DESIGN AND CONSTRUCTION OF AN AUTOMATIC FLOW CONTROL DEVICE AND WATER LEVEL DETECTOR FOR PUMPING MACHINE

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THIS PROJECT IS SUBMITTED TO THE DEPARTMENT OF ELECTRICAL/COMPUTER ENGINEERING IN PARTFULFILMENT OFTHE REQIREMENT FOR THE AWARD OF A DEGREE OF BACHELOR OF ENGINEERING (B.ENG)

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DEDICATION

I dedicate my project to GOD my Heavenly father whom I put first in everything I lay my hands on or do. I also give him all the glory and adoration because I experienced his mighty hand during the execution of my project and to my Parents Mr and Mrs Odupe for their love support and care for me.

DECLARATION

I declare that this project titled "Automatic Flow Control and Water Level Detector for Pumping Machine" was carried out by Odupe Olukayode Oluwamayowa, of the Department under the Supervision of Mall am Suleiman Zubair for an award of Bachelor of Technology (B. Tech.) of the Department of Electrical/Computer Engineering Department, The Federal University of Technology Minna, Niger State.

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(Signature and Date)

ACKNOWLEGEMENT

With thanks to GOD ALMIGHTY the author and finisher of all things in the world. I owe to my GOD everything, because he is my creator and without him I am nothing and also without him this project wouldn't have come to past.

My thanks also go to my father and mother Mr and Mrs Odupe for giving me the best gift in life which is "Education". I thank my parents for giving up all they have to ensure that I get Educated. I thank them for their love, support, encouragement, understanding & advice that I used to see through the university. I also want to thank my parents for their struggle in putting me back on track when I seem to derailing and losing my focus while I was still in school. I want them to know that no amount of words can ever express my gratitude for their love and care. I will forever be grateful to them.

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- My supervisor Mallam Zubairu Suleiman for being there for me when I needed a supervisor and for the fear of God embedded in him.

ABSRTACT

The water level detector and the flow control device for the pumping machine concept are to control the operation of the pumping machine and also detect the Maximum and Minimum level of water in a tank. The ideology of the device is to better the pumping machine operation and to bring convenience in the operation of pumping of water and liquid. The device is electronically calibrated and operated to control the level; of water and other liquid in a tank and also calibrated to a visual output to indicate the water level to indicate a specified level. After the successive design of the Flow Control Device, It was tested and found very efficient for Pumping and distribution of water.

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CHAPTER ONE

GENERAL INTRODUCTION

1.1.1 Introduction

In the world we live today, technology has become a thing of great importance and advantage to the human world and the use of machines to better improve the daily activities of people in their place of work & homes. Also, as a result of technological applications, electrical components and devices, chemical components coupled together alongside mechanical components to form an entity such as machines that improve the standard of living of people are by products of our modern day technology. These various machines include motor vehicles, used in transporting heavy load, Turbine generators, used in power generation. Pumping machines used in drawing water and so on.

Our area of focus on technological applications is the use of Pumps and how it can be designed to better improve the operations of pump machines. In most factories, homes and various place of work like offices, pumping machines are used to draw and distribute water into the building for daily use.

Water, Urine, Juice drinks are "Non Volatile Liquid" which are our basic concern of the type of liquid is in this context. All this mentioned liquids require pressure to flow effectively. So therefore the pumping machine was designed to control the flow of these waters.

Most operation of the pumping machine to pump water in a tank requires an operator to always monitor the liquid level or water level in a tank. Whoever operates the machine is always obliged to monitor the liquid level of water in the tank, which may be some meters above the ground level. The operator in most cases has to monitor constantly the water level to avoid flood or wastage of water from where the water is being pumped from which is stressful.

Hence, a device to tackle this type of problem was constructed to help reduce the stressful act. The device is electronically calibrated and constructed to determine the level of water in a vessel or a tank by means of sensing the water in the tank. Not only is the device constructed ton detect the water level in a tank, but also it its design include "flow control mechanism" which automatically pumps water into a tank from a reservoir after reaching a minimum level in that tank, so that water can be in the tank at all times. The device activates the pump to pump back water into a tank at all times so long as water is in the reservoir. Absence of water in the reservoir bring about no pumping of water, and when water is being pumped from the reservoir to the tank, the pumping stops automatically, as soon as the water reaches the highest level in the tank.

1.1.2 Aims and Objectives

The aims of constructing and designing the "AUTOMATIC FLOW CONTROL AND WATER LEVEL DETECTOR" are to achieve the following goals.

1) To provide automatic control option of the pumping machines, should incase an operator is not present to monitor the operation of the machine.

2) To put into practice, the various theories learnt in school such as analogue digital and power electronics, diode, transistor operation and their various types.

3) To better improve the standard of operation for sake of ease and convenience to an operator.

4) To avoid wastage of resources through spillage due to the tanks overflow of any liquid in consideration.

5) To create indicators that will alert a user of such machine to detect and monitor the water level.

CHAPTER TWO

THEORETICAL BACKGROUND

2.1.1 Theory of water conductivity

Water conductivity is a quantitative measure of the ability of water to pass electric current. The ability depends on the movement of ions (dissolved species carrying on electric charge) in the water. Generally, it can be said that, the greater the number of ions specific type in water, the greater will be its ability to conduct. It should be noted that conductivity varies with temperature. In this report the conductivity different sources of water at 25^0C are summarized in tabular form.

SOURCES	**CONDUCTIVIYTY IN MICRO SECONDS PER CM**	**P.H**
SEA WATER	**51,100**	**7.9**
RIVER WATER	**915**	**7-8**
WELL WATER	**570**	**7.3-7.9**
MOOR LAND WATER	**150**	**6.5-7.2**
WATER FROM ARID ZONES	**1,000-7,000**	**7.5-8.5**

It should be noted that the reciprocal of these conductivities, give the resistivity in mega ohm per cm. For instance, the resistivity of river is 1/915m ohms/cm. Now for a unit length, the resistivity of river is 1/915 x 100 mega ohms = 109kΩ. Generally, if treated, I have a lesser conductivity as compared with treated water. This is because most of the conducting ions have been removed during the treatment process. The conductivity of water has made this project be put into considerations

2.1.2 Literature review

The use of float switches in detection and control of water level has been in existence for a very long time. These float switches are used in industries where weather level need to be detected or controlled. The basic principle of a float switch is that, one of the switch contact floats on water while the other contact is made to be stationary. As water rises the float rises until the switch becomes closed. This contact may be part of a motor control circuit, which drives the pump. Float switches have some mechanical elements since there is movement before contact is made in them. On the other hand, electronic devices have been used as switch, light operated switch e.t.c. Most of these switches are sensors. The sensor may be a voltage divider network to apply potential to a switching circuit.

Some of the switching circuits include: Single transistors circuits, thyristors switching, and Schmitt trigger switching circuits and so on.

Earlier, Barry G. W. (1984) revealed that single transistor could be used as light operated switch. In his design, a photocell was used in a voltage divider network to forward bias or reverse bias a transistor depending on the intensity of light on the photocell.

2.1.3 Historical background

Throughout history, the supply of water for drinking, domestic, irrigation and industrial purposes has always been a vital consideration in Muslim countries. The problem has always consisted of finding effective means of raising water from its source.

Early examples of water raising machines include the shaduf saqiya and noria. The shaduf was known in ancient times in Egypt and Assyria. It consists of a long beam supported between two pillars by a wooden horizontal bar. A counterweight was attached to the short arm of the beam. A bucket suspended by a rope or a pole was attached to the long arm of the beam. The bucket was lowered into the water by bearing down on the rope/pole and the counterweight raised the full bucket. The shaduf is still widespread in Egypt.

The saqiya is an animal powered machine. The central mechanism consists of two gears- a large vertical cogwheel and a horizontal lantern pinion-meshing at right angles. The vertical cogwheel is mounted over the source of the water and drives another wheel carrying a chain of earthenware pots ('pot garland') secured by rope. An animal- donkey, mule or camel- is used to turn the horizontal lantern pinion. As the animal walks in a circular path the pot garland wheel turns. The pots dip into the water, raise it to the surface and discharge it into a tank. The saqiya was known in Roman times.

The saqiya is still in use in the Muslim world and in the Iberian Peninsula and the Balearic islands.

The noria is a water powered machine that is most suitable in areas where there are fast flowing streams whose courses are some distance below the surrounding fields. The wheels are mounted between piers which carry the bearings for the axle. The diameter of the largest wheel is about 20m and there are 120 compartments in the rim. The wheel is turned by the impact of water on paddles mounted on the rim. The compartments dip into the water and are carried to the top where they discharge into a head tank connected to an aqueduct. The noria was already in use in Roman times and was described by Vitruvius in 1 BC. References in the works of Arab geographers show that norias were in use throughout the Muslim world. Although, the machines are now rarely used now.

At an early stage Muslim engineers were exploring new methods for increasing the effectiveness of water raising machines.

There were modifications of the shaduf. The machines used a flume-beam: instead of a pole, an open channel is connected to a scoop, which has its spout elongated into a flume. The scoop dips into the water and when the beam rises the water runs back through the channel and discharges into the irrigation system. The machines were animal powered as in the saqiya.

The saqiya in which water power replaced animal power. Flowing water turned a water wheel which via a system of perpendicular gears caused a chain of pots to raise the water. The fourth machine again used a flume-beam and was animal powered. The beam was moved up and down by an intricate mechanism involving gears and a crank. This is the first known instance of the use of a crank as part of a machine- the earliest appearance in Europe of a crank as part of a machine occurred in the fifteenth century C.E. Modification of the water machines was constant in these countries, and a water-driven pump was a more radical device. A water wheel turned a vertical cog wheel which in turn turned a horizontal wheel. The latter caused two opposing copper pistons to oscillate. The cylinders of the pistons were connected to suction and delivery pipes which were guarded by one-way clack valves (i.e. hinged at one end). The suction pipes drew water from a water sump down below and the delivery pipes discharged the water into the supply system about 12m above the installation. This pump is an early example of the double-acting principle (while one piston sucks the other delivers) and the conversion of rotators to reciprocating motion.

In this our Modern day 21st century, technology has brought about more effective means of pumping water using machines with integrated control circuits, which lead to the design of our modern day "AUTOMATIC FLOW CONTROL & WATER LEVEL DETECTING DEVICE" for pumping machines

CHAPTER THREE

DESIGN, CONSTRUCTION AND TESTING

3.1.1 Principle Operation of the Automatic Flow Control and Water Level Detecting machine

The design makes use of the simple conductor strand as the sensor probe which together with a logic I.C which is a digital counter forms the sensory module. The body of the tank is connected to the negative terminal of the rectifier circuit. The circuit is powered from the rectifier and well regulated dc power supply. The position of the copper conductor (sensor) with the liquid determines the input voltage level of these two-input digital integrated circuit. The output of biases is activated through the BC547B Switching transistor.

A high voltage from the logic gate output switches the transistor into saturation. This serves as the energizing input to the d.c relay that puts the circuit into operation as required. The potentiometers in the circuit are to regulate the sensitivity of the probes with respect to the different liquid used.

3.1.2 Power supply unit.

Every Electric and Electronic circuit requires a power supply to power or energize their circuits, and the most convenient and economical source of power is the domestic ac power supply. It is possible to convert the alarming voltage (usually a 240Vrms) to a d.c voltage usually smaller in value and safer for small electrical devices.

Normally the d.c voltage using a transformer and then rectifying and filtering using resistors and capacitors t obtain our desired d,c voltages. The process of converting a,c voltages to d.c voltages is called rectifying and it shown with the aid of the diagram below with the various stages of rectification.

1) Transformer

2) Rectifier

3) Filter

4) Voltage regulator

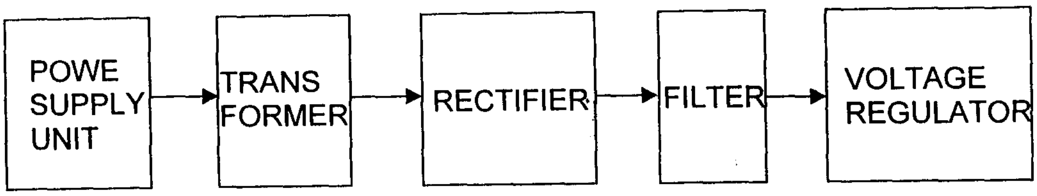


Fig 1.0: Block Diagram of Power supply Unit

3.1.3 Transformer action

This is a stage of the power supply design which involves stepping down the 240Vrms a.c supply to 18Vrms a.c supply. Using a 240V/18V transformer. The coil type's transformer was chosen because in these types of transformer, the leakage flux is reduced. The primary and secondary winding surrounds a considerable part of the core. The current rating of the transformer is up to 2though the circuit does not consume above 1A.

A transformer is an electric device which provides physical isolation between the 220Va.c mains and the rest of the system. The only link occurs through the magnetic flux linkages. This eliminates the risk of shock. The transformer is made of two coils wound on a single core, the primary input and the secondary input winding. The ratio of the second voltage v2, to that of the primary voltage V2 to that of the primary voltage V1 is equal to that of the primary voltage V1 equal to the ratio of the number of turns in the secondary windings n2, to that of the primary winding n1 and is called transformation ratio the

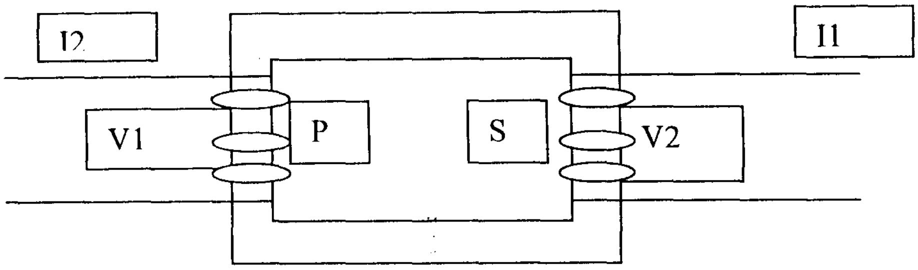


Fig 1.1: Simplified Diagram of a Core Type Transformer

3.1.4 The rectifier

Rectification is defined as the process of converting an a.c current to a unidirectional current which is d.c current. In this stage, the power unit converts the a.c supply at the secondary terminal of the transformer into its equivalent d.c supply of the same rating, in this case 18V. The process of conversion is called rectification process. Rectification can be achieved using a P N junction diode arranged in various forms. These forms are: half wave and full wave rectifications.

The full wave bridge rectifier is the most commonly used rectifier circuit for several reasons which include the following:

1) It does not require the use of a center taped transformer.

2) It provides a high peak out put voltage than the full wave rectifier does. This is ultimately a higher d.c output voltage from the power supply.

3) It consist of four discrete diodes as shown in the diagram below

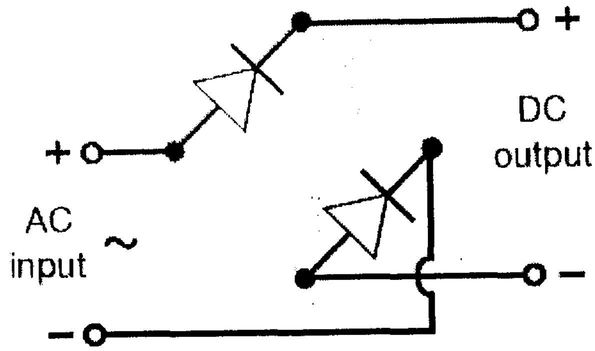


Fig 1.2: Full Bridge Rectifier Circuit

3.1.5 Filter capacitor selection.

Most electronic circuit require d.c voltages of constant value to operate properly, but the output obtained from the rectifier stage is a pulsating d.c voltage (as shown earlier) which only is suitable for limited applications such as battery charging and running d.c motors. The output of the rectifier stage therefore has to be filtered using appropriate filtering circuit & Capacitors are employed for filtering in virtually all circuits.

Capacitors store electric charge. They are used with resistors in timing circuits because it takes time for a capacitor to fill with charge. They are used to smooth varying DC supplies by acting as a reservoir of charge. They are also used in filter circuits because capacitors easily pass AC (changing) signals but they block DC (constant) signals.

Capacitance

This is a measure of a capacitor's ability to store charge. A large capacitance means that more charge can be stored. Capacitance is measured in farads, symbol F. However 1F is very large, so prefixes are used to show the smaller values.

Three prefixes (multipliers) are used, μ (micro), n (nano) and p (pico):

- μ means 10-6 (millionth), so 1000000μF = 1F
- n means 10-9 (thousand-millionth), so 1000nF = 1μF
- p means 10-12 (million-millionth), so 1000pF = 1nF .There are many types of capacitor but they can be split into two groups, polarised and unpolarised. Each group has its own circuit symbol.

Polarised capacitors (large values, 1μF +)

Electrolytic Capacitors

Electrolytic capacitors are polarised and **they must be connected the correct way round**, at least one of their leads will be marked + or -. They are not damaged by heat when soldering.

There are two designs of electrolytic capacitors; **axial** where the leads are attached to each end (220μF in picture) and **radial** where both leads are at the same end (10μF in picture). Radial capacitors tend to be a little smaller and they stand upright on the circuit board.

Unpolarised capacitors (small values, up to 1μF)

Small value capacitors are unpolarised and may be connected either way round. They are not damaged by heat when soldering, except for one unusual type (polystyrene). They have high voltage ratings of at least 50V, usually 250V or so. It can be difficult to find the values of these small capacitors because there are many types of them and several different labeling systems!

Many small value capacitors have their value printed but without a multiplier, so you need to use experience to work out what the multiplier should be!

For example **0.1** means 0.1μF = 100nF.

Sometimes the multiplier is used in place of the decimal point:

For example: **4n7** means 4.7nF.

A capacitive filter is adopted for this design where a large electrolytic capacitor is connected across the rectifier output. This capacitor charges up during the diode conduction period the peak value and when the rectifier voltage falls below this value, so that the load receives almost steady d.c voltage. The discharge time constants, which is the time taken for the capacitor to drop to 33% of the peak value is given thus;

$$T_d = R_L C \quad \ldots\ldots\ldots\ldots (2.3)$$

Where; T_d = Discharge time constant of capacitor

R_L = Load resistance

C = Capacitance

For any given circuit, R_L is constant therefore the larger the capacitance, the smaller the ripple voltage. A Capacitor has the basic properties of opposing charges in voltages, thus, a high value capacitor will tend to reduce the ripple magnitude, it has been found that increasing the capacitor value tends to:

1) Increase the magnitude of ripple voltage.
2) Reduce the magnitude of ripple voltage.
3) Reduce the time flow of current pulse through the diode.
4) Increase the peak current in the diode.2

3.2.0 The Voltage Regulator

The final circuit in the basic power supply is the voltage regulator. There are many types of voltage regulators. Many of these circuits contain the number of transistor of an integrated circuit (I.C) voltage regulator. I.C unit provide a fixed positive voltage, a fixed negative voltage, or an adjustable set voltage.

In an unregulated power supply, the output voltage changes whenever input voltage or load resistance changes. It is stable; voltage regulation is the change in voltage from no load to full laod condition. The purpose of the voltage regulator circuit is to reduce the variation to zero or the minimum possible value. The percentage regulation or simply regulation of power is given by:

$$\% \text{ Regulation} = \frac{V_{max} - V_{min}}{V_{max}} \times 100$$

V_{max} = maximum d.c output voltage.

V_{min} = minimum d.c output voltage.

3.2.1 The Switching Unit

The switching unit of the circuit consist mainly the Relay and the Transistor.

3.2.2 Relays

A relay is an **electrically operated switch**. Current flowing through the coil of the relay creates a magnetic field which attracts a lever and changes the switch contacts. The coil current can be on or off so relays have two switch positions and they are **double throw (changeover)** switches.

Relays allow one circuit to switch a second circuit which can be completely separate from the first. For example a low voltage battery circuit can use a relay to switch a 230V AC mains circuit. There is no electrical connection inside the relay between the two circuits; the link is magnetic and mechanical.

The coil of a relay passes a relatively large current, typically 30mA for a 12V relay, but it can be as much as 100mA for relays designed to operate from lower voltages. Most ICs (chips) cannot provide this current and a transistor is usually used to amplify the small IC current to the larger value required for the relay coil. The maximum output current for the popular 555 timer IC is 200mA so these devices can supply relay coils directly without amplification.

Relay coils produce brief high voltage 'spikes' when they are switched off and this can destroy transistors and ICs in the circuit. To prevent damage you must connect a protection diode across the relay coil.

The figures below shows a working relay with its coil and switch contacts. You can see a lever on the left being attracted by magnetism when the coil is switched on. This lever moves the switch contacts. The relay's switch connections are usually labelled COM, NC and NO:

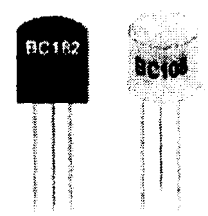
- **COM** = Common, always connect to this; it is the moving part of the switch.
- **NC** = Normally Closed, COM is connected to this when the relay coil is **off**.
- **NO** = Normally Open, COM is connected to this when the relay coil is **on**.

- Connect to COM and NO if you want the switched circuit to be **on when the relay coil is on**.
- Connect to COM and NC if you want the switched circuit to be **on when the relay coil is off.**

Protection diodes for relays

Transistors and ICs (chips) must be protected from the brief high voltage 'spike' produced when the relay coil is switched off. The diagram shows how a signal diode (eg 1N4148) is connected across the relay coil to provide this protection. Note that the diode is connected 'backwards' so that it will normally **not** conduct. Conduction only occurs when the relay coil is switched off, at this moment current tries to continue flowing through the coil and it is harmlessly diverted through the diode. Without the diode no current could flow and the coil would produce a damaging high voltage 'spike' in its attempt to keep the current flowing.

3.2.4 Transistors

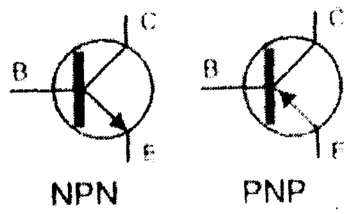


Transistors **amplify current**, for example they can be used to amplify the small output current from a logic chip so that it can operate a lamp, relay or other high current device. In many circuits a resistor is used to convert the changing current to a changing voltage, so the transistor is being used to **amplify voltage**. A transistor may be used as a **switch** (either fully on with maximum current, or fully off with no current) and as an **amplifier** (always partly on).

The amount of current amplification is called the **current gain**, symbol h_{FE}.

Types of transistor

There are two types of standard transistors, **NPN** and **PNP**, with different circuit symbols. The letters refer to the layers of semiconductor material used to make the transistor. Most transistors used today are NPN because this is the easiest type to make from silicon. If you are new to electronics it is best to start by learning how to use NPN transistors.



Transistor circuit symbols

The leads are labelled **base** (B), **collector** (C) and **emitter** (E). A Darlington pair is two transistors connected together to give a very high current gain.

In addition to standard (bipolar junction) transistors, there are **field-effect transistors** which are usually referred to as **FETs**.

3.2.0 Relays and transistors compared

Like relays, transistors can be used as an electrically operated switch. For switching small DC currents (< 1A) at low voltage they are usually a better choice than a relay. However transistors cannot switch AC or high voltages (such as mains electricity) and they are not usually a good choice for switching large currents (> 5A). In these cases a relay will be needed, but note that a low power transistor may still be needed to switch the current for the relay's coil! The main advantages and disadvantages of relays are listed below:

Advantages of relays:

- Relays can switch **AC and DC**, transistors can only switch DC.
- Relays can switch **high voltages**, transistors cannot.
- Relays are a better choice for switching **large currents** (> 5A).
- Relays can switch **many contacts** at once.

Disadvantages of relays:

- Relays are **bulkier** than transistors for switching small currents.
- Relays **cannot switch rapidly** (except reed relays), transistors can switch many times per second.
- Relays **use more power** due to the current flowing through their coil.
- Relays **require more current than many chips can provide,** so a low power transistor may be needed to switch the current for the relay's coil.

3.2.1 Design Operation

The designed operation controller is a type of automatic liquid controller. It is electronically operated to control the level of liquid (water) in the tank and also allow water to be pumped into the tank when the water reaches minimum level. The design makes use of a simple conductor strands as the sensor probes which together with the logic I.Cs from the sensory module. The body of the tank is connected to the negative terminal of the rectifier circuit. The circuit is powered from the rectifier and well regulated d.c power supply. The position of the copper conductor (sensor) with the liquid determines the input voltage level of these two-input digital integrated circuit. The output biases the switching transistors. A high voltage from the logic gate output biases the BC547B switching transistors. A high voltage from the logic gate output switches the transistor into saturation. This serves as the energizing input to the d.c relay that puts the circuit into operation as required.

The single phase pump is used in pumping the water at a remote position from the tank into another compartment as the need arises.

The potentiometers in the circuit are to regulate the sensitivity of the probes with respect to the different liquid used.

3.2.2 Design procedure

The sensory module is the combination of upper conductor (i.e. probe) and the CMOS digital ICs. The digital I.C is set to perform the operation of an X-OR Gate output. So that the I.C act as a digital counter and give out the output of an X-OR Gate. It should be noted that the body of the metal tank is connected to the negative terminal of the d.c supply. The sensor is such that it creates a zero resistance path when in contact with the water. It creates a high resistance path and allowing the 12v supply to be across it. This is translated as high (logic'0') to the input terminal of the logic I.C. The material for the sensor is such that it does not corrode with the liquid so as not to create unnecessary change in characteristics.

. The logic I.C CD 4001 operates with a Four X Gates from The Gates of the logic I.C is from N1-N4.

To determine the output at the different I.C. Output terminal, in the designed circuit as a result of input from the sensors, this is illustrated in the figure below and logic gate table below

A	B	X
0	0	1
0	1	0
1	0	0
1	1	0

Fig 1.5: The truth table of a **NOR Gate**

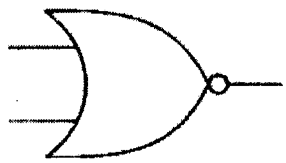


Fig 1.6: Circuit Symbol of a **NOR Gate**

1) **When there is NO WATER the INPUT LOGIC = 1**
2) **When there is WATER the INPUT LOGIC = 0**

AND

1) **When the output logic = 1 = the WATER PUMPS**
2) **When the output logic = 0 = no WATER PUMPS**

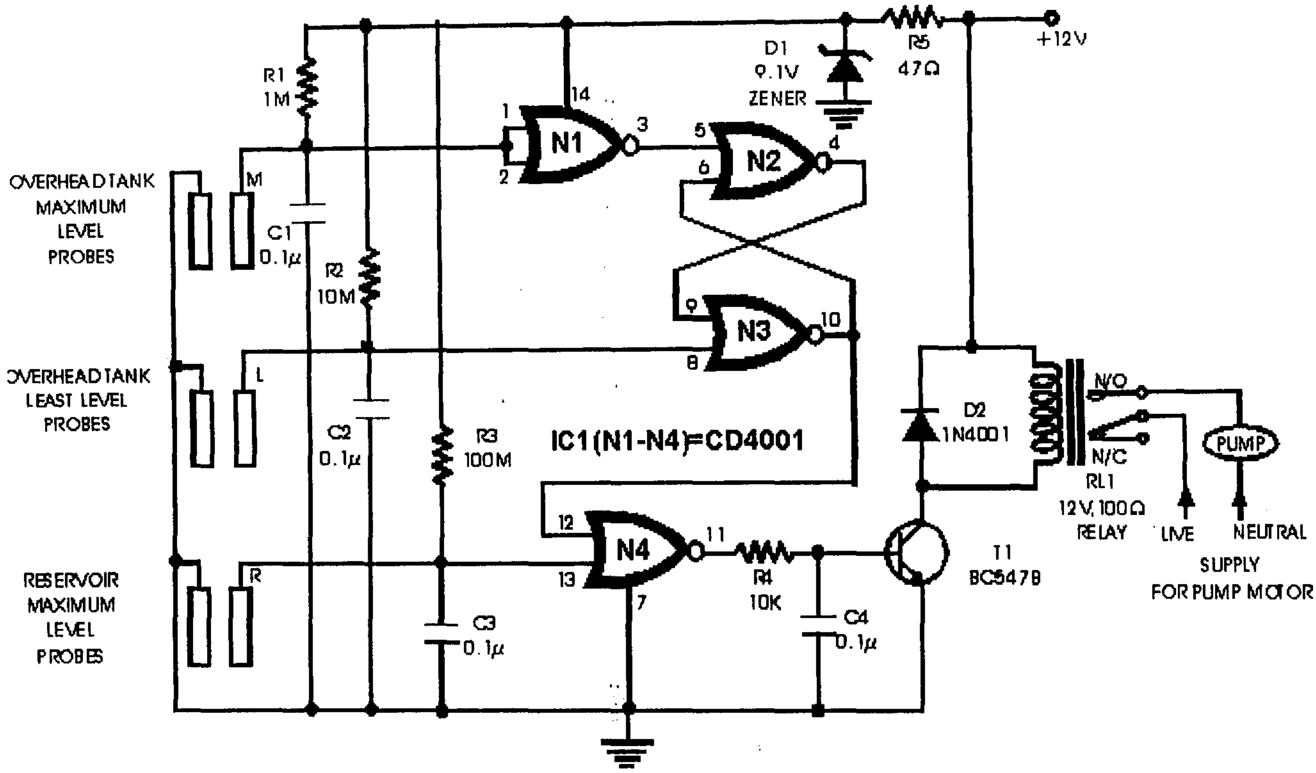


Fig 1.7 Circuit Diagrams of the Automatic Flow Control and Water Level Detecting device for Pumping Machines

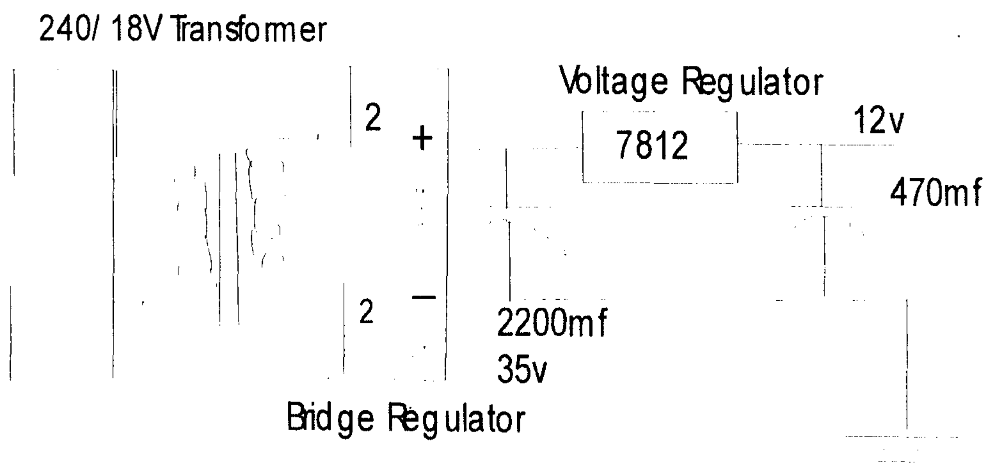


Fig 1.8 Circuit Diagram of the Power Supply

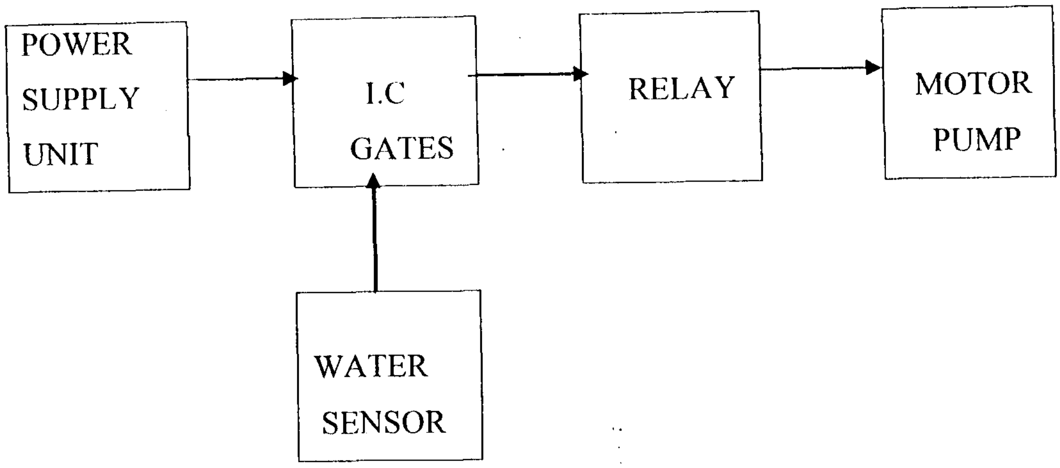


Fig I.5 Block Diagram Of the Pumping Device

3.2.4 Operation of the Automatic Pump Control Unit System

There are five levels of operation to be considered

(1) When the Tank is empty.

(2) When the liquid makes contact with the lower probe.

(3) When the liquid makes contact with the upper probe .When the liquid inside the tank is put into operation (use), stage iv and v are considered.

(4) What operation is/are carried out when the liquid falls below the upper probe (sensor).

(5) When there is no water in the reservoir.

3.2.5 When the tank is empty (i.e. when water falls below the minimum level in Tank)

When tank is empty and switch is ON, the upper and lower probes are at logic level "1" and t there is Water in the tank. This produces a low i.e.'0' at the output of Nor gate **N1**. Hence the logic follows the trend.

No water in the Max level **1** (N1input) ------ (N1 out) **0** (N2 in) ------------- **1** (N2 out)

Water in the Min level **1** (N3input) ------ (N3 in) **1 + 1** (N2 out) -------------- **0** (N3 out)

Water in the Reservoir **0** (N4input) ------ (N4in) **0** + **0**(N3 out)) -------------- **1 (output)**

A Logic **1** output activate the switch ON, the supply voltage of 220v is applied to the coil of the motor contact via the normally closed relay auxiliary terminal that energizes it to supply the motor terminal that pump water up the tank.

3.2.6 When it makes contact with the lower probe

As the water level increases in the tank, it reaches a point where it makes contact is made with lower probe. When this occurs, the upper probe is at logic high i.e.'1' and the lower probe is a logic low i.e.'0'. From the truth table only a **"0"** – **"0"** logic input or a **"1"** - **"1"** logic input can cause pumping to enter the set and reset state. Therefore pumping will continue until the water gets to the maximum probe level at Logic input **"0"**, because at this time the least probe level will also be**"0"**, which resets and stops the pump.

3.2.7 When it makes contact with the upper probe

As the water level rises & makes contact with the top probe, both the upper and lower probes are at logic '0' and follow the Nor-Gate trend.

A no water in the Max level **0** (N1input) ------ (N1 out) **1** (N2 in) -------------- **0** (N2 out)

Water in the Min level **0** (N3input) ------ (N3 in) **0 + 0** (N2 out) -------------- **1** (N3 out)

Water in the Reservoir **0** (N4input) ------ (N4in) **0** + **1** (N3 out) -------------- **0 (output)**

In this stage the Logic output reads a **0** which turns off the switches and this de-energizes the relay and the auxiliary contact goes back to the normally closed position causing pumping action of the motor to stop and no water is pumped.

3.2.8 When the water level falls below the upper probe

When the water is put into use and its level falls below the upper probe, the upper sensor at logic '**1**'. While the lower probe is at logic "**0**", from the truth table, only an input logic "**0**" "**0**" & logic "**1**" "**1**" will reset and set the gate. Therefore there Gate will remain at its former state not until the water fall below the least probe to produce an input logic "**1**" "**1**" which sets the Nor gate.

3.2.9 When there is no water in the reservoir

When there seem to be no water in the reservoir, the input Logic gate of the reservoir reads a "**1**". Be there water in the tank or not, no water pumps from the reservoir, because the Nor gate logic outputs in all cases will always be "**0**" which indicates no pumping. This can be confirmed from the truth table that any Logic **1** input results in a "**0**" output except for a 0 input that has a one of its logic output being a "**0**".

CHAPTER 4

TEST, RESULT, DISCUSSION

4.1.1 Brief description of the I.C 1 C.D4001

It I.C CD4001 is not very expensive but highly versatile clock generation circuits. They can be designed to give symmetrical or non-symmetrical output and can be of running or the crate type. In the later case, they can be designed to turn on with either logic 0 or logic 1 gate signals and to give either a logic 0 or logic 1 output when in the mode. These very inexpensive I.C circuit and can even be used as simple voltage controlled oscillator (VCO).

4.1.2 Evaluation of relay coil shunt diode

When the energizing current of a relay coil is switched OFF, the energy in the relay coil magnetic field produces a back e.m.f, which in turn could cause a damaging effect, a diode is connected in reverse direction with respect to the relay driven polarity , such that , the relay coil dissipates its energy across the diode.

The PIV rating of the diode should be greater than the coil applied voltage (12v).Hence, a diode of PIV=50v is selected.

4.1.3 Discussion

The circuit was coupled and soldered on a Vero-board as shown in the project layout. During the soldering process, some important considerations were observed. These considerations include the following:

For the fact soldering heat is capable of damaging integrated circuits, IC sockets were used. But due to the fact that the sockets were first soldered before the I.C was inserted, therefore the IC sockets totally eliminate the soldering heat to the ICs.

The casing of the soldered components which makes up a circuit was another aspect of construction. The device was cased in a metal box.

On the case, there are points provided for attaching the power sockets of the pump to the system (switch), visual output devices, power supply LED indicator. The case was further provided with airspaces to enhance cooling of the electronic components.

4.1.4 Testing

The testing of the whole system actually began at the very beginning of the design, right from the circuit diagram even before the circuit components were actually soldered. The testing exercise was carried out on a breadboard. The breadboard provided an opportunity to couple the electronic components without soldering. In addition, the soldering joints were checked over with a magnifying glass and the errors detected were corrected by appropriate soldering and desoldering actions.

The I.C was protected from heat by the use of I.C sockets, which were soldered to the board while the IC was inserted into the socked afterwards.

At the end of the soldering operation, each unit was tested at every stage and the results obtained were adequate.

4.1.5 Results

Every step taken in constructing this project is tested and the result is as desired. The ICs respond to the signal from the sensing elements (probes), the transistor in turn works in line with the signal produced by the ICs and gives their output results to energize the relays. The relay coil also opened and closed the auxiliary contact as the case may be in order to stop or to start the motor for the pumping process. In a case were the system is inefficient due to occurrence of faults or as a result of bad working conditions of some of the components used to build up the system, an alarming circuitry is used to check if there is water flow or no flow or even if the system is in a good working condition. This has been put to test and was discovered to work as desired. In short, the desired result is achieved because all the components function as expected.

CHAPTER FIVE

CONCLUSION AND RECOMMENDATION

5.1.1 Conclusion

An automatic pump control unit system with visual indicators was designed and constructed. The device produced visual indications whenever liquid-level reached the specified level. The ICs respond to the signal from the sensing elements (probes), the transistor in turn work in line with the signal produced by the IC and gives their output result to energize the relays. The relay coil also opened and closed the auxiliary contacts as the case may be in other to stop or start the motor for the pumping process. As a result of the above operation, the desired result has been achieved. That is, the liquid in the tank is properly monitored from overflow, dryness etc

5.1.2 Recommendation

It is a known fact that water is capable of making copper wire rust, when wire is rust; the conducting ability is greatly reduced. Since the probes are to be used in water,

1) The need to silver coat the uninsulated part of the wire cannot be over-emphasized.

2) I recommend that the power supply LED must be checked ON to ensure that there is supply to the device.

3) That the vessel containing the liquid should be firmly fixed to stand & protect the water (liquid) from splashing on to the sensor in case if the vessel is being shaken, as these may cause false sensing.

4) For domestic water tanks in industries, homes and offices where pumping and distribution of water is major.

5) To fish pond farmers that often use the pumping machine use to refill water in their artificial ponds after draining the pond. Farmers do not have to worry about overflow of water that will make them lose their fishes.

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DEDICATION

I dedicate my project to GOD my Heavenly father whom I put first in everything I lay my hands on or do. I also give him all the glory and adoration because I experienced his mighty hand during the execution of my project and to my Parents Mr and Mrs Odupe for their love support and care for me.

DECLARATION

I declare that this project titled "Automatic Flow Control and Water Level Detector for Pumping Machine" was carried out by Odupe Olukayode Oluwamayowa, of the Department under the Supervision of Mall am Suleiman Zubair for an award of Bachelor of Technology (B. Tech.) of the Department of Electrical/Computer Engineering Department, The Federal University of Technology Minna, Niger State.

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(Name of H.O.D)	(Name of External Examiner)
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(Signature and Date)	(Signature and Date)

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With thanks to GOD ALMIGHTY the author and finisher of all things in the world. I owe to my GOD everything, because he is my creator and without him I am nothing and also without him this project wouldn't have come to past.

My thanks also go to my father and mother Mr and Mrs Odupe for giving me the best gift in life which is "Education". I thank my parents for giving up all they have to ensure that I get Educated. I thank them for their love, support, encouragement, understanding & advice that I used to see through the university. I also want to thank my parents for their struggle in putting me back on track when I seem to derailing and losing my focus while I was still in school. I want them to know that no amount of words can ever express my gratitude for their love and care. I will forever be grateful to them.

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ABSRTACT

The water level detector and the flow control device for the pumping machine concept are to control the operation of the pumping machine and also detect the Maximum and Minimum level of water in a tank. The ideology of the device is to better the pumping machine operation and to bring convenience in the operation of pumping of water and liquid. The device is electronically calibrated and operated to control the level; of water and other liquid in a tank and also calibrated to a visual output to indicate the water level to indicate a specified level. After the successive design of the Flow Control Device, It was tested and found very efficient for Pumping and distribution of water.