DESIGN AND CONSTRUCTION OF AUTOMATIC WATER LEVEL CONTROLLER USING FLOATING SENSOR

BY

DANLADI, JAMES

(EE/08/1726)

DEPARTMENT OF ELECTRICAL AND ELECTRONICS ENGINEERING, SCHOOL OF ENGINEERING AND ENGINEERING TECHNOLOGY, MODIBBO ADAMA UNIVERSITY OF TECHNOLOGY, YOLA.

DECEMBER, 2012

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A PROJECT REPORT SUBMITTED TO THE DEPARTMENT OF ELECTRICAL AND ELECTRONICS ENGINEERING, SCHOOL OF ENGINEERING AND ENGINEERING TECHNOLOGY, MODIBBO ADAMA UNIVERSITY OF TECHNOLOGY YOLA, IN PARTIAL FULFILMENT OF THE REQUIREMENTS FOR THE AWARD OF THE DEGREE OF BACHELOR OF ENGINEERING.

DECEMBER, 2012

DECLARATION

I **Danladi, James** hereby declare that this project report was written by me and it is a record of my own research work. It has not been presented before in any previous application for a bachelor's degree. References made to published literature have been duly acknowledged.

………………………… Date………………….

Danladi, James

(Student)

The above declaration is confirmed

…………………………. Date………………….

Engr. S. W. Pallam

(Supervisor)

CERTIFICATION

This project entitled **"Design and Construction of Automatic Water Level Controller using Floating sensor"** by **Danladi, James (EE/08/1726)** meets the regulations governing the award of bachelor's degree of the Modibbo Adama University of Technology, Yola and is approved for it's contribution to knowledge and literary presentation.

...……………………   Date………………………..

Engr. S. W. Pallam

(Supervisor)

..……………………..   Date……………………….

Engr. I. M. Visa

(HOD)

………………………..   Date…………………….

Prof. E. E. Omizegba

(External Examiner)

DEDICATION

This project is dedicated to Almighty God for his grace and strength, and also to my lovely family.

ACKNOWLEDGEMENTS

I must begin by appreciating my project supervisor, Engr. S. W. pallam who took his time to read through my report, corrected it, and make valuable suggestion which led to the accomplishment of the work.

The kindness of the project coordinator, Engr. A. S. Kadalla for providing power at the Ericsson G.S.M training center during power outages in the school, contributed immensely towards the project completion.

I am also grateful to the Head of Department Engr. I. M. Visa and all lecturers in electrical and electronics department, particularly those that imparted knowledge that led to successful completion of this project.

Special appreciation also goes to the external examiner Prof. E. E. Omizegba for correction and examination of the work.

Finally, I also want to thank M. B. Yaro, Ebenezer Oluwasesan, Um cedric, Domwa Felix, Madjissembaye Samuel, just to mention but a few as well as Zira Peter for their contributions and advice.

ABSTRACT

The need to eliminate water and power wastage when pumping water from reservoir to overhead tank which requires manual operation and supervision is a major concern. This project is aimed at the design and construction of an automatic water level controller capable of detecting the presence or absence of water at desired levels in the overhead tank and automatically operates water pump to pump water to over head tank or to stop. The design was carried out with the use of float switch, as the floating sensor. Switching transistor and relay are employed to perform the switching operation. The project aim was achieved as the circuit operates as designed.

The work can be further modified or improved upon especially by replacing the 555 Timer IC with a microcontroller.

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CHAPTER ONE: INTRODUCTION

1.0 INTRODUCTION

Generally, in most countries, houses and buildings tend to have water tanks, one situated on the roof and another on the ground or underground. The received water supply is allowed to fill the lower tank first, and a water pump is then switched ON manually so that the water from the lower tank is pumped and shifted into the upper tank on the roof. Once the water from the lower tank is completely transferred into the upper tank, the water pump is again manually switched OFF. This process may have to be repeated quite regularly and at times may become a bit of headache. Moreover, in case someone forgets or fails to do the manual operation on time, it may result in an overflowing of water and wastage of electricity as well.

An automatic device called water level controller is employed to monitor a particular level (for example in an over head tank) and restrict it from exceeding the limit. It automatically turns the water pump ON or OFF by sensing the water levels in the tank. This saves time, energy and wastage of electricity as well.

1.1 BACKGROUND OF THE STUDY

The need to preserve water for the existence of life in household, including industries and agricultural development has increased the field of exploration in electronics. There have been many cases of water scarcity, and water wastage resulting from lack of proper monitoring of water level in over head tanks, or water storage facilities for domestic, agricultural, industrial and environmental use. Hence, there is a need to improve the various water monitoring and control system for adequate timely supply of water for domestic use, agricultural development and industrialization of the country.

An automatic water control system is employed to perform this function. There is no need to monitor and supervise the water supply once the system is installed. The system uses floating sensor to detect the water level; whether low or high. The sensor floats as the water level rises in the tank and vice versa. The sensor's response to water level, triggers the integrated circuit, whose output energizes the relay to switch the water pump ON or OFF depending on the situation. The lower sensor switches ON the water pump to pump water while the upper one switches OFF the water pump when the tank is full.

1.2 STATEMENT OF THE PROBLEM

It is obvious that water like air and sunlight is indispensable to mankind, as water can be classified as domestic, agricultural and industrial. Scarcity of water is the biggest obstacle to development [1], since every project and almost every process in the society is dependent on water. When this system is developed and installed, there will be no need for manual supervision when pumping water to over head tank. It checks the water in the overhead tank to avoid over flow even when no one is present.

1.3 OBJECTIVE OF THE STUDY

The aim of designing and constructing this system is to eliminate the use of manually operated water pumps, thereby reducing water and power wastage in our society. It is also aimed at producing a cheap and reliable device that will automatically control the water level in the over head tank in order to overcome the problem associated with the manual control of the pump. This system can be adopted in both developed and developing countries.

1.4 SIGNIFICANCE OF THE STUDY

This project finds application in domestic, agricultural and industrial system. The application of this system in the various areas mentioned above is an improvement in the knowledge of liquid level monitoring system in engineering at large. It also helps at curtailing power wastage in our society, considering the critical power problem facing our nation. Advancement in preserving and sustaining human life, leads to high output in industrial and agricultural development which in turn leads to greater output and maximum efficiency.

1.5 SCOPE OF THE STUDY

The construction of the water control system that uses floating sensors is primarily for domestic and other applications. It is not the programmable version of the device that uses microcontroller, but the type that use 555 Timer to energize relay via driver transistor to turn the water pump ON or OFF. The device ensures constant supply of water to the over head tank as long as the reservoir is not empty. Unlike the programmable type that can be programmed to pump water or not once the set time is reached, avoid running the pump during odd hours particularly at night and also ensures maximum water supply during peak hours especially during morning hours. The system to be developed supplies water at any time once the water level in the over head tank falls below the desired level. However, the action of switching the water pump ON or OFF to pump water is done automatically.

CHAPTER TWO: LITERATURE REVIEW

2.0 INTRODUCTION

Automation of water level control was adopted to monitor and control water supplies to the storage tanks to achieve the following: save water which is the first necessity of human being, save electricity, increase pump set life and protect motor from getting damaged in case of no load (that is no water).The system to be developed is an automatic water level controller using floating sensors which is an improvement on the type that uses stationary sensors. The system uses sensors (floating type) and electronic circuit (control unit) to perform this operation. Sensors control the workings of the pump. Working of the pump is controlled by the water level in the over head tank. If the over head tank is low, the pump gets turned ON automatically and when it is fully filled the pump turns OFF automatically.

The system consists of four parts namely; over head tank, water pump, sensors and electronic circuit (control unit).

2.1 OVER HEAD TANK

This is the water storage container into which water from the reservoir is pumped by the water pump. It is usually made either of plastic or metal material.

2.2 WATER PUMP

Water pumps have been existent since 3000 B.C. Early pumps were made with waterwheels and chutes and used animals to provide the energy to move the wheels. Modern pumps [2] include centrifugal pump, axial flow pump, jet pump and electromagnetic pump.

Centrifugal pump is the type employed as the water pump. It is a device that uses the energy of rotary motion to pump water. Rotation can come from any source such as hand crank, but most often comes from an electric motor or turbine. It is used to move fluid through system of pipes by the use of a rotating impeller shaft. Fluid is accelerated by the impeller and flows out to a diffuser. Fluids flow around the pump casing and deposits into narrowing areas of the pipe to build pressure. The pumps are design for high flow and consistent pressure through standard flow heads by creating a vacuum at the impeller's center to continuously draw more liquid. The types are:

2.2.1 SINGLE-STAGE RADIAL FLOW

The pump's impeller draws liquid into the impeller's center and forces it through the impeller's valve. As it exits the valve, it travels down the narrow valves, increasing pressure in the pump and generating strong flow. This is the common form of the centrifugal pump.

2.2.2 MULTI-STAGE CENTRIFUGAL PUMP

Contains more than one impeller mounted on a common shaft. The pump produces greater overall pressure and discharge higher quantities of liquid.

2.2.3 MAGNETIC DRIVE PUMP

Uses a magnetic field that joins a drive motor and impeller to pump fluids and increase pressure. They are similar in design to the single stage, but because of the magnetic field, there is no need for a long shaft or seals between motor and impeller. Leaks are virtually eliminated as well as significant reduction in internal combustion, wear and friction. They are the most expensive of centrifugal pumps.

2.2.4 MECHANICALLY COUPLED CENTRIFUGAL PUMP

It uses a rotating impeller driven by the shaft with a motor connected by a strong seal. These are the least expensive centrifugal pump available for use, and offer only moderate pressure and flow rates when compared to the other types.

2.3 FLOATING SENSORS

Float-type sensors are designed such that a shield protects it from turbulence and wave motion. Float sensors operate well in a wide variety of liquids, including corrosives. Float-type sensors should not be used with high viscosity (thick) liquids, sludge or liquids that adhere to the stem or floats, or material that contain contaminants such as metal chips.

2.3.1 TYPES OF WATER LEVEL CONTROL

In the past, so many water level control systems have been developed in various ways. Some of these water level controls are; fluid liquid level measurement by optical reflection, water level measurement by thermo-conductive sensor, water level measurement by sonar, water level indicator with alarm and so many others.

2.3.2 FLUID LIQUID LEVEL MEASUREMENT BY OPTICAL REFLECTION

The types of fluid liquid level measurement have a number of applications in homes and industries. This relies on the internal reflection of light on a prism. Complete internal reflection between the prism and outside is sufficiently great when the prism is immersed in liquid, the difference in indexes will be small and therefore transmission of light beam to a photo detector will drop. This variation in light heating the photo detector is transmitted to the control circuit.

2.3.3 WATER LEVEL MEASUREMENT BY SONAR

Another method of useful measurement is the water level measurement by sonar. In this method, sound waves are transmitted through the air and reflected from the liquid surface back to the receiver. The echo time Te is immediately converted to distance x by the relation

$$X = C \times \frac{Te}{2}$$

where $C =$ velocity of sound

$Te =$ Echo time

$X =$ Distance

2.3.4 WATER LEVEL MEASUREMENT BY THERMOCONDUCTIVE SENSOR

The water level measurement by thermoconductive sensor system has a number of important applications in homes and industries. This employs the use of the thermistor mounted on a heater, and installed at desired level. The change in conductivity when immersed in water and when in air is transmitted in the form of signal to the control circuit.

2.3.5 WATER LEVEL INDICATOR WITH ALARM

This circuit not only indicates the amount present in the overhead tank but also gives an alarm when the water of water is filled up. The circuit uses the bilateral switch CMOS IC to indicate the water level.

2.4 ELECTRONIC CIRCUIT (CONTROL UNIT)

This unit consists of 555 timer integrated circuit, transistor, relay, resistors and capacitor and diodes. The 555 timer integrated circuit is connected in monostable mode. The timer’s input is the sensors’ response to water level in the overhead tank, applied to its trigger pin. The output of I.C is use to energize relay via transistor.

Transistor amplifies the I.C output to energize relay resulting in either opening or closing of the relay to switch the water pump ON or OFF. The components of this unit operate in interdependence.

CHAPTER THREE: DESIGN AND CONSTRUCTION PROCEDURES

3.0 INTRODUCTION

The developed system, consist of several sub-units for its operation. Control unit is the heart of the system and made up of different components, it's being powered by the power supply unit.

The choice of components is determined by project requirement as well as its availability. The system's block diagram is shown in figure 3.0 below.

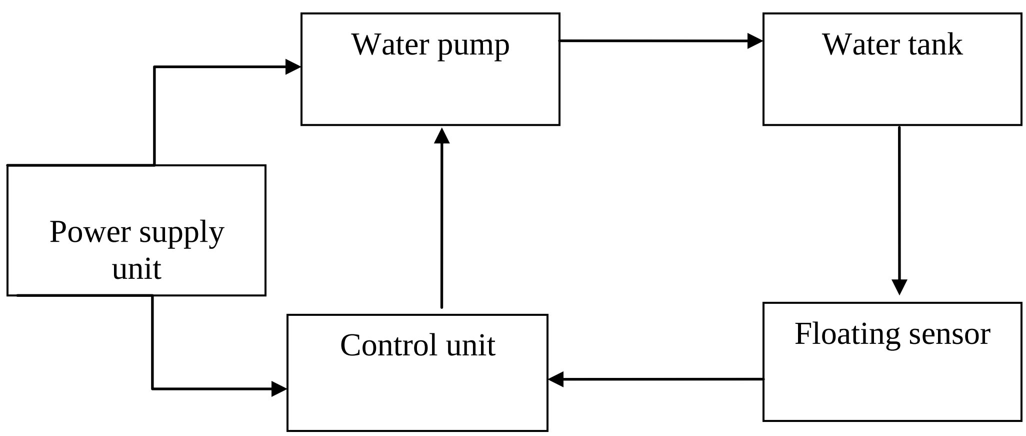


Figure 3.0 Block diagram of an Automatic Water Level Controller using Floating Sensor.

3.1 DESIGN OF REGULATED POWER SUPPLY UNIT

Electronic system invariably requires a source of DC power supply; source of battery which is the purest and regulated form of dc supply. But more usually, the power is obtained from a unit that converts the normal single phase AC mains supply (220V/240V at 50HZ or

110V at 60HZ) to some different value of DC voltage. This is performed in the power supply unit which comprises of transformer, rectifier, filter and regulator.

The function of power supply unit is to provide the necessary DC voltage with good stability and regulation. The block diagram is shown in figure 3.1below. [3]

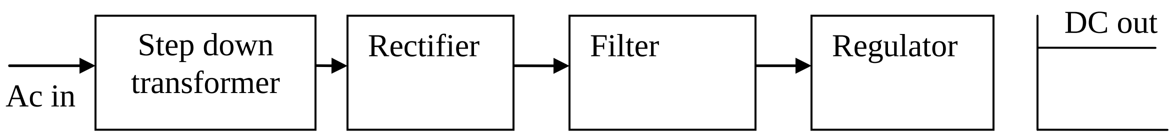


Figure 3.1 Block diagram of Regulated Power Supply Unit

3.1.1 STEPDOWN TRANSFORMER

Transformer is an electrical device which converts AC mains to a higher or usually lower AC voltage with corresponding decrease or increase in current at the same frequency. It does so by making use of the principle of mutual induction; the alternating current in one coil provides an alternating flux and the consequent continual change in flux linkage induces voltage in the other coil.

The step-down voltage transformer used at this stage has two windings or coils, inductively coupled by a magnetic core which serves to increase magnetic flux linking the windings. It steps down voltage from 220V/240V input to 18V output. The input and output windings or coils are called primary and secondary windings respectively. Other types of transformers are power transformer, auto transformer and current transformer. The 18V output of the transformer is chosen so that the IC regulator output will always be 12V despite fluctuations of the AC mains. The diagram of a step-down transformer is shown in figure 3.2 below.

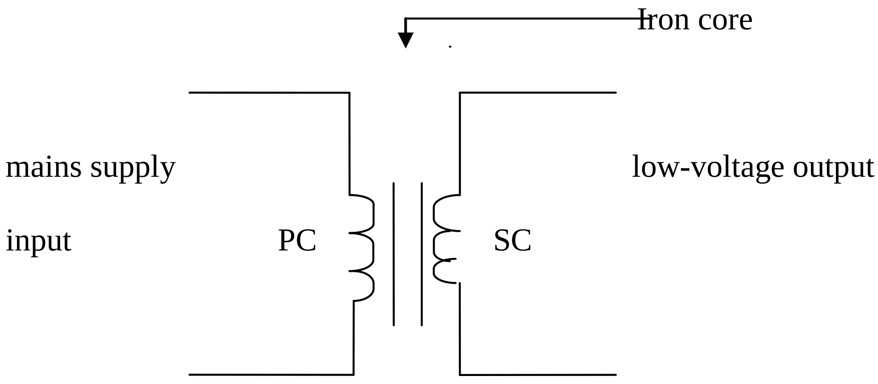


Figure 3.2 step-down transformer

3.1.2 RECTIFICATION STAGE (RECTIFIER)

Since transformer output is an AC voltage, there is a need to convert it by rectification to obtain DC voltage.

Rectifier is made up of one or more diodes and is unidirectional in nature, to convert AC voltage into pulsating DC voltage. The two categories are half-wave rectifier and full-wave rectifier. Full-wave bridge rectifier is used for this project because of the higher output voltage needed. It can either be four discrete diodes connected as shown in figure 3.3 below.

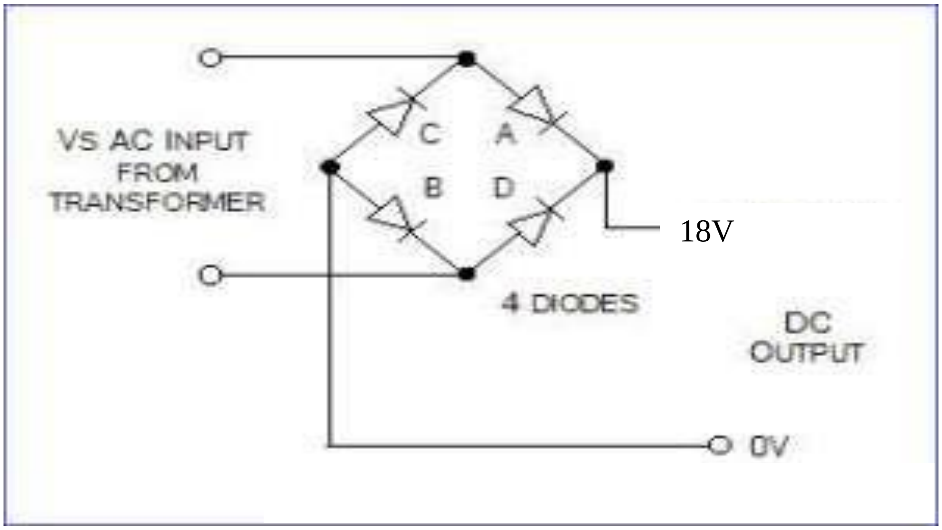
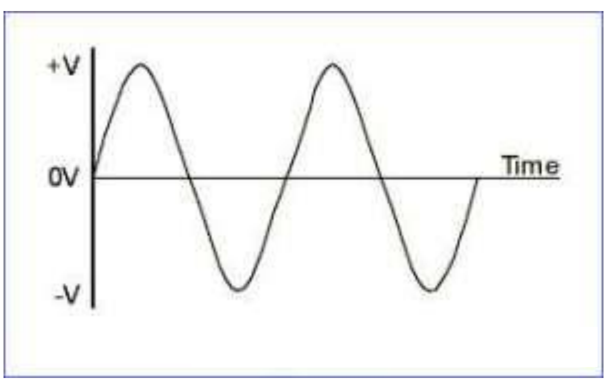


Figure 3.3 Full-wave bridge rectifier

From figure 3.3, Diodes A and B conduct during the positive half cycle while C and D conduct during the negative half cycle. The waveform before and after rectification are shown in figure 3.4 below.



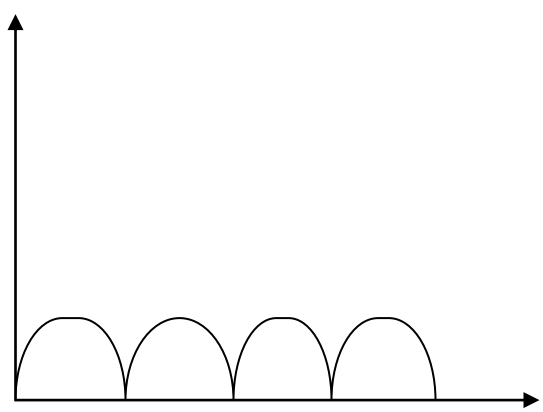


Figure 3.4   AC input   DC output

3.1.3 SMOOTHING STAGE (FILTER)

The main function of the filter circuit is to minimize the ripple content in the rectifier output. The pulsating output of the rectifier has DC value and some AC components called ripples. This type of output is not useful for driving sophisticated electronic devices [3]. These devices, require a steady DC output that approaches the smoothness of a battery output. Other types of filters are series capacitor filter, series inductor filter, R-C filter, R-L-C filter e.t.c.

. The type of filter used at this stage is a single capacitor, connected across the rectifier, to achieve filtering action. This type of filter is known as capacitor input filter and depends for its operation on the property of the capacitor which states “a capacitor opposes any change in voltage’’. When connected across a pulsating DC voltage, it tends to smoothen out the voltage pulsation (ripples) as shown in figure 3.5 and 3.6 below.

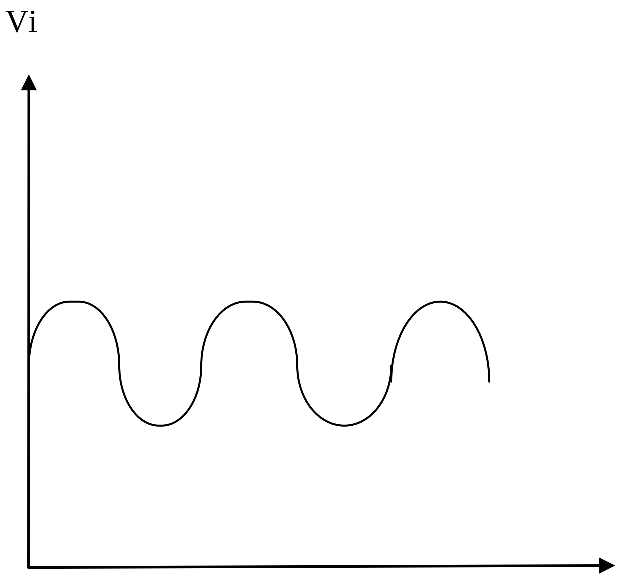


Figure 3.5 Pulsating DC

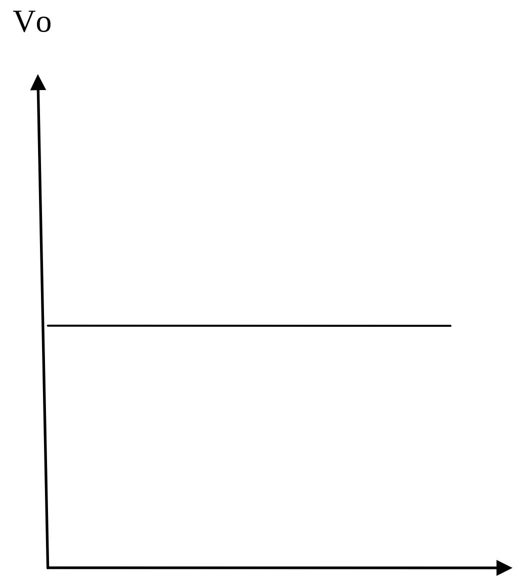


Figure3.6 Filtered DC

To determine the ripple content of the rectifier output [3], the below equation is used.

Ripple factor $r = \frac{1}{4\sqrt{3}\times F\times C\times Rl}$……………………………………………(i)

Where $R_L = \frac{Vip}{Idc}$ ……………………………………………………….(ii)

$$Vip = Vs - 2Vds$$

$$= 18 – 2\ (0.7)$$

$$=18\ -1.4$$

$$Vip = 16.6V$$

Substituting equation (ii) into (i)

$$r = \frac{1}{4\sqrt{3}\times F\times C\times\left(\frac{Vip}{Idc}\right)}$$

$$C = \frac{Idc}{4\sqrt{3}\times F\times r\times Vip}$$

The equation is use to determine the value of the capacitor used

$$C = 500 \times \frac{0.001}{4\sqrt{3} \times 50 \times 0.482\% \times 16.6}$$

$$= 0.0018039F$$

$$C = 1800\mu F$$

The value of capacitor used was $2200\mu F$ because increase in capacitor’s value increases ripples elimination.

However, the following are;

$Vs =$ Maximum transformer output.

r = 0.482% for single phase full- wave rectifier.

$Vip =$ Maximum rectifier output.

$Vs =$ Voltage drop by silicon diode.

$F =$ Mains frequency.

$Idc =$ 500mA = 500 x 10^{-3} A. maximum load current.

3.1.4 REGULATION STAGE (REGULATOR)

Sometimes there are variations in the input voltage which may not be much but will affect the output voltage of the power supply and sometimes changes occur in the current which also affects the Dc output voltage. In order to prevent this variation from occurring, a regulator is incorporated into the power supply circuit. Regulator has the ability to stabilize Dc output, even when the output of the smoothing device is much higher than the regulation voltage. The three categories of regulator are:

i. Those used with only positive voltage (78xx series)
ii. Those used with only negative voltage (79xx series)
iii. Those having fixed or adjust role output voltage (LM series)

78 xx series is used in the design, i.e 7812 regulator,

To provide 12v output. Note that 'xx' indicates the IC's regulation value.

3.2 CONTROL UNIT

The unit contains both active and passive components. It is responsible for the operation of pump in relation to water level in the tank as determine, by the floating sensors, to make logical decision and pass it in form of voltage to the suitable.

3.2.1 555 TIMER

The 555 circuit [4] consists of just a handful of main components; two comparators, a flip –flop, discharge path, output stage and a resistor network. NE 555 (also known as LM 555, CA555 and MC1455) is a widely used I.C timer; a circuit that can run in either of these modes; monostable (one stable state), astable (no stable state) or bistable (two stable state). In the mono-stable mode, it can produce accurate time delays from microseconds to hours.

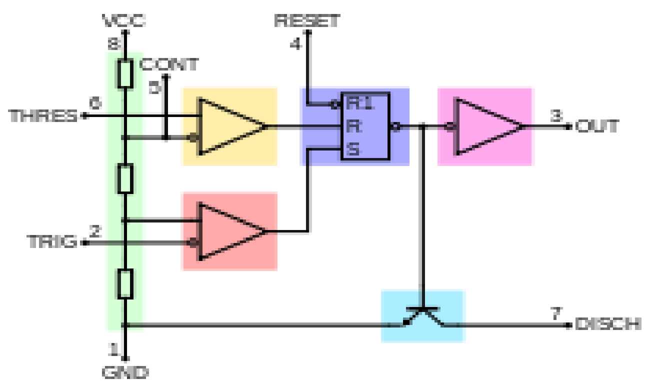


Figure 3.7 Internal diagram of a 555 Timer

3.2.2 MONOSTABLE OPERATION

In the mono-stable operation [4], initially, the 555 timer has a low output voltage at which it can remain indefinitely. When the 555 timer receives a trigger pulse, the output voltage switches from low to high. The output remains high for a while and then returns to the low state after a time delay. The output will remain in the low state until another trigger arrives.

When the 555 timer is used in the mono-stable mode, it is sometimes called a mono-stable multi-vibrator because it has only one stable state. It is stable in low state until it receives another trigger which causes the output to temporarily change to high state. It is also referred to as a one-slot multi-vibrator because it produces only one output pulse for each input trigger.

However, for this project, the 555 Timer is configured in the mono-stable mode but the timing network (R-C) is not included, as they do not determine the pump's switching operation. The pump is switched ON or OFF based on the trigger at pin 2 or pin 3.

3.2.3 555TIMER PIN CONFIGURATION

The 555 timer [5] is an 8 pin dual- in- line (DIL) package. Pin 1 in connected to ground and pin 8 is connected to the positive supply voltage. The timer will work with any supply voltage between + 3 and +18v. Trigger pulse goes into pin 2 and output comes from pin 3. Other pins not shown are connected to external component that determine the pulse width of the output. The diagram of a 555 Timer configuration and pin numbering are shown in figure 3.8 and 3.9 respectively.

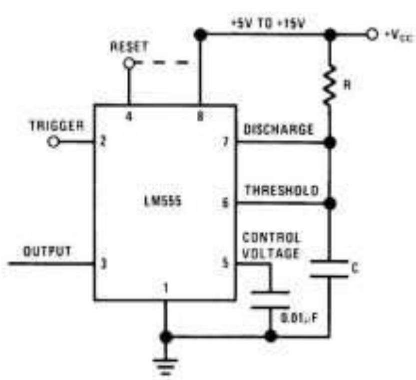


Figure 3.8 **555** Timer pin configuration

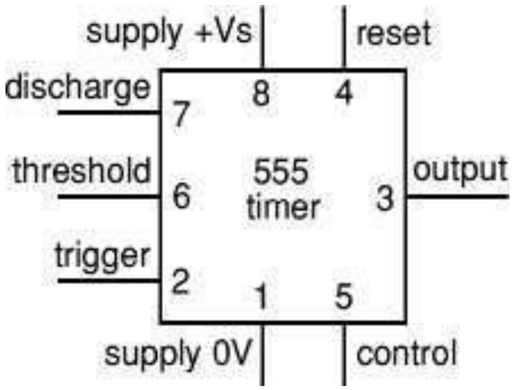


Figure 3.9 **555** Timer pin numbering

Pin 1- This is the ground pin and should be connected to the negative side of the supply voltage.

Pin 2- This is the trigger input.

Pin 3- This is the output pin and capable of sourcing a load requiring up to 200mA and can serve TTL circuits. Minimum voltage at this point is approximately (+Vcc = 1.7v).

Pin 4- This is the reset pin used to reset the flip-flop that controls the state of the output pin 3.

Pin 5- This is the control input voltage. A voltage to this pin allows the device timing variation independent of external network.

Pin 6- This is the threshold input voltage pin.

Pin 7- This is the discharge pin.

Pin 8- This is the supply pin and is connected to the positive terminal of the supply.

3.3 SWITCHING UNIT (TRANSISTOR AND RELAY)

The BC548transistor switches electronic signal and amplifies 555timer's output; that is base current, to open and close relay. Relay remains closed when base current flow; but Vcc flow through collector. Transistor switch provides the appropriate current for the control relay to operate the output of the 555 timer which is fed to the transistor switch.

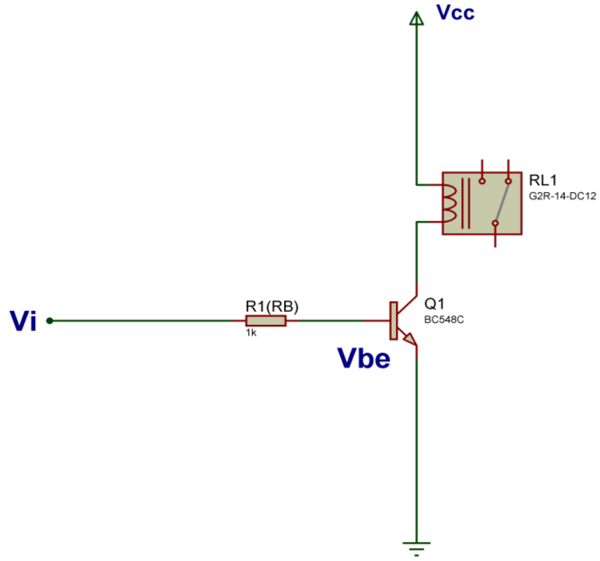


Figure 3.10 Switching unit

3.3.1 TRANSISTOR BIASING

OFF state is achieved by reverse biasing the emitter junction. In this condition, the transistor does not conduct between its emitter and collector and only the output leakage current (I_c) flows provided V_{be} is more negative than 0.5v.

ON state is achieved by forward biasing the emitter junction such that I_c is large enough to drive the transistor into saturation. In this case, V_{ce} is very small and collector current has maximum value.

From the figure above [6]

$Vi = IbRb + Vbe$ ……………………..…..... (iii)

$Rb = \frac{Vi - Vbe}{Ib}$……………………….………....(iv)

Also from $\beta = \frac{Ic}{Ib}$ ………….……………..(v)

$Ib = \frac{Ic}{\beta}$………………………(vi)

Substituting equation (vi) into (iv)

$$Rb = (Vi - Vbe) \times \frac{\beta}{Ic}$$

Where: Vi = minimum output voltage from 555 timer.

V_{be} = base – emitter Voltage drop of silicon transistor (0.7).

I_c= 100 x 10^{-3} A for BC548 transistor from data sheet.

$\beta = 100$, for BC548 transistor from data sheet.

$Rb = (1.7 - 0.7) \times \frac{100}{0.1}$

Rb = 1000-ohm, is the minimum value of base resistor that can be used.

3.3.2 CONTROL RELAY

Relay is an electro-mechanical switch operated electrically to turn ON or OFF current in an electrical circuit. They are control devices used in automatic control and in industries. The three categories of relays are; control relay, power relay and specialized relay. For this project, control relay is used. The choice of control relay depends on the voltage rating of the water pump. A 12v Dc relay is use to used to control the water pump.

3.4 FLOATING SENSOR

Any device which converts physical variable to an electrical variable is called sensor. The floating sensor used is more of a mechanical float switch; it floats vertically as the water level rises or falls in the water tank, to make contact with two levels. Contact with lower and higher levels, switches the pump ON and OFF respectively. Figure 3.11 shows the sensor arrangement in the overhead tank.

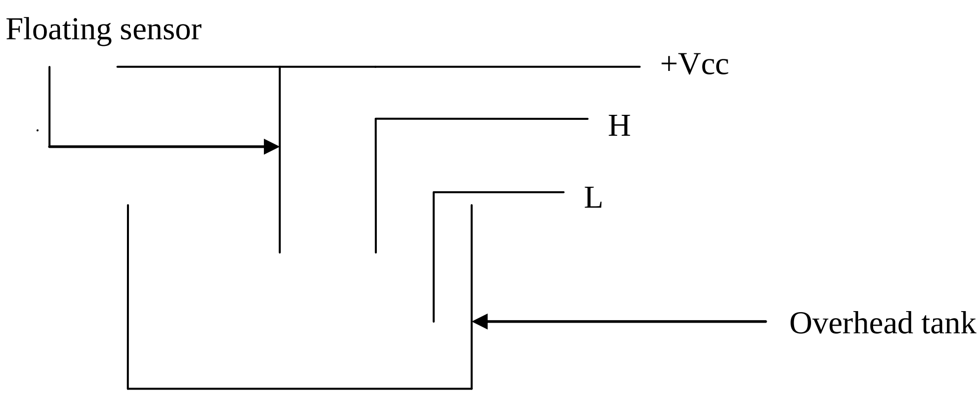


Figure 3.11 sensor arrangement

3.5 WATER PUMP

Pump is a device used to move fluid, such as water, liquid etc. A pump displaces a volume by physical or mechanical action. For this protect, a submersible 12 V DC (car fuel pump) pump is used. It can be placed under water and still carry out its function .The motor is protected from the liquid being pumped as it is placed in a water tight compartment filled with oil. The two types are; sump pump and sewage pump electrically operated whether on AC or DC.

3.6 CIRCUIT'S POWER INDICATION

A LED connected across +Vcc and –Vcc through limiting resistor to indicate power in the circuit by lighting up.

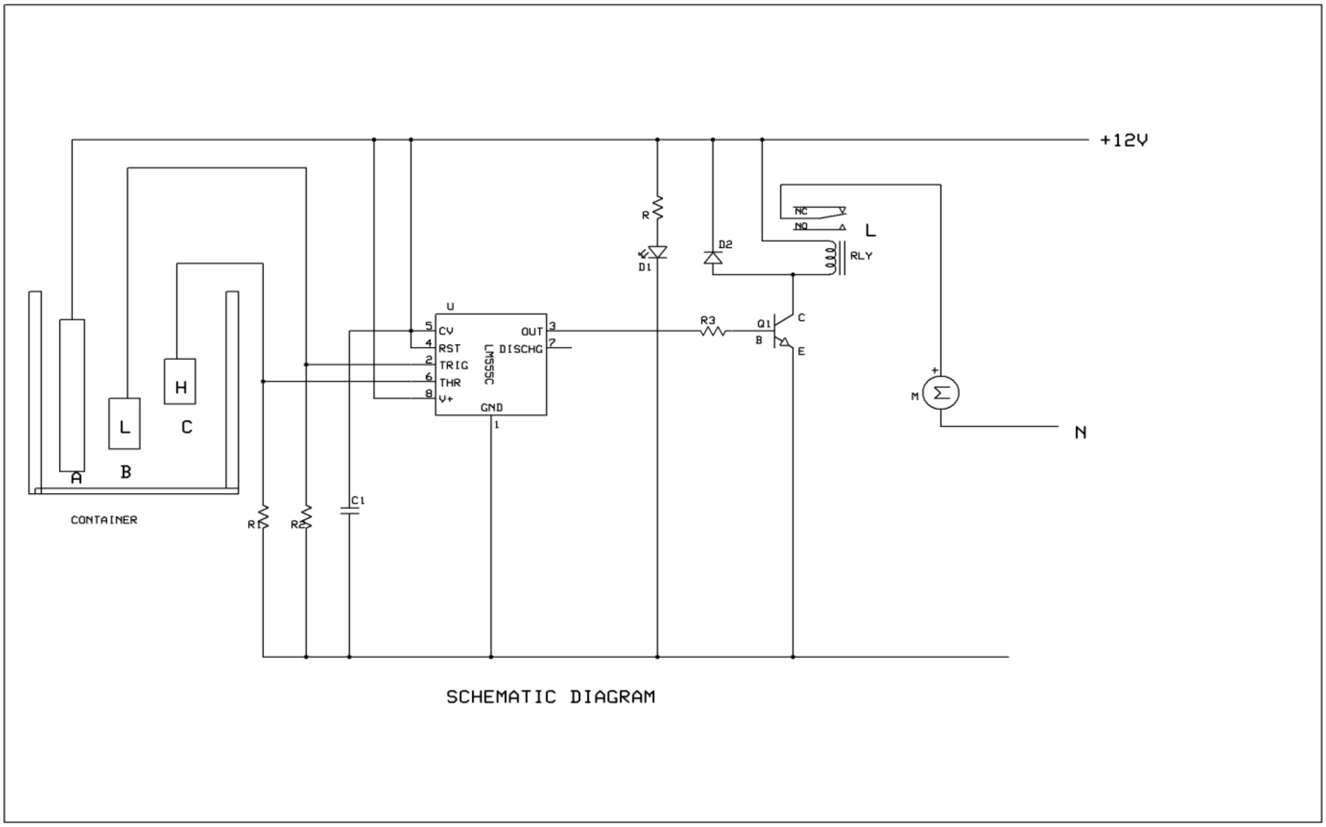


Figure 3.12 complete diagram of the constructed circuit

3.7 CONSTRUCTION PROCEDURE

3.7.1 INTRODUCTION

This stage deals with purchasing required components of correct values, assembling and testing on bread board to know the right connections, mounting on veroboard, casing of the system and problems encountered.

3.7.2 BREAD BOARD

All the stages of the circuit were mounted on bread board first before being transferred to a veroboard. This was to ensure that all the components were working and the circuit assembling was right.

3.7.3 MOUNTING OF COMPONENTS ON VEROBOARD

The entire circuit was mounted on veroboard (though on different pieces). The spacing of the components was for good ventilation. Jumper wire was used to link other parts of the circuit that are not on the same conducting line.

As each component was mounted on the veroboard and soldered, continuity test was carried out to ensure that continuity and discontinuity are between points that are expected. Hence, any short or open circuit detected was promptly corrected.

IC socket was used to mount the IC. This was to prevent it from damage due to high temperature of the soldering iron. Components and circuit test were all done using digital multimeter.

3.7.4 SOLDERING OF COMPONENTS

All components were wired on the veroboard with soldering lead and care was taken not to use unnecessary long wires. Care was also taken in the soldering of the active components used to avoid damage by excessive heat. A low power rated soldering iron of 40w at 25^0c was used to avoid dry joint and short circuiting. However, some calculated component values were approximated to the ones available in the market. At the end of the soldering process, the board was carefully examined to make sure that none of the parallel running lines had been bridged during soldering process as well as partial contact.

3.7.5 CASING

The entire circuit was housed in a plastic case of dimension 15cm length, 15cm width and 5.5cm height. The casing is cuboid in nature. The dimension chosen is sufficient enough to accommodate all the circuit with the exception of the water pump and floating sensor.

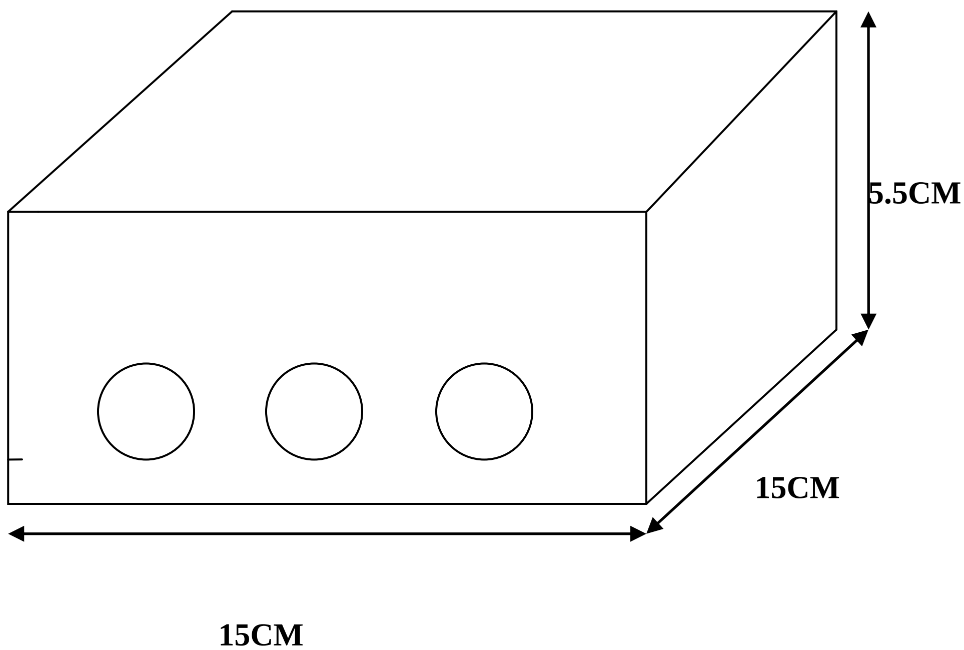


Figure 3.13 Complete circuit casing

CHAPTER FOUR: PERFORMANCE AND COST EVALUATION

4.1 INTRODUCTION

The performance of the system after construction, test results and total cost of the work are outlined in this chapter.

4.1 PERFORMANCE EVALUATION

After completion of the project, the circuit was connected to the 12v submersible pump situated in the reservoir, and was switched ON after being powered. Since the floating sensor rises and falls with water level, that enables it to detect water level in the overhead tank. It's response to any of two desired water levels is the 555 timer input in form of voltage at pin 2 or pin 6. Trigging pin 2 switches water pump ON while pin 6 switches it OFF. Output at pin 3, due to trigger at pin 2 or pin 6 produces or not, transistor's base current to drive it into saturation or cut-off, and initiate relay switching .

The circuit's performance was satisfactory as it was design to automatically switch ON or OFF water pump when pumping water to overhead tank.

PUMP AUTOMATIC OPERATION ARRANGEMENT

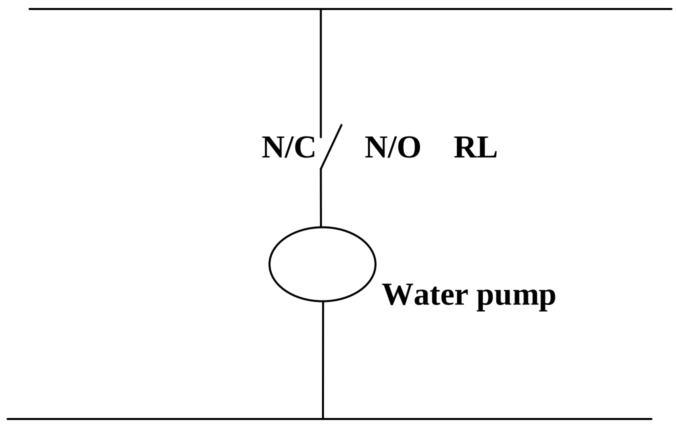


Figure 4.1 pump automatic operation arrangement

TABLE 4.1 TEST RESULTS

S/N	Test	Result
1	Mains input supply	210v
2	Rectifier out put	16.30v
3	Regulator out put	12.20
4	Motor operating voltage	10-12v

4.2 DISCUSSION OF RESULTS

The values of components in the power supply unit are chosen so as to enable the circuit achieve desired output (i.e 12V output) but due to some errors, the constructed circuit does not achieve the desired output , but it provides reasonable voltage output.

Some components used such as resistors, diodes, and capacitors are to limit, block and prevent discharge respectively.

The construction works according to design which indicates aim accomplishment.

TABLE 4.2 COMPONENTS COST

S/N	Component	Description	Rating	Unit used	Cost per unit(Naira)	Total cost(Naira)
1	Transformer	240/220V		1	200.00	200.00
2	Diode		IN4001	5	20.00	100.00
			LED	1	20.00	20.00
3	Capacitor		2200µF	1	50	50.00
			0.01µF	1	30.00	30.00
4	Resistor		68kΩ	2	10.00	20.00
			1kΩ	1	10.00	10.00
5	IC	LM555		1	200.00	150.00
6	IC Socket			1	30.00	30.00
7	Transistor	BC545		1	100.00	100.00
8	Cable cord			1	150.00	150.00
9	Jumper wire			7yards	30.00	210.00
10	Bread board			1	550.00	550.00

11	Lead			7yards	20.00	140.00
12	Vero board			1	150.00	150.00
13	Switch			1	50.00	50.00
14	Pump			1	3500.00	3500.00
15	Relay			1	200.00	200.00
16	Water pipe			1	250.00	250.00
17	Transport				500.00	500.00
18	Casing				800.00	800.00
19	Browsing				500.00	500.00
						7750.00

CHAPTER FIVE: CONCLUSIONS

5.1 SUMMARY

Chapter one presents general overview and importance of the project. Chapter two reviews similar works carried out with different types of automatic water level control system. Chapter three presents the design and construction procedure detailing out components value calculations. Chapter four highlights performance of the construction, test results and components costs. Chapter five contains summary, conclusions and recommendations.

Several problems encountered while carrying out the work include; lack of availability of some components or exact values of components obtained from design calculations. As a result, approximated values of some components were used in some cases.

5.2 CONCLUSIONS

The project aim stated at the beginning of the research work has been achieved. The design and construction of this project is of tremendous engineering benefit; as an improvement in the knowledge of liquid level monitoring system, as it detects various levels of water in an overhead tank and at the same time be able to operate water pump automatically.

5.3 RECOMMENDATIONS

Despite the design and construction of this project, it can be further modified or improved upon especially by replacing 555 Timer with microcontroller.

However, the modification should be determined by the task or operation it will perform.

REFERENCES

1. www.worldnature.org/water-scarcity.

2. Val S. Labanoff and Robert R. Ross (1992). Centrifugal Pumps; Design and Application, Second Edition..

4. www. Kpsec. Freeuk.com/555 timer. Htm.

5. www. En. Wikipedia. Org/wiki/555-timer-IC.

6. Engr. A. S. Kadalla (2010) EE305 Electronics I. An unpublished lecture note, Modibbo Adama University of Technology, yola, Nigeria.

APPENDICES

1.0 LIST OF ABBREVIATIONS

1. HZ=Hertz (unit of frequency)

2. AC=Alternating current

3. DC=Direct current

4. V=Voltage (AC or DC)

5. Vcc=Dc Voltage supply

6. Ic=Transistor saturation current

7. F=Supply mains frequency

8. µ=micro $(\frac{1}{1000000})$

9. K=kilo (1000)

10. f=farad (unit of capacitance)

11.Vi=Input voltage

12. Vo=Output voltage

13. N/C=Normally close

14. N/O=Normally open

15. D=Diode

16. R: Resistor

17. L=Inductor

18. C=capacitor

19. RL= Relay

20. PC= Primary Coil

21. SC= Secondary coil

2.0 CIRCUIT PICTURES

Assembled parts of the device

Complete Arrangement