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ASHESI UNIVERSITY

DESIGNING AN AUTOMATIC WATER PUMP FOR HOUSEHOLD AND SMALL SCALE INDUSTRIES

CAPSTONE PROJECT

BSc. Electrical and Electronic Engineering

ALEXANDER

DENKYI

2020

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DESIGNING AN AUTOMATIC WATER PUMP SYSTEM FOR HOUSEHOLD AND SMALL SCALE INDUSTRIES

CAPSTONE PROJECT

Capstone Project submitted to the Department of Engineering, Ashesi University in partial fulfilment of the requirements for the award of Bachelor of Science degree in Electrical and Electronic Engineering.

ALEXANDER

DENKYI

2020

DECLARATION

I hereby declare that this capstone is the result of my own original work and that no part of it has been presented for another degree in this university or elsewhere.

Candidate's Signature: ………………………………………………

Candidate's Name: Alexander Denkyi

Date: 4/1/2021

I hereby declare that preparation and presentation of this capstone were supervised in accordance with the guidelines on supervision of capstone laid down by Ashesi University College.

Supervisor’s Signature:

……………………………………………………………………………………………

Supervisor’s Name:

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Date: ……………………………………………………………………………………………

ABSTRACT

Water plays an important role in our daily lives and also the scarcity of it increasing. Most countries in Africa are facing this kind of problem. Most countries in Africa are facing this kind of problem due to mismanagement and a high illiteracy rate. People are mostly busy and ignorant that they forget to turn off the pump motor when the overhead tank is full. The overhead tank then overflows. Water and power are wasted in this process. This paper presents a solution to this problem. An automatic water pump system is designed to monitor the water level of the water tank and turn the pump on and off due to the water pump level. Also, a water level indicator is built to show the status of the tank to the user. The system consists of three sensors. Two of the sensors are placed at the maximum and minimum levels, respectively. When the sensor does not touch the water at the minimum level, the pump turns ON and turns OFF when the water touches the sensor at the maximum level. The system consists of a CD4001BP which performs the logical operation for the pump to turn ON and OFF.

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CHAPTER 1

INTRODUCTION

1.1 BACKGROUND

Water is a fundamental human need. We need water to survive. Water is used for domestic agriculture, industry, and consumption. According to the U.S Department of Interior's Bureau of Reclamation, Ninety-seven percent of all water on the earth is salt water which is not suitable for drinking, whereas only three percent is freshwater [1]. And as the population of the world is still rising, we must preserve and conserve water. Water conservation is the act of using water efficiently. Over recent years, water wastage is on the rise. In Africa, in many households, there are water storage tanks installed which serves as a reservoir that helps distribute water around the house for domestic activities. In most countries in Africa, water companies limit water supply to their citizens in the country. As a result, it is very difficult for countries to have access to water at that period. Some citizens who can afford it tend to you use water pumps. These pumps are usually operated manually; that is, you have to turn them on to fill storage water tanks or stop the tank's flow. There is no way of controlling when the pump should go off. You have to physically interact with the pump to put it on or off. This can lead to water wastage if the pump is not turned off when it is full. This results in the water overflowing, which wastes water.

The water pump controller controls how the pump operates. This depends on the water level of the Storage tank. It turns ON when the Storage tank's water level is LOW and turns OFF when the storage tank is FULL. Turns OFF the Pump when the water level is low in the tank and turns ON the pump when there is water in the tank. With the automatic water pump, there is no need to manually operate the pump that pumps water from the reservoir to the Storage tank. It automatically turns on the pump when the tank's water level falls below a certain level if there is water in the reservoir. When the water level rises to the maximum level, the pump automatically switches off. A water level indicator is also added to the circuit to show the status of the water level. This feature is important and it makes the user work very easy.

1.2 AIM

This project aims to design a circuit that controls a water pump. The circuit allows the water pump motor to automatically switch ON when the storage tank is empty to pump water into it. And also, switch off when the tank is full to prevent overflowing. A circuit for the water level indicator is built to notify the resident of the water's state in the Storage tank.

1.3 OBJECTIVES

The main objective is to design a device that automatically pumps water into a water storage tank. The specific objectives are as follows:

1. To design an automatic water pump system
2. To prevent waste of water
3. To reduce the labor of users.
4. To save energy since the electricity demand is high.

1.4 EXPECTED OUTCOMES

1. A functional prototype
2. Energy conservation
3. A well-simulated circuit of the water pump system.

1.5 MOTIVATION OF THE PROJECT TOPIC

Water is part of our basic life. We use water every day in our life. As the world's population is still on the rise, water demand is also on the rise. The amount of drinkable and usable water is also reducing. There needs to be a way to utilize the amount of usable water we have left to prevent us from wasting them.

Hence, this project's motivation includes the need for an automatic, effective, and affordable water pump system.

1.6 RESEARCH METHODOLOGY

1. Systematic Literature Review
2. Computer Simulation
3. Physical Prototype

1.7 SCOPE

This scope of the project is limited to designing an automatic water pump system. The design of this system also includes a water level indicator which shows the amount of water in the overhead tank. Different color LEDs represent the various levels. The automatic pump system uses different logic gates to operate. It uses the high and low signal provided by the probes, which are the sensors in the overhead tank. The probes detect the levels of water in the overhead tank. With the help of the CMOS chip, the circuit can turn the water pump ON or OFF. It switches off when the tank is Full and switches back on when the water is at the lower limit of the overhead tank. The circuit is built around a CD4011 IC and a 12v power supply, which consumes less power to save energy. The project also consists of a water level indicator that switches various LEDs ON, showing the storage tanks' status and sounds off an alarm when the tank is full. Also, we need a 12V power supply for the automatic water pump system to operate. Due to COVID 19 and lack of accessibility to a power supply, I decided to build a 12V power supply from scratch to power my water pump system.

1.8 LIMITATION

Rusting and corrosion may occur because the sensors are made of conductive material. This can prevent the sensors from working, which can affect the device.

CHAPTER 2

LITERATURE REVIEW

2.1 INTRODUCTION

In this chapter, we look at the various related literature on the topic.

This literature review consists of discussions of recent work on an automatic water pump. Water is important, and it is part of our daily life. It is used in the irrigation of farms and domestic uses. The most common way of getting water into the tank is the manual process. This process results in the waste of water due to users' inability to turn off the pumps when the tank is full, which leads to overflow. Wasting water reduces the earth's water level, and most lands are becoming unirrigated lands (Muhammed, 2013). When using the manual system, the user always has to be present to turn the water pump ON and OFF

There have been several water pump controller projects and related studies concerning it.

2.2 REVIEW OF RELATED STUDY.

This literature review contains works concerning the automatic water pump controller.

Gowri *et al.* [2] proposed controlling the flow of water into storage tanks automatically by using a Mobile Application in android. With the Mobile Application. The connectivity between the circuit and the mobile application is made possible with the help of a Bluetooth device. The Bluetooth device handles the communication between the mobile application and the tank overflow circuit. This system comprises 8051 microcontrollers, a Bluetooth device, a three-level sensing terminal, and a mobile phone application—the 8051 microcontroller acts as the brain of the circuit. The Bluetooth device serves as connectivity between the circuit and the mobile application. The three-level sensing terminals are fixed into the tank. The three levels are; full, medium, and low. The three-level sensing terminal helps control the flow of water into the tank—the mobile phone application installed onto the mobile phone. The moisture of the water is checked by the three-level sensor, which indicates the level of the water. The motor switches the water motor ON and OFF with the help of the mobile application. Below is the block diagram of the proposed study.

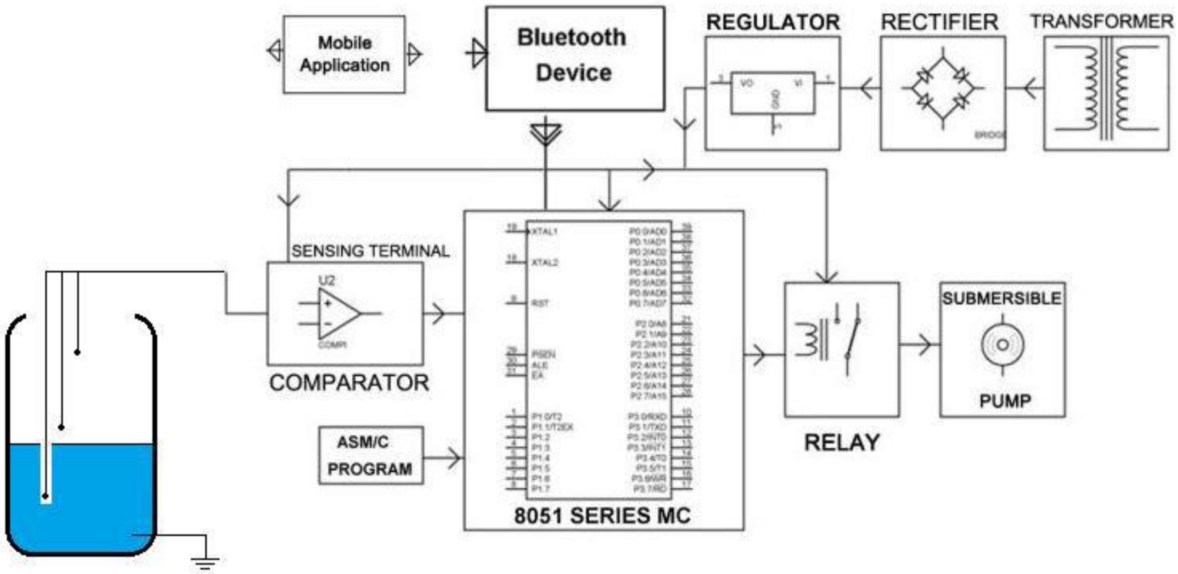

Figure 2.1 Block Diagram

Souvik *et al.* [3] proposed a model to preserve and utilize water properly. This model consists of the use of a wireless radio transmitter and Wi-Fi Router. This model consists of a water level detector, wireless radio transmitter, router, and smartphone. The water level detector is fitted into the water tank. The transmitter is connected to the Wi-Fi router. The transmitter collects information from a water level detector and transmits it wirelessly to the smartphone. The smartphone can access the data transmitted to it. A switch that controls the pump is attached to the transmitter, which is connected to the router. As a result, the user can control the water pump without manually operating the pump. This is done via the smartphone.

The smartphone application interface used to control the water pump shows the status of the tank and the pump. And The time left and elapsed while filling the tank.

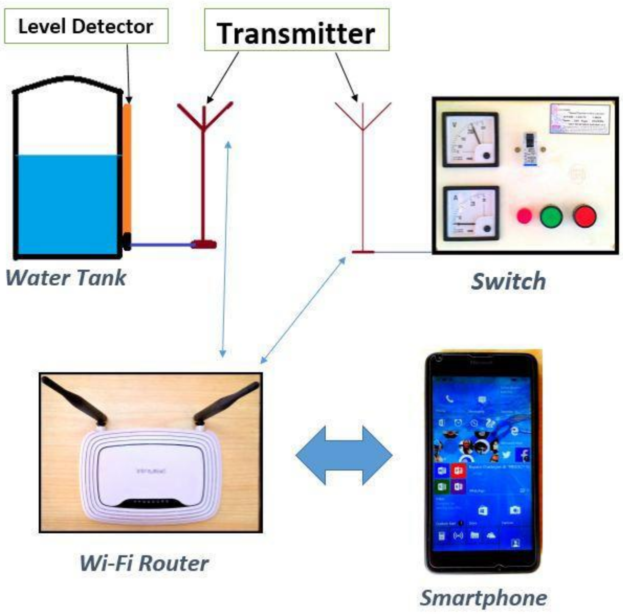

Figure 2.2- Block Diagram

The interface of the smartphone application used to control the water pump shows the status of the tank and the pump.and the time left and elapsed while filling the tank.

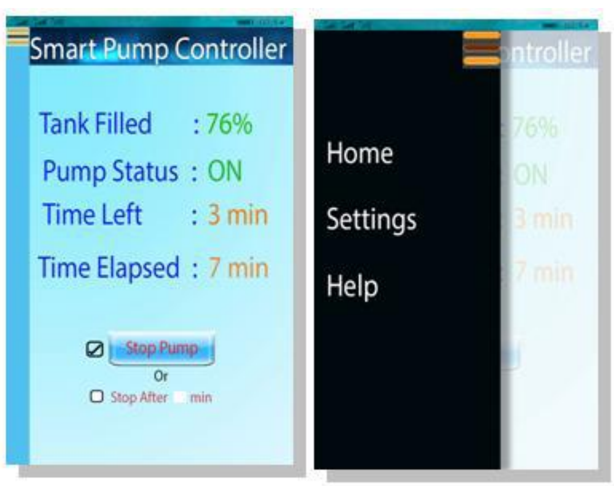

Figure 2.3- Mobile Interface

Pooja *et al.* [4] proposed a model of an automatic irrigation system that uses valves to turn the pump motor ON and OFF. The valves are automated with the use of a controller. With this kind of model, farmers are able to apply the right amount of water to the crops at the right time. The model comprises of

Moisture sensor, GSM, Arduino microcontroller, power supply, and a mobile phone application. The GSM is assembled with the communication interface. The GSM transmits data to the mobile phone. The Arduino acts as the brain of the model. It acts as the intermediate between the pump motor and the mobile device. The moisture sensor communicates with the Arduino board, which helps. This encourages water conservation. This helps reduce runoff from over watering saturated soil and also helps avoid irrigation at a wring time. With automatic irrigation, there is accurate soil moisture control. It is a precise method for irrigation. It saves time and reduces human error.

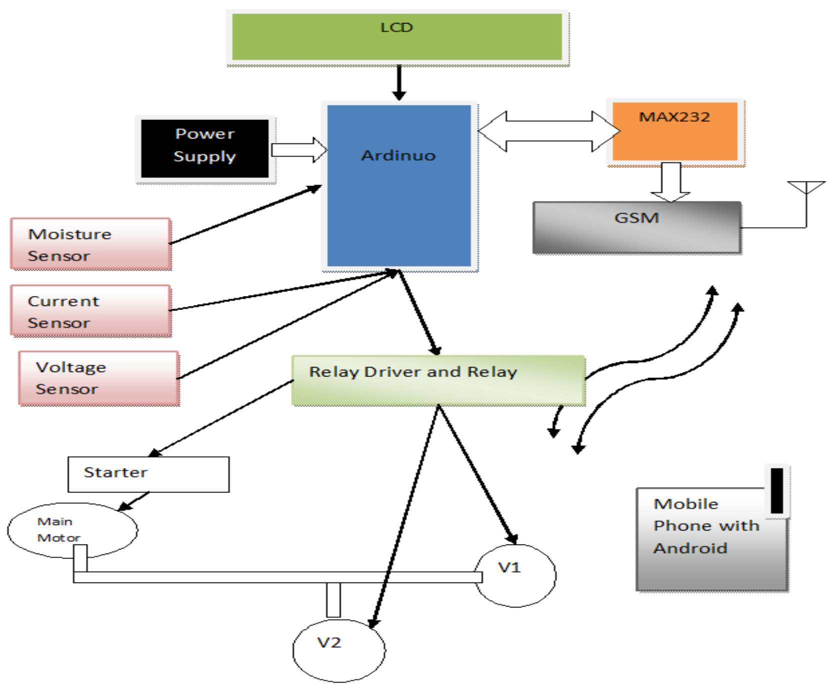

Figure 2.4- Block Diagram

Aniket *et al.* [5] designed a project that monitors the water level of a tank with the help of an ultrasonic sensor. The data retrieved from the ultrasonic sensor is sent to a server with the help of a Wi-Fi module. The user will then be notified through SMS when a pump starts or stop. This helps the user to keep track of the activities. The ultra sensor detects the water level in the tank. The water flow sensor helps determine the amount of water needed in the storage tank. This data from the water flow sensor is sent to the Arduino. The data from the Arduino board is sent to a cloud. The data is then sent to the user's smartphone. A solenoid valve is used to allow water to enter the tank. Because the solenoid valve is controlled remotely, the user can cut off or allow water to enter the tank remotely. Also, the water supply is cut off when there is an abnormality in water consumption.

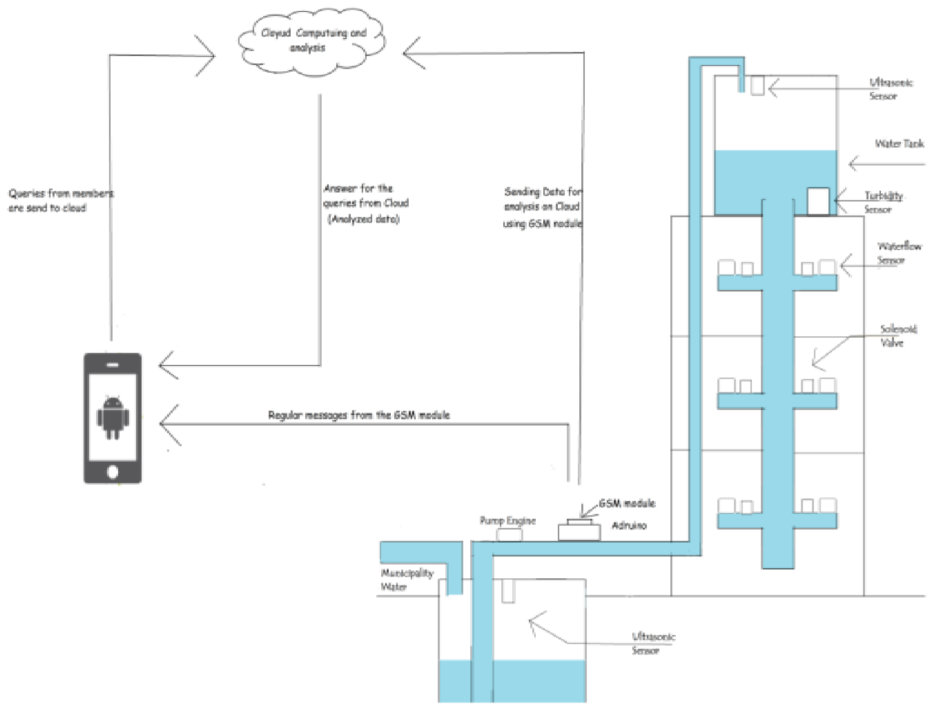

Figure 2.5-Flow Diagram

CHAPTER THREE.

DESIGN METHODOLOGY

3.1 CIRCUIT OPERATION

For this project, a circuit is built. This circuit turns water pumps turns automatically ON and OFF depending on the water level of the tank. For this circuit, no user interaction is need. Everything operates automatically. I use three water level sensors for this project—one at the top, the middle, and the last one at the bottom.

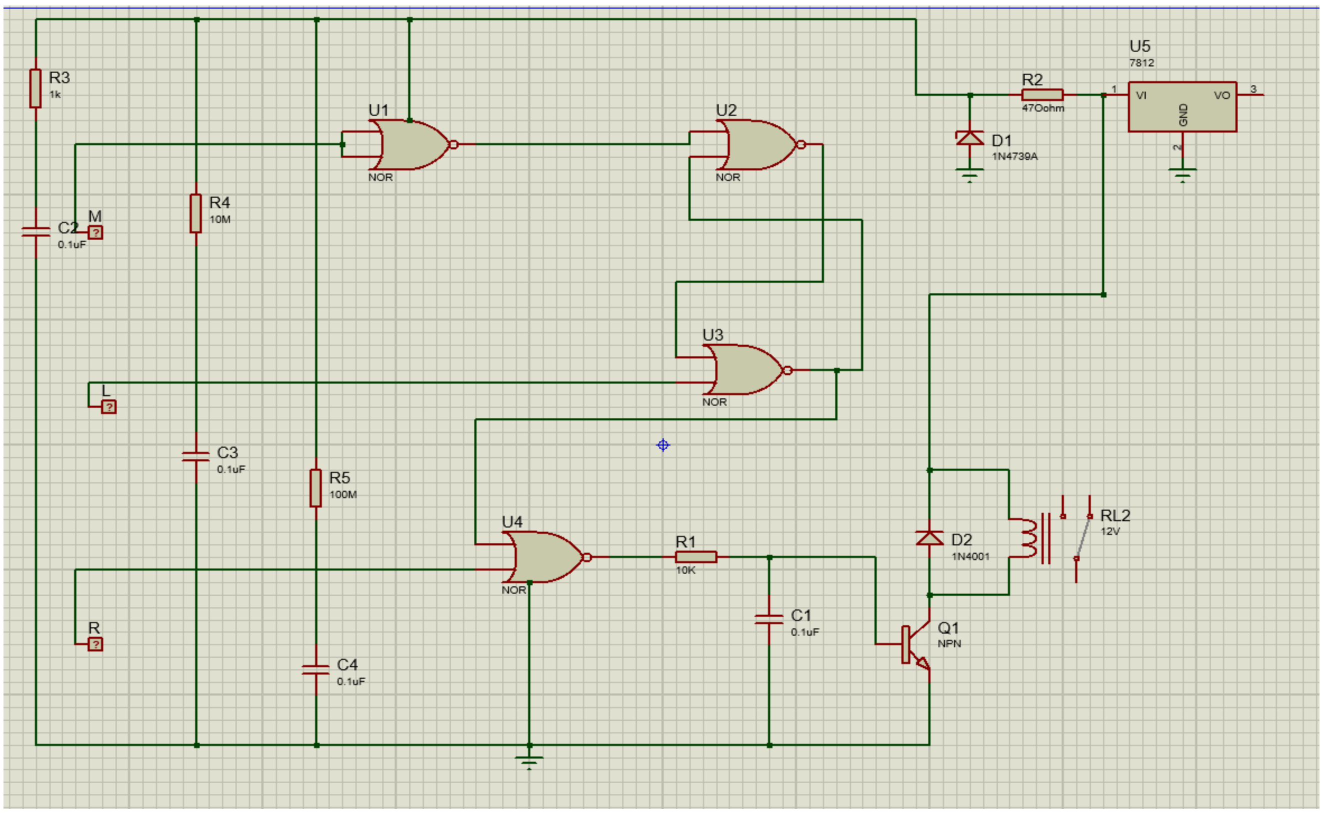

Figure 3.1: Schematic Diagram of the Automatic Water Pump Circuit

3.1.1 PRINCIPLE OF OPERATION.

This circuit contains probe wire which can be used as a sensor. There are three probes. Each probe is fixed at a certain level in the water tank. Low (L), Middle (M) and High (H). the probe are connected to a resistor which is then connected to the CD4001. The CD4001 acts as the brain of the circuit. It performs logical processing. The CD4001 is represented by the four NOR in the circuit. They are the architecture of the CD4001 chip. The IC is connected to a 0.1uF capacitor which connected to the emitter of an NPN transistor. The transistor is then connected to a diode. The diode is then connected in series with the a 12V relay. A 12V relay is used because of the amount of power supplied to the circuit. Any voltage below 12V will allow the circuit to work. The relay is connected to the Motor Pump. The circuit is connected to the 12V power supply.

3.2 WATER LEVEL INDICATOR

For my project, I also designed a water level indicator that can help the user know the storage tank's status. This circuit contains three 100 ohms resistors, three NPN transistor, four probes which indicates the different levels of the water (P1- LOW, P2- HALF, P3-FULL)

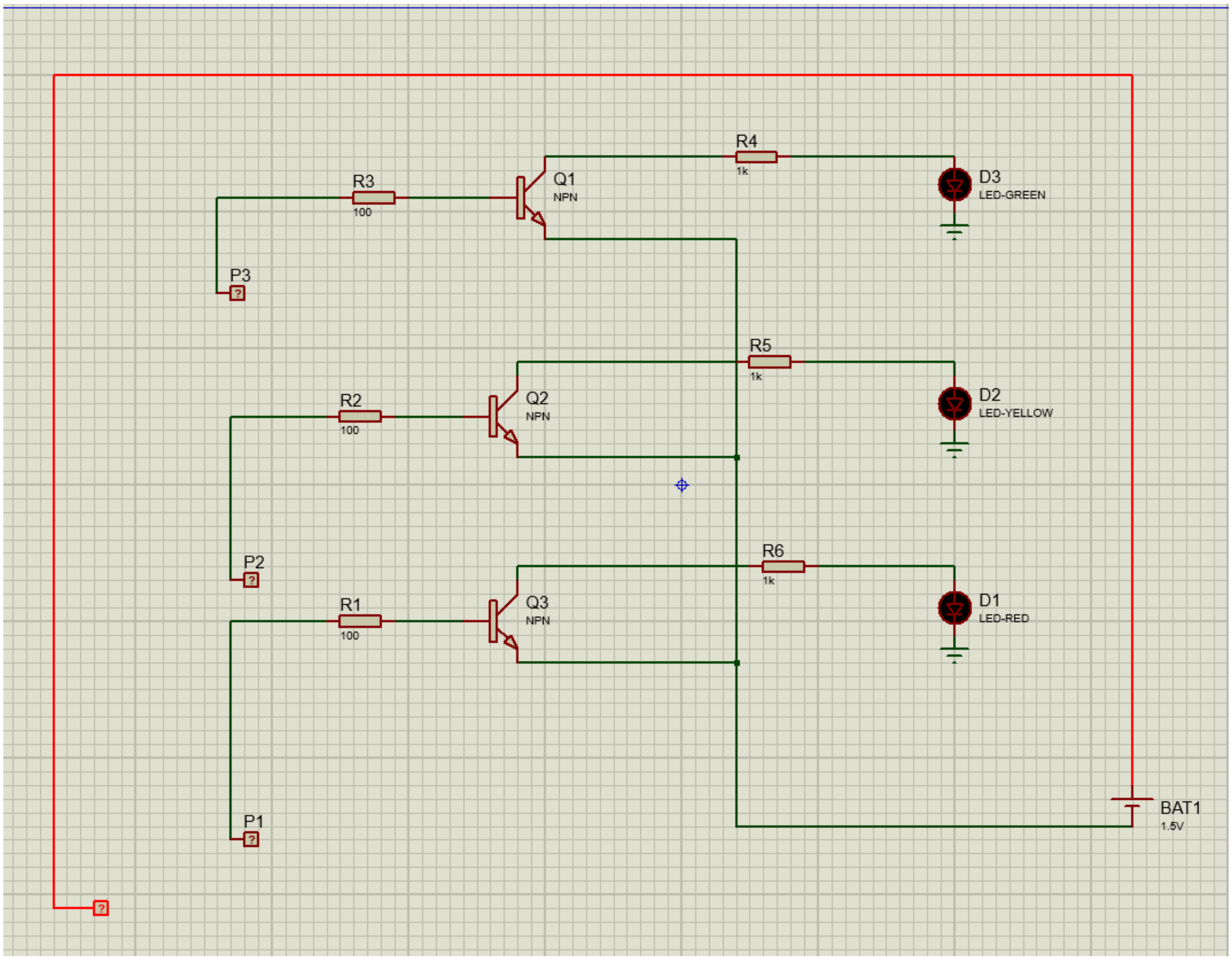

Figure 3.2 Schematic Diagram of a Water Level Indicator

3.2.1 HOW IT WORKS

The positive terminal of the power supply (battery) is immersed into the water. It was placed at the lowest level of the water. The bases of the three transistors according to the depth of the water tanks. The collector of the three transistors is connected to a resistor which is then connected to LEDs. When the water touches the P1, the RED LED turns ON, indicating the water is at its lowest level. When the water touches P2, the YELLOW LED turns ON, indicating the water level is halfway. When the water touches P3, the GREEN LED turns ON, indication the water is at its maximum level.

3.3 COMPONENTS REQUIRED

1. CD4001
2. RESISTORS ((R1 is 1M Ω, R2 is 10M Ω and R3 is 100M Ω, R4 is 10k Ω, R5 is 47K Ω)
3. RELAY(12V,30A)
4. BC 548 transistor
5. IN4007 Diode
6. Capacitors (0.1μF)
7. Zener diode(9.1V)

3.3.1 POWER SUPPLY UNIT

Power supply reduces mains electricity down usually in Alternate current to a useable direct current [7]. For my project,, I need a 12V power supply to order to operate the water pump circuit. I used the linear power supply mode instead of the switching power supply mode. The linear power supply mode utilizes a transformer to drop voltage from the AC line to a much lower AC voltage then uses a series of rectifier circuitry and filtering processes to produce a clean DC voltage. Linear power supply is increases reliability. The linear power supply also has a superior transient response, meaning it takes less time is required for the output voltage to recover from load unlike the switching power supply

3.3.2 OPERATION OF POWER SUPPLY UNIT

A 220V 50Hz transformer is connected to a bridge rectifier which consists of 4 diodes. The bridge rectifier is connected in parallel to a 1000uF capacitor and in series with a voltage regulator, and a 220 ohms resistor and a yellow LED. The yellow LED shows if the power supply is working. A conventional DC power supply is used because it is more convinent. The stepdown 220V 50Hz transformer decreases the incoming Ac voltage. This incoming AC voltage is from our household outlets. Household outlets are AC instead of DC. The bridge rectifier changes the decrease AC voltage which is from he stepdown transformer to DC voltage. The DC output is then smoothen with the filtered capacitor form the circuit. The ripple from the DC is eliminated by the voltage regulator

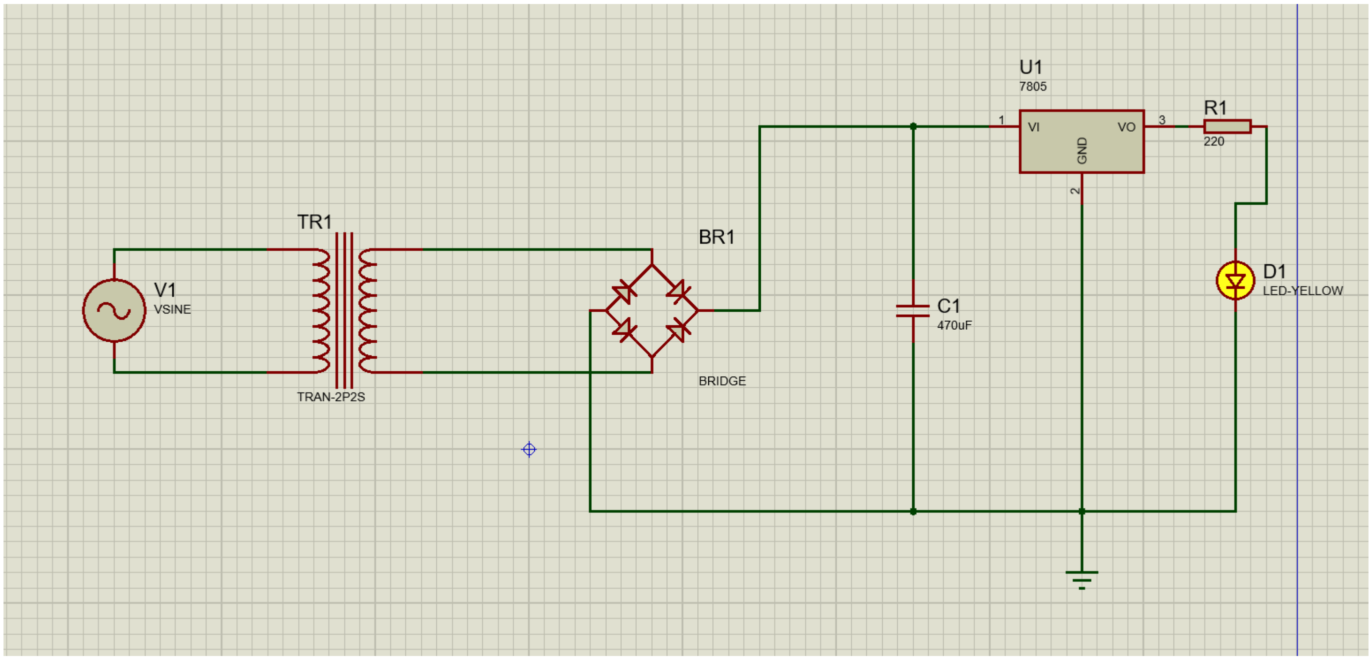

Figure 3.3: Schematic diagram of a 12V DC power Supply.

3.4 DESCRIPTION OF SYSTEM COMPONENTS

The components used are:

1. CD4001BP
2. Resistor
3. Capacitors
4. Diode
5. Transformer
6. Transistor
7. Light emitting diode (L .E. D)

3.4.1 CD4001BP

CD4001BP was used for the logic gate. For logic gates, it processes signals which are true or false. Positive supply voltage represents +V which is true, and 0V represents false. Gates consist of two or more inputs apart from the NOT gate, which has one input. Below are the types of gates used in logic.

TRUTH TABLE OF CD4001

Truth table is a way to illustrate how a logic gate functions. The table consists of the combination of two or more inputs to show the output state. The symbols used in this truth tables are usually ones(1) and zeros (0)

NOR Gate

The CD4001 uses NOR gate in its operation. A total of 4 NOR gates. NOR gates is a combination of NOT and OR. For NOR gate, the output is true if NOT input A or B are true. NOR gate consist of two or more inputs with a single output [6].

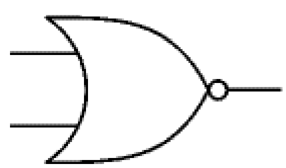

Figure 3.4.1: Symbol of the NOR gate

TABLE 2.1

Truth Table

Input A	Input B	Output O
0	0	1
0	1	0
1	0	0
1	1	0

3.4.2 RESISTOR

A resistor is a component that opposes the flow of current through it. Most resistors contain a small amount of capacitance and inductance. These small amounts can be neglected because they do not make any difference. There are also pure resistors that contain only resistance. They are hard to come by. For this project, we used normal resistance. Resistors are made from a mixture of finely powdered carbon and ceramic. They are connected in either parallel or series. They protect some devices such as transistors and diodes from excess current. They are measure in ohms

Figure 3.4.2: An Image of a Resistor

Table 1.1

Resistor Color Code Scheme

COLOUR	FIRST BAND	SECOND BAND	THIRD BAND	TOLERANCE
BLACK	_	0	x10	
BROWN	1	0	$x10^1$	±1%
RED	2	00	$x10^2$	±2%
ORANGE	3	000	$x10^3$	
YELLOW	4	0000	$x10^4$	
GREEN	5	00000	$x10^5$	
BLUE	6	000000	$x10^6$	
VIOLET	7	0000000	$x10^7$	
GREY	8	00000000	$x10^8$	
WHITE	9	000000000	$x10^9$	
GOLD	_	_	x0.1	±5%
SILIVER	_	_	x0.01	±10%

The color of the resistor help me to easily identify the appreciate resistor needed. In my project I used several resistors. The 1M resistor (Brown, Black, Orange), 10M (Brown, Black, Blue), 1K resistor (Brown, Black, Red)

3.4.3 CAPACITOR

Capacitors are devices that store electric charges. Capacitors are used in varying DC supplies. They act as a reservoir of charge. Capacitors are used for filtering circuits, signal coupling, and decoupling.

CAPACITANCE

Capacitance is the capacitor's ability to store charge. The larger the capacitance, the more charge it can store. Capacitance is measured in farads (F)

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 two groups of capacitors. Ther are the polarized and unpolarized

POLARIZED CAPACITOR

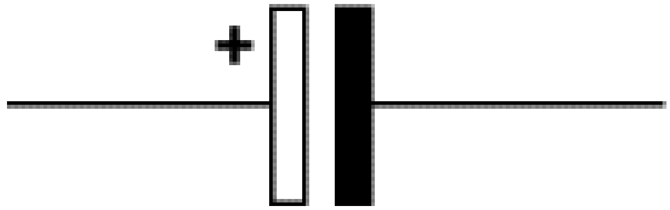

Figure 3.4.3: Schematic Symbol of a Capacitor

ELECTROLYTIC CAPACITORS

Electrolytic capacitors are polarized capacitors. They are not damaged by heat. There are two designs of an electrolytic capacitor. The axial is where LEDs are at each end, and radial, where both LEDs are the same. The radial is smaller than the axial. Values of electrolytic capacitors are printed on them. That is the capacitance and voltage rating.

TANTALUM BEAD CAPACITOR

They are polarized capacitors with low voltage ratings. They are quite expensive. They are used where large capacitance is needed. Some tantalum capacitors use a color scheme. For others, the values are printed on them.

UNPOLARISED CAPACITORS

Capacitors with smaller values are unpolarized capacitors. They also have high voltage ratings of at least 50V. They have different labeling systems, so it is hard to know the values.

For my project, I used the unpolarized capacitor. This is because it has no implicit polarity. There is no need to be concerned about polarity. It maintains the capacitance with bias in both direction this allows you to build your circuit freely. It cannot be destroyed by reverse voltage unlike the polarized capacitor.

3.4.4 DIODE

A diode is a semiconductor device that allows electricity to flow in one direction. On the symbol, the arrow shows the direction in which the current can flow.

Figure 3.4.4: Image of Diode

This occurs when there is a small voltage across a conducting diode. Forward voltage drop is about 0.7V for diodes made from silicon. The forward voltage drop of a diode is always constant when current passes through the diode.

Reverse Drop

A perfect diode that does not conduct when the reverse voltage is applied to it. Most diodes have a reverse voltage of about 50V, and when the maximum reverse voltage is passed, the diode will fail.

There are two types of Diodes. Signal diodes and rectifier diodes. For the signal diodes, it passes a small current of about 100mA or less. The rectifier diode passes large currents. Signal diodes can be damaged by heat, but the probability of that happening is very low. For rectifier diodes, they are robust; therefore, special caution is not needed.

You can use a multimeter to check whether a diode can flow in a direction.

Doides ere very important in my design. Without them, there is no way my circuits were going to work. They were used in building the 12V power supply and the automatic water pump circuit.

3.4.5 ZENER DIODES

Zener diodes are used to maintain a fixed voltage. They are also known as the breakdown diode. They operate in the reverse direction. Zener diodes are known to be highly doped. For a Zener diode, when reversed, the potential reaches the Zener voltage; this allows the junction to breakdown and makes the current flow in the reverse direction. Zener diodes are rated by their breakdown voltage and maximum power:

· The minimum voltage available is 2.4V.

· Power ratings of 400mW and 1.3W are common.

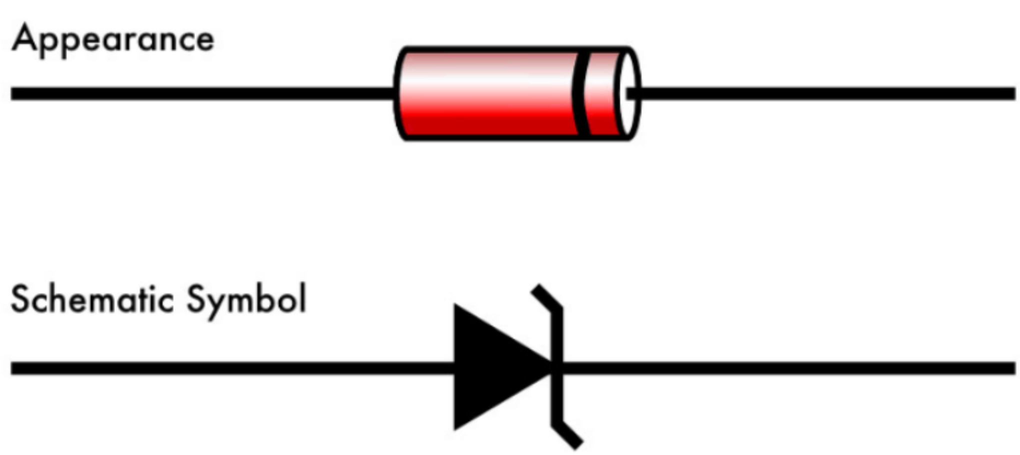

Figure 3.4.5: Real and Schematic model of a Diode

3.4.6 BRIDGE RECTIFIERS

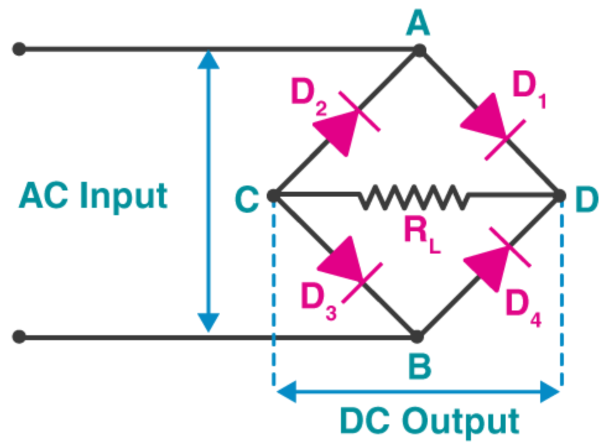

Figure 3.4.6: Schematic model of a Bridge Rectifier

One way to connect diodes to make a rectifier to convert AC to DC is the bridge rectifier. Bridge rectifier contains four diodes. They are rated by their maximum current and maximum reverse voltage. There are four terminals on the bridge rectifier. There are two AC inputs and two DC outputs.

3.4.7 TRANSFORMERS

A basic transformer is an electrical device used to transfer alternating current from one circuit to another circuit through magnetic coupling of the transformer's primary and secondary windings. Mutual inductance makes it possible for transformers to operate. In a transformer, the coupling (K) coefficient depends on the position of the secondary coil with respect to the primary coil. The coefficient of coupling also varies from zero to one. An ideal transformer is a transformer free from all kinds of losses. In an ideal transformer, the magnetic lines of flux produced by primary cuts the secondary. Voltage has to be applied to the primary winding to allow current to flow through the primary. This current generates a magnetic field that generates a counter emf which is the opposite phase of the voltage. Also, the magnetic field generated by the current in the primary that cuts the secondary winding and induces a voltage in this winding.

CONSTRUCTION OF A TRANSFORMER

To construct a transformer, you need two coils with mutual inductance, and a laminated steel coil is needed. The two coils are insulated from each other and the steel core. The transformer's core is constructed from the lamination of steel sheets assembled to provide a continuous magnetic path.

TURNS RATIO: TURNS RATIO of a transformer is the ratio of the number of turns of the wire in the primary winding to the secondary winding number. The primary number of turns is stated first, followed by the number of turns of the secondary. For example, 1:3 turns mean the secondary has the number of turns thrice as the primary. Also, the voltage across the secondary is thrice that of the voltage applied to the primary.

Power and current ratio: This ratio depends on the fact that the power delivered to the secondary is always equal to the power delivered to the primary minus the transformer's losses. The power and current law states that current through a transformer is the inverse of the voltage of the voltage or turms ratio, with power remaining the same regardless of the number of secondaries

VOLTAGE RATIO: the voltage of the windings in a transformer is directly proportional to the number of turns on the coil

VP/Vs=Np/Ns

VP = voltage on primary coil

VS = voltage on secondary coil

NP = number of turns on the primary coil

NS = number of turns on the secondary coil

When the secondary voltage is greater than the primary voltage, the transformer is called a step-up transformer. Also, when the secondary voltage is less than the primary voltage, the transformer is a stepdown transformer.

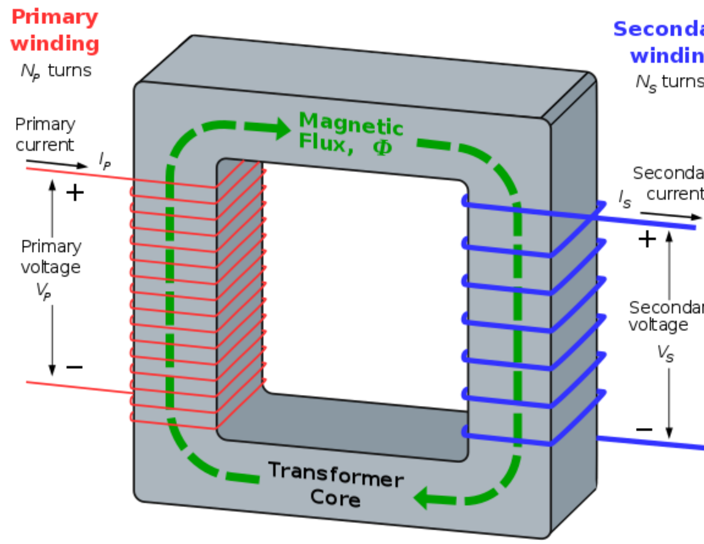

Figure 3.4.7: Step down Transformer

The figure above is a step down transformer. In my project, I used the step down transformer to make my power supply. This is because I was moving from a higher voltage to a lower voltage. The step down transformer was less expensive as compared to the step up. It was more reliable and durable

3.4.9 TRANSISTORS

Transistors are used to amplify or switch electric signals. It consists of terminals (Base, Collector, and Emitter)

FUNCTION

Transistors can amplify the current from the logic IC, which is known to be small to operate a lamp. In most circuits, the resistor converts the currents to voltage, and the transistor is used to amplify the voltage. Current amplification is known as current gain

Types of Transistors

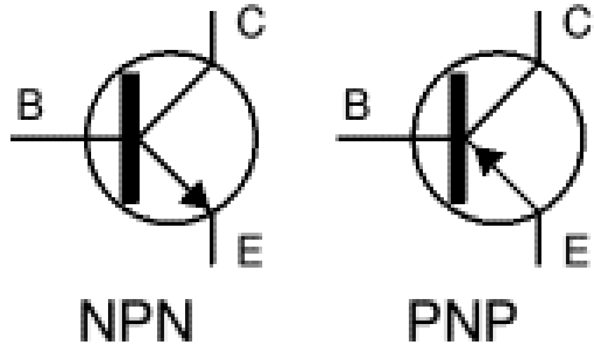

Figure 3.4.8 Schematic Symbol of NPN and PNP transistor

Testing a transistor

When a transistor is misused in a circuit or soldered it can be damaged. To know if a transistor is not damaged, You can you these various ways.

1. Testing with a multimeter

You can use a multimeter to check if each pair of leads for conduction. Set the digital multimeter to diode test.

Results from Testing each pair of leads both

· The **base-emitter (BE)** junction should behave like a diode and conduct one way only.

· The **base-collector (BC)** junction should behave like a diode and conduct one way only.

The **collector-emitter (CE)** should not conduct

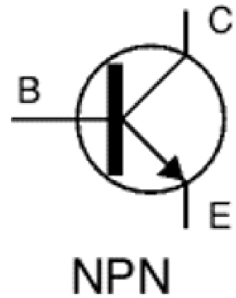

Figure 3.4.9: Schematic of NPN transistor

The figure above shows how the junctions behave in an NPN transistor

3.4.9 LIGHT EMITTING DIODE (LED)

LED is a semiconductor light source that emits light when current is pass through them. For an LED the cathode is the short lead and he long lead is the anode. For an LED the cathode is the larger electrode. It is important to note that an LED can be damaged when soldered

TESTING AN LED

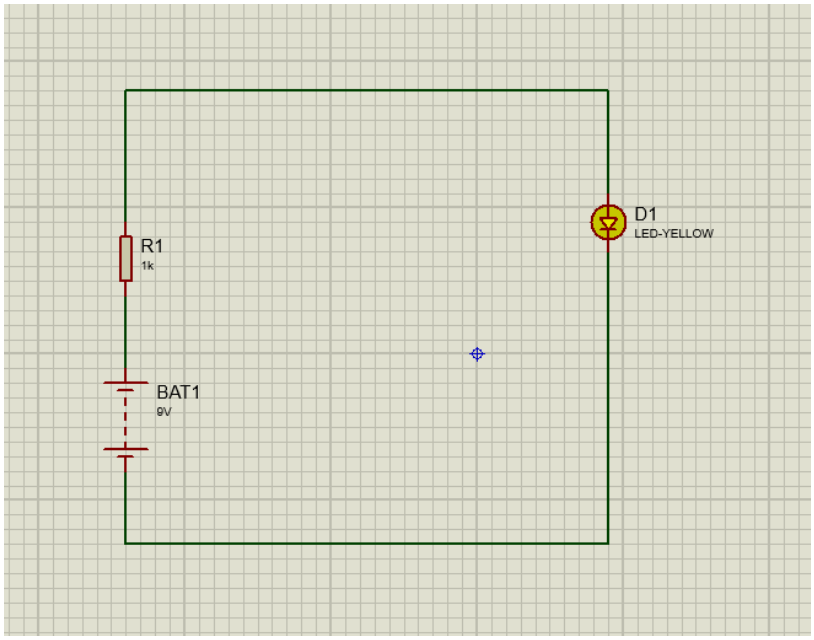

Figure 3.4.10 Schematic of an LED circuit

The images above shows how LED should be connected.

There are two types of standard transistors. There is the NPN and PNP transistor, as seen in the image above. Most transistors used today is the NPN transistor. The leads are labeled base(B), collector (C), and Emitter (E)

LEDs should never be connected directly to the battery. The LED is destroyed because there is too much current passing through it. LEDs should be in series with a resistor to limit the current through it. Mostly 1k resistor is suitable for most LEDs with a supply voltage Of 12V.

Calculating the Resistor Value of an LED

LEDs must be connected to a resistor in series to limit the current that passes through the LED. This prevents the led from burning out.

The resistor value is given as

$$\boxed{R = (V_S - V_L) / I}$$

$\mathbf{V_S}$=supply voltage

$\mathbf{V_L}$ = LED voltage (usually 2V, but 4V for blue and white LEDs)

I = LED current (usually 10mA = 0.01A, or 20mA = 0.02A)

Always remember that the the led chosen is less than the maximum permitted. Also convert the current from mA to A. This will help give the resistor value in ohms.

An Example

If the supply voltage V_S = 9V, and you have a red LED (V_L = 2V), requiring a current I=20mA=0.020A, R = (9V - 2V) / 0.02A = 350Ω, so choose 390Ω (the nearest standard value which is greater).

CHAPTER 4

RESULT ANALYSIS

4.1 RESULTS AND ANALYSIS

This chapter contains the results from the integration of the three circuits to make an overall system. These results are solely based on the design of the circuits. The three circuits consist of the 12V power supply, the automatic water pump circuit and water level indicator circuit

Results from the Automatic Water Pump Circuit.

The inlet and outlet of the submersible water pump are connected to two different transparent tubes. Each tube is one yard long. This makes the prototype a little more realistic. Each of the tubes are placed in two different plastic buckets. The plastic bucket that has the inlet tube is filled with water. The bucket with the outlet tube has no water in it. That bucket contains wires which act as the probes. They are placed at different heights of that bucket (LOW, MID and HIGH). The 12V power supply is not turn on all this while.

Three tests are performed. For the first test, the bucket acting as the storage tank is completely empty. The 12V power supply is turned ON from the power outlet and the DC output is connect to the positive and negative terminal of the main bread board. The circuit begins to operate. I hear the motor in the submersible water pump starts running. I see water being drawn from the bucket containing the inlet tube. It goes through the submersible pump and goes through the outlet tube into the bucket acting as the storage tank. water continues to pour into the outlet bucket until the water touches the maximum wire probe (H).

For the second test. The outlet bucket is filled to a certain limit. It is filled to a medium limit. This test was conducted to see if it water will still flow into the storage even when there is a certain amount of water in the tank. When this test was conducted, I noticed that water still flow from the bucket with the inlet tube into the bucket the outlet tube is placed in. Water continues to flow until it reaches the maximum height. The water pump stops working when the water reaches the maximum height.

For the final test, the bucket acting as the storage tank (bucket containing the outlet) is filled to its maximum height. This test is conducted to see if there is any chance the storage tank will overflow under any circumstance. When the power supply was switched ON the submersible water pump did not pump water.

Figure 4.1: An Image of Water being pumped into an empty bucket (First Test)

Results from the Water Level Indicator Circuit

The test was quite straightforward and simple. This test show if the various LEDs will show at the various level of the water tank. This helps the user know how much water is left in the storage tanks without having to climb on top of the tank and look through it. First we emptied the bucket which contains the three probes (LOW,MID and HIGH). When the tank is completely empty, none of the LEDs is ON. When water reaches the probe labelled low, the RED LED switches on. When water reaches the MID probe, the Yellow LED is switched ON. And finally when water touches the HIGH probe, the Green LED turns on signifying, the storage tank is full.

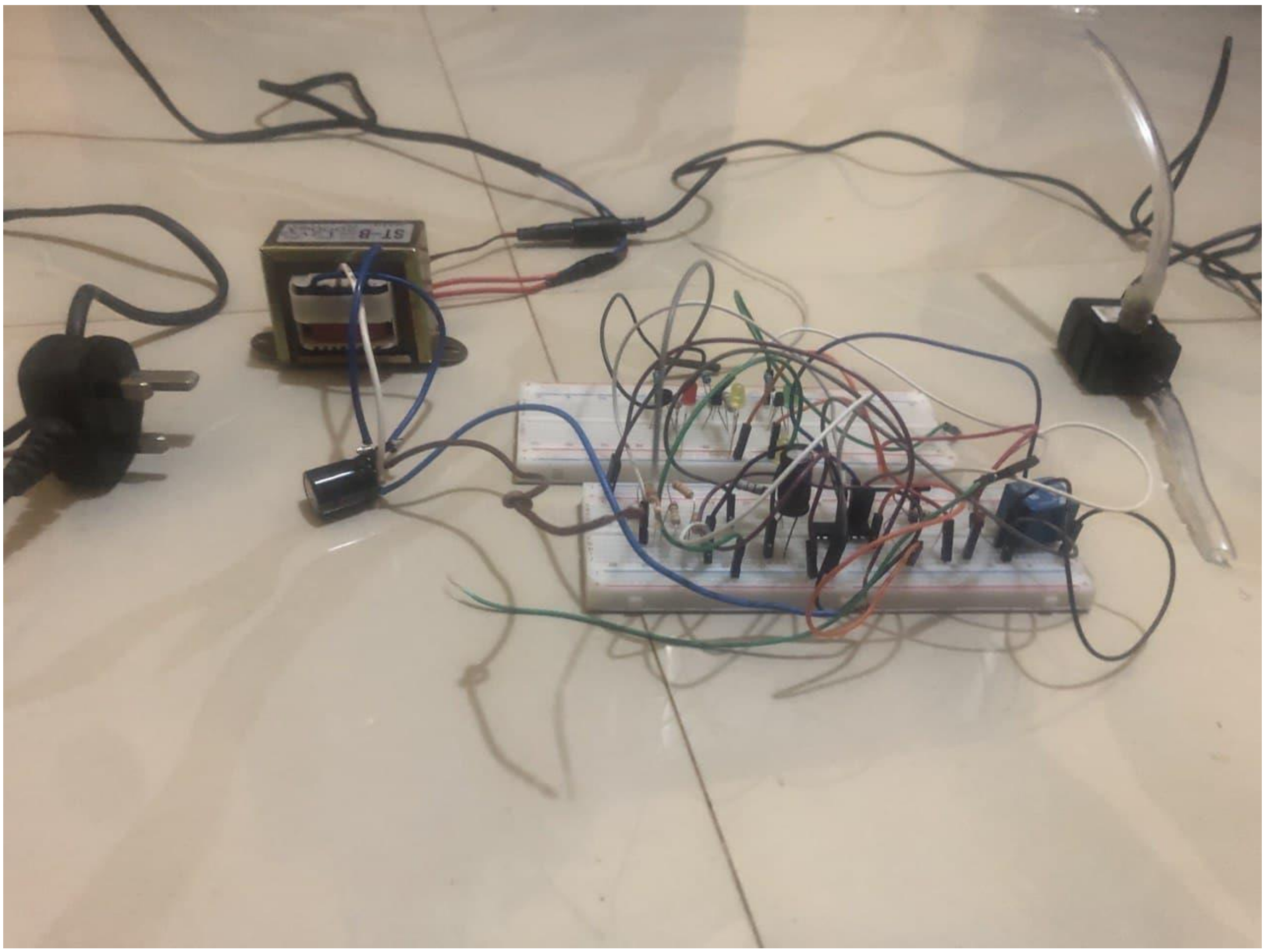

Figure 4.2: A prototype of the Automatic Water Pump System

Figure 4.2 contains the 12V dc power supply, the automatic water pump circuit and the water level indicator circuit.

4.2 PROBLEM ENCOUNTERED

In every engineering work, there is always one or more problem that is often encountered. And as engineers, we must identify these problems and endeavor to resolve these problems. This project suffers from some noticeable drawbacks. There were so many limitations whiles conducting this project. Most of these limitation was as a result of the current state of the world now. Some of the devices and tools I ordered outside Ghana never arrived. Because of this, I had to make the best out of everything. Some notable problems I encountered whiles working on this project includes;

1. My transformers blew up. This is because I didn't do the right configurations for it. I purchase three transformers for this project. The first two I purchased were faulty. These transformers were hard to come by and were quite expensive.
2. Finding thr right component to install was quite challenging sometime because I didn't want to risk the circuit blowing up since most of the parts are hard to come by.

CHAPTER 5

5.1 CONCLUSION

Automatic water pump system can help preserve water which are being wasted on daily basis. Eventhough it is not the only way, it is a step in the right direction. Water is an important resource and it should be used efficiently. One of the ways water wastage can be avoided is by using an automatic water pump system. This automated system helps manage water carefully and it also reduces labor. This project has taught me a lot and I have also learned a lot.

5.2 RECOMMENDATION

Other integrated circuits (IC) can be explored. Researches should be conducted in order to find a way to make these IC to behave in the same manner as the CD4001BP in order for it to power an automatic water pump circuit. Integrated circuits (IC) such as the CD400 series are very hard to come by and are becoming more and more expensive. Therefore, finding an alternate with other IC is the best options.

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