show zero (o). The yellow LED illuminate with seven segment display 1 when water reached the position of the low water level.

The green LED illuminate with seven segment displaying 2 when the water level reached the mid point position of the high level of the container.

Tabble3.1 show a summary of digital water test and results obtained.

Table 2 Water Level Test And Results

WATER LEVEL	YELOW LED	GREEN LED	RED LED	SEVEN SEGMENT DISPLAY
BELOW LOW PROBE	OFF	OFF	OFF	0
LOW PROBE	ON	OF	OF	1
MIDDLE PROBE	OF	ON	OF	2
HIGH PROBE	OF	OF	ON	3

4.2 CONSTRUCTION PRECAUTION

1. All soldered joints (points) more tested for continuity so as to avoid unnecessary open circuits.
2. All the excess load line removed to avoid (short circuits) on the boards.
3. Polarities of the electrolytic capacitors and LEDs were properly checked to be correctly positioned before connecting (soldering) in the Vero board.
4. ICs were mounted on IC sockets to avoid over heating then during soldering by soldering the IC socket first on the Vero board.
5. Excessive heating of the components was 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. the probes were then positioned to be directly above the reference probe and the reference voltage to the reference probe was adjusted. On testing again, a satisfactory result was obtained with the LED illuminating as expected with the seven segments giving 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 our come.

CHAPTER FIVE

CONCLUSION AND RECOMMENDATIONS

5.1 CONCLUSION

From the results at the tests carried out after the construction of the project the water level detector was ale to detect when the water in a tank is at low level, middle level (height) of the tank or at a high level of the tank, with seven segment displaying the volume of water at the appropriate levels.

In summary, the aims 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.

5.2 RECOMMENDATON

In the design, the water level was measured at pre-set points only. This can be improved by using differential approach like varying resistance with liquid level using an analogue to digital converter (ADC) to generate corresponding binary data to be processed. This will make it possible to know the exact liquid level in the container at any point in time and communicated to the user instantly on the display window.

Further research study was carried out on the suitability of infra-red signal where the visible line of sight between the transmitter and receiver is obstructed by rising water level and thus the generation of electrical signal to appropriate decoding circuits.

Particular interest in the choice of infra-red signal transmission is based on the fact that in accessible areas like swamping areas or 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.

As a result of the constant action of various liquids with the probes, it will be necessary to ensure that metallic points of contact for the probes are made of metallic coats or corrosion resistance materials. Chromium, Vanadium and Silver are good corrosion materials. [6]

REFERENCES

[1] ALANS. MORRIS, principles of measurement and instrumentation. John Willey and sons Inc. 1992 pp 98-100

[2] A.K THERAJA, B.L THERAJA, A Textbook of electrical technology, S. Chand and company limited. Ram Nagar. New Delli, 1999. ISBN: 81-219-0289-4. pp 1742-1746.

[3] DORF R.C and BISHOP R.H, modern control system, eight edition. Addison Wesley, Longman Inc. England 1998. ISBN: 0-201-32677-9 pp 4-8.

[4] D. ROY, CHOUDHURY, SHAIL JAIN, linear integrated circuit. John Wilby and sons 1991. 0-470-21705-7 pp 221-225

[5] JOHN C.C NELSON, Operational Amplifier circuit: Analysis and Design. Batter Warth-Heineman publishers. 313 Washington street Newton, Boston USA 1995. ISBN: 0-506-9468-8 page 22-26.

[6] Lenc Jones basic electrics for tomorrow's would. Cambridge university press 1996, ISBN: 0-521-58687-9 page 77-78

[7] Malvino P.A principles of electronics mc-Grow-Hill publishing company Inc. New York 1999. ISBN: 0-521-49846-5 pp 98-100

[8] MICHEAL NELKON, PHILLIP PAKER. Advance level physics seventh edition, Heineman publishers, 1993 pp 803-804.

[9] REIS R.A DIGITAL electronics through project analysis.

[10] WILLIAM L. Faissler. an introduction to modern electronics, john will and sons Inc 1991: pp 295-297 ISBN. 0-471-62242-7

[11] WWW. all about circuits. Com

[12] WWW. Electronics lab.com

[13] WWW. Kpsec. Freeuk.com

[14] WWW. National.com

[15] WWW. Ougelph. Ca

[16] WWW. Stevens's water.com.