BAYERO UNIVERSITY KANO

DEPARTMENT OF ELCETRICAL ENGINERING

DESIGN AND CONSTRUCTION OF AN AUTOMATIC WATER DISPENSER

BY

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A PROJECT REPORT SUBMITTED TO THE DEPARTMENT OF ELECTRICAL ENGINEERING, BAYERO UNIVERSITY KANO IN PARTIAL FULFILMENT OF THE REQUIREMENTS FOR THE AWARD OF THE DEGREE OF BACHELOR OF ELECTRICAL ENGINEERING

SUPERVISED BY

ENGR FATIMA D. SANI

AUGUST, 2021

DECLARATION

We hereby declare that this project was conducted by us under the guidance and supervision of Engr. Fatima D. Sani, to the best of our knowledge, it has not been presented by any other person or a group of people for the award of a Bachelor Degree (B.Eng.) in computer/electrical engineering. All literature cited have been duly acknowledged by means of citation and references.

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CERTIFICATION

This is to certify that this project titled, "DESIGN AND CONSTRUCTION OF AN AUTOMATIC WATER DISPENSER" by the group of people mentioned above meet the standard expected of the award of Bachelor of Engineering degree of the Bayero University, Kano.

Engr. Fatima D. Sani **(Project Supervisor)**	**Date**
Prof Nuraddeen Magaji **(HOD)**	**Date**
Dr. A. A. Bature **(Project Coordinator)**	**Date**

DEDICATION

This project is dedicated to almighty Allah the most gracious and merciful who gave us strength and wisdom all through our study period, and also our beloved parents for the love, understanding, financial and moral support given to us throughout the duration of our studies.

ACKNOWLEDGEMENTS

In the name of Allah the most gracious most merciful who has taught man the use of pen. Praise be to Allah, the cherisher and sustainer of the world. All appreciation to Allah for guidance and love in our lives. May peace and countless of blessings of Allah be upon his noble Muhammad (P.B.H).

First and foremost, we would like to express our sincerity and profound gratitude to our parents for their support, love, guidance, prayers and encouragement not only in the course of our academic pursuit, but also through our other endeavors.

We would like to acknowledge our intelligent, hardworking supervisor in person of Engr. Fatima D. Sani, for supervising this project and her guidance and necessary assistance towards the completion of the project.

Finally our appreciation goes to the entire lecturers of electrical/computer engineering department and Lab Technicians in the faculty of engineering, Bayero university, Kano. In addition, our friends and colleagues are also appreciated. Thank you all.

ABSTRACT

The project titled “Design and construction of automatic water dispenser” is a microcontroller based system using Arduino microcontroller. This system is capable of detecting the presence of a cup at a predetermined distance and the dispensing water to fill the cup and stop dispensing once the cup has reached at least 70% of cup volume or stop dispensing when the cup is removed. A buzzer and LEDs notify the presence of a cup and also notify when the cup has filled up. The Arduino microcontroller is used to limit tolerance values by the discrete components and enable more flexibility and modification of the system without necessary changing the hardware.

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CHAPTER ONE

INTRODUCTION

1.1 INTRODUCTION

With rapid advancement in technology everywhere, we want each and every gadget of ours to be automatic. There has been an upsurge in the quest for man to get his devices automated. With latest innovations such as IOT (Internet of things) based on development boards like Arduino, Raspberry pi, Galileo, etc. we try to control our gadgets from our Smartphones [1]. In this project an automatic water dispenser is developed [2]. A conventional water dispenser can be converted to automatic water dispenser that dispenses water only by the presence of a cup without the need to press any button or switch to get water.

The project titled "design and construction of an automatic water dispenser" is capable of sensing the presence of a cup at a predetermined distance and automatically dispense water to fill up the cup up till about 70% of its total volume. Once it reaches the set limit it stops dispensing. It can also stop dispensing water by taking out the cup. There are certain notification components such as buzzer, LEDs that notify the presence of a cup and also notify when the cup has filled up.

1.2 PROJECT MOTIVATION

Personal hygiene is an important practice. With an automatic water dispenser system personal hygiene can be achieved greatly. It lead to a maintenance free system as there is no tear and wear that may happen due to the press of a push button to dispense water. Also it's faster when using an automatic water dispenser than the manual one.

1.3 AIM AND OBJECTIVES

AIM: The aim of this work is to design and construct an automatic water dispenser

Objectives: the project has the following objectives

i. To design and construct the power supply.

ii. To design and construct sensing and notifications

iii. To develop the program using arduino IDE for sensing and notifications

iv. To design and construct wooden body

v. To design the tank that stores water.

1.4 METHODOLOGY

The design of the project as regards the research of the previous project done and copied some parts of those project in order to achieved this project works, followed by selecting the components after synthesized each unit done in chapter three.

1.4.1 DESIGN AND CONSTRUCTION OF POWER SUPPLY

Power supply is designed to provide 13v output mainly to charge the batteries. This unit is design with the following components; step-down transformer, rectifier diode, filter capacitor and variable regulator.

1.4.2 DESIGN AND CONSTRUCTION OF SENSING AND NOTIFICATIONS

The sensing unit is designed with ultrasonic sensors to detect the presence of a cup and to track the level of water dispensed inside the cup. The notification unit is designed with LEDs and the buzzer. The LEDs provide light notifications, the first led is for power indication, the second led is for dispensing of water and the last led come up when the cup is filled up.

1.4.3 DEVELOPMENT OF PROGRAM USING ARDUINO IDE FOR SENSING AND NOTIFICATION

The program that controls the activities of the sensing unit and notification unit is designed using arduino ide after which the program is uploaded unto the arduino microcontroller board.

1.4.4 DESIGN AND CONSTRUCTION OF WOODEN BODY

A wooden body is design for housing the whole system with different section; there is a section for panels, a section for water tank and another section for placement of cup. The body has a wooding frame and the frame is covered with plywood.

1.4.5 DESIGN OF TANK THAT STORES WATER

Water tank is designed to provide water for the pump. the tank is designed in such a way that it has two tank one is permanent and the other is temporary that serve as filling for the permanent tank.

1.5 SCOPE AND LIMITATION OF THE PROJECT

The scope of the project is to dispense water to fill a cup automatically without the press of any button, when a cup is placed within the range of ultrasonic sensor radiation of about (distance <= 5cm) that detect the present of a cup. the water will be dispensing until the water level reaches set limit which also monitor by another ultrasonic sensor that track the water rising in the cup, of about (distance <= 17cm).

1.5.1 LIMITATIONS

The limitation of this project is that it cannot differentiate between a cup and a similar object. Once an object blocks the radiation of ultrasonic sensor water will start dispensing. And a predetermine size of cup has to be used for it to be able to stop dispensing while it reaches at least 70% of it's volume if not taken off.

1.6 REPORT ORGANIZATION

This study comprises five different chapters.

- Chapter one gives a general introduction of the project; aim and objectives, motivation, methodology, scope and limitation and report organization
- Chapter two gives a literature review of the various forms of automatic water system and their technological advancement of the project
- In chapter three, the design, calculation and implementation of the whole project work is discussed fully.
- Chapter four presents the result, discussion drawn from tests performed on the system and circuit construction, assembly and packaging, and construction of wooding body.
- The last chapter gives conclusion and recommendation on the entire work.

CHAPTER TWO

LITERATURE REVIEW

2.0 INTRODUCTION

This chapter introduces literature of some existing work done by others. It discusses literature related to automatic water dispenser using discrete electronic components down to the available advanced technology of arduino microcontrollers.

This chapter also discusses detailed principles of operation of each component involved in the system

2.1 REVIEW OF RELATED LITERATURE

Efforts have been made by several individuals and organization towards the design of automatic water dispenser using the ultrasonic sensor to measure the distance of the desired object and dispense water when the object fall within the range. To tackle this problem, different approaches have been taken; some of which are discusses below:

Automatic water dispenser has been designed that only turns ON when a metal tumbler is placed near the proximity switch. The design, automatic water dispenser is made with the following components; relay, inductive proximity switch and a water solenoid valve. The proximity switch sense the presence of an object in it range of radiation and send a signal to the relay acting as a switch that turns ON or OFF the solenoid valve that pump water. We can integrate this machine to the existing water purifiers and thereby we can eliminate the water spillage and this technique is far more hygienic as it eliminates the human touch from the process [1].

It limitations are, water spillage and only useful when there is main power supply, it also designed for a specific object, metal tumbler.

Automatic water dispenser has been deisgn for corona virus prevention. This research is one of the applications of ultrasonic sensor. The whole system is constructed using HCSR04 ultrasonic sensor, ATMEGA328P microcontroller, relay and water dispenser. The ultrasonic sensor is used to sense the presence of hands below the outlet of the water dispenser. ATMEGA328P microcontroller is used as the main control and processing device of the whole system. The relay is used for switching the power of the water

dispenser. The water pump is used to pump-out the water to the outlet of the water dispenser. In this work, an AC 220 V water pump is used as the water dispenser The ATMEGA328P microcontroller always monitor the output of HC-SR04 ultrasonic sensor and produce the switching signal to the relay based on the presence of hands. The CircuitMaker 2000 software is used to draw the required circuit connection diagram. The control program for ATMEGA328p microcontroller is written with C programming language and compiled using arduino 1.8.12 software. When the hand is below the outlet of dispenser, the water will automatically flow out. Therefore, it is not required to operate the tap with our dirty hands, and corona virus can also be prevented [3].

It limitations, it only work with the main power supply as it has no backup power, also there is no control over the dispensing of water as long as hand is place below the outlet it dispenses water

2.2 DISCUSSION OF OUR APPROACH TO SOLVE THE PROBLEM

This section will focus on the approach we take to solve the same problem inherit from the previous ideas studied to designed the project and proposed an improvement upon them. With regards to previous related ideas, this project will be improved by allowing cup made from different materials metal, ceramic, glass plastic.

Also this project will be improve by automatically stopping dispensing of water when it reaches at least 70% of the total volume.

It also improved by the additional features of having two different power sources as primary and secondary power supply. This project consist of an ultrasonic sensors and a programmed Arduino microcontroller and some other components to develop an automatic water dispenser thus improves personal hygiene, safe time and reduces water wastage.

The circuit has six units:

1. The power supply unit
2. Microcontroller unit
3. Sensing unit
4. Relay unit
5. Notification unit

6. Pump unit

2.2.1 THE BLOCK DIAGRAM OF THE SYSTEM BOARD

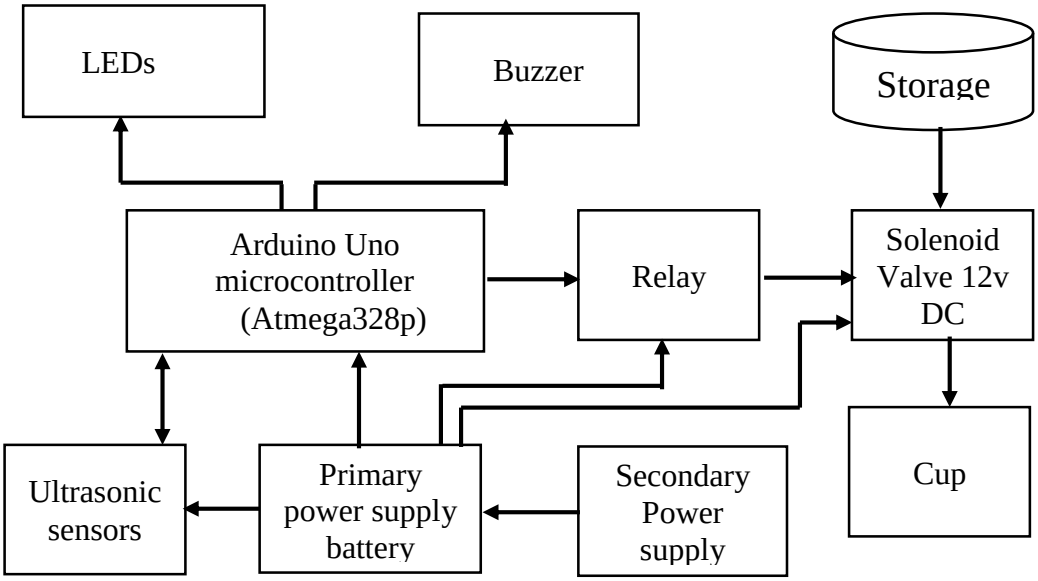

fig2. 1: System block diagram

The system block diagram is shown in fig2.1 above. The block diagram consist of Arduino microcontroller that interface with various units in the system. Also we have ultrasonic sensor that send and receive signal from the microcontroller to sense the presence of cup and track the water level. We also have a relay receiving signal from the microcontroller to turn ON/OFF of the solenoid valve (pump). The pump is in between the water storage and the cup. LEDs and buzzer are also connected to the microcontroller for notifications. We have a primary power supply(battery) that provide power for every components in the system and a secondary power supply that charges the battery.

2.2.2 POWER SUPPLY UNIT

The power supply unit is the unit that supplies power to all other sub component of the circuit, the power supply unit convert A.C voltage of 220/240v 50Hz to D.C voltage according to circuit requirement [3]. In this design, 13v D.C voltage levels are required for

charging of the battery. Power supply circuit has the following stages; transformation stage, rectification stage, filtering stage and regulation stage.

- ✓ Transformation of power supply circuit this stage step down the ac 220/240v incoming signal into 15v Ac output with the use of step down transformer.
- ✓ Rectification stage this stage of power supply, the step down voltage get converted to a DC voltage level with the use of different rectifier circuit which could be half wave rectifier or full wave rectifier. Full wave rectifier is used in this project.
- ✓ Filtering stage, the rectified signal has ripples which need to be removed to get an ideal dc output with the help of dc capacitor.
- ✓ Lastly the regulation stage, this stage used to keep the output voltage constants with the use of 78XX or 79XX series and lm 338 or lm317 can be used to vary the output voltage. In this project Lm338 variable regulator is used.

In this system four diodes will be use as rectifier has it is the best and universal accepted form of power supply configuration as far as the rectification process is concerned. The clever use of four diode make things very simple, only a single secondary winding is all that is required, the core saturation is perfectly optimized resulting in an efficient AC to DC conversion. The Fig2.2 shows how a full wave rectifier is made using four diodes and a relatively low value filter capacitor [4].

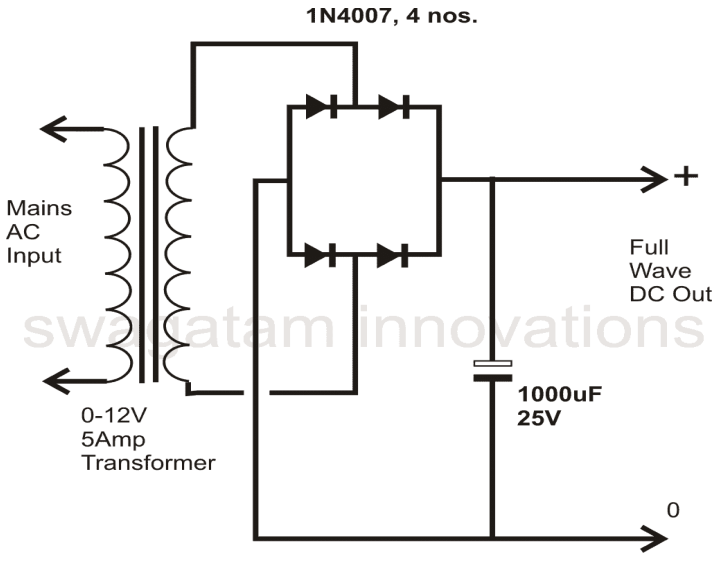

fig2. 2: Full wave bridge rectifier

Fig2.2. consist of the first three stages of power supply which are transformation, rectification and filtering of the input signal the output of a rectifier is a dc voltage level which cannot be considered perfect, this fail to provide ideal DC output and therefore are not desirable for many sophisticated electronics circuit. Moreover this configuration does not include a variable voltage and current control features.

However the above features may be simply integrated to achieved a controllable voltage and current output, using a single IC and a few other passive components. Lm338 is used to achieved a controllable voltage and current. The fi2.3 below shows a full circuit diagram of power supply with a variable voltage regulator [4].

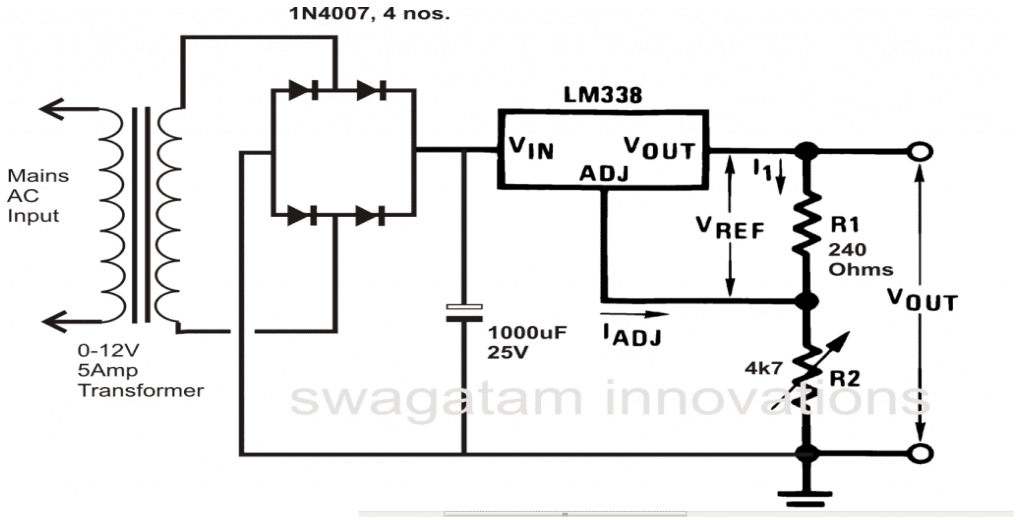

fig2. 3: Power supply

2.2.3 MICROCONTROLLER UNIT

Microcontroller unit is the central unit to every other unit as it provides necessary coordination and control throughout the entire system. It receive a signal from the sensing device, process the signal make decision and execute decision by relaying message signal to the relay unit and notification unit. The Arduino Uno is an open-sourcemicrocontroller board based on the MicrochipATmega328P microcontroller and developed by Arduino.cc. The board is equipped with sets of digital and analog input/output (I/O) pins that may be interfaced to various expansion boards (shields) and other circuits. The board has 14 digital I/O pins (six capable of PWM output), 6 analog I/O pins, and is programmable with the Arduino IDE (Integrated Development Environment), via a type B USB cable. It can be powered by the USB cable or by an external 9-volt battery, though it accepts voltages

between 7 and 20 volts. It is similar to the Arduino Nano and Leonardo [5]. A pictorial of Arduino microcontroller is shown in fig2.4 below.

fig2. 4: Arduino microcontroller board

The Atmel Pico Power ATMEGA328P is a lowpower CMOS 8-bit microcontroller based on the AVR enhanced RISC architecture. By executing powerful instructions in a single clock cycle, the ATMEGA328P achieves throughputs close to 1MIPS per MHz. This empowers system designed to optimize the device for power consumption versus processing speed. ATMEGA328P is a high performance, low power 8-bit microcontroller family. It is also advanced RISC architecture including:131 powerful instructions, most single clock cycle execution, 32 x 8 general purpose working registers, fully static operation, up to 20 MIPS throughput at 20 MHz and on-chip 2-cycle multiplier.

ATMEGA328P has high endurance nonvolatile memory segments such as 32 kilo bytes of insystem self-programmable flash program memory, 1 kilo byte EEPROM, 2 kilo bytes internal SRAM, Write/Erase cycles: of 10,000 Flash/100,000 EEPROM, and data retention of 20 years at 85°C/100 years at 25°C All AVR ports have true Read-Modify-Write functionality when used as general digital I/O ports. Each output buffer has symmetrical drive characteristics with both high sink and source capability. The pin driver is strong enough to drive LED displays directly. All port pins have individually selectable pull-up resistors with a supply voltage invariant resistance, as in . The device operates between 1.8 V to 5.5 V. The pin diagram and the photograph of ATMEGA328P microcontroller are shown in Fig2.6 and Fig2.7 respectively [5].

fig2. 6: Pin diagram photograh

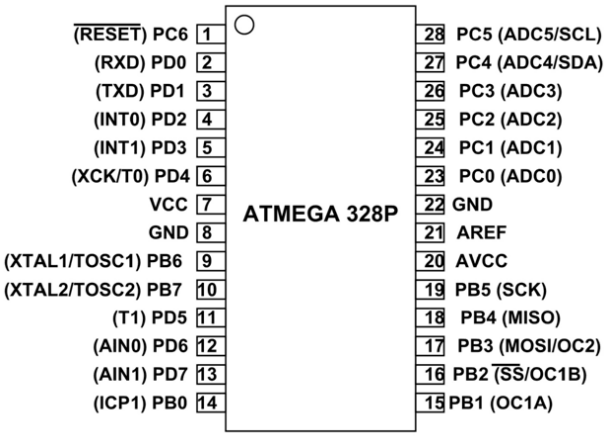

fig2. 5: Pin diagram

2.2.4 SENSING UNIT

HC-SR04 ultrasonic sensor is used to detect the presence of a cup. The HC-SR04 ultrasonic sensor is a popular and low cost solution for non-contact distance measurement function. It is able to measure distances from 2 cm to 400 cm with an accuracy of about 3 mm. This module includes ultrasonic transmitter, ultrasonic receiver and its control circuit. HC-SR04 sensor consists of four connection pins namely: Vcc (+5 V), Trig (Trigger input of sensor), Echo (Echo output of sensor) and Gnd (Ground) pins. Trig and Echo pins are used for interfacing between the HC-SR04 ultrasonic sensor and ATMEGA328P microcontroller. Ultrasonic sensors measure distance by using ultrasonic waves. The sensor head emits an ultrasonic wave and receives the wave reflected back from the target. Ultrasonic Sensors measure the distance to the target by measuring the time between the emission and reception. The photograph of HC-SR04 ultrasonic sensor is shown in Fig.2.7 [3].

fig2. 7: Ultrasonic Sensor

2.2.5 RELAY UNIT

A relay is an electromagnetic switch. In other words it is activated when a current is applied to it. Relays are used where it is necessary to control a circuit by a low-power signal with complete electrical isolation between control and controlled circuits. In this project relay is used to provide power ON and OFF to the solenoid valve. The main part of a relay is the coil at the centre. A small current flowing through the coil in the relay creates a magnetic field that pulls one switch contact against or away from another. Usually relays are used to turn on a second circuit. The first circuit activates the relay which then turns on the second circuit. Transistors and ICs must be protected from the brief high voltage produced when a relay coil is switched off. Current flowing through a relay coil creates a magnetic field which collapses suddenly when the current is switched off, as in. In this research, a protection diode (1N4001) is connected backwards across the relay coil to provide this protection. There are different types of relays and they operate at different voltages. In this project, a 5V relay is used to switch the water pump. Pictorial image of relay is shown in fig2.8 below [1].

fig2. 8:5v Relay

2.2.6 NOTIFICATION UNIT

a. Arduino buzzer is also called a piezo buzzer. It is basically a tiny speaker that you can connect directly to an Arduino board. You can make it sound a tone at a frequency you set. The buzzer produces sound based on reverse of the piezoelectric effect. In this project a buzzer is used to give notification when the cup has filled up. Fig2.9 shown below gives a pictorial view of a buzzer [6].

b. in the simplest term, a light emitting diode(LED)is a semiconductor device that emits light when an electric current passed through it. Light is produced when the particles that carry the current (known as electrons and holes) combine together within the semiconductor materials. In this project LEDs are used for notifications like power, filling, full. Fig2.10 below gives pictorial view of LEDs [6].

fig2. 9: Buzzer

fig2. 10: LED

2.2.7 SOLENOID VALVE (DC PUMP)

A solenoid water pump is used in this project for pumping water, it dispense water when 12v is applied to the two terminals, the valve opens and water can push through. The valve work with solenoid coil which operate electronically with DC 12volt supply. As it is normally closed assembly, it opens the flow of liquid as soon as power ON and Stop/block the flow when the supply voltage removed. [1]

fig2. 11: Solenoid valve

2.3 SOFTWARE PART

Software is a set of intelligent instruction design to make the hardware to perform a particular task. The software or program code, also called source code in microcontroller programming. Software part of this project work was developed and designed using arduino IDE(integrated development environment) and finally uploaded onto the microcontroller arduino module [3]. The software development process used in designing the software of this project is linear model or waterfall model.

The waterfall, software development model shows a process where software developers are to follow. Fig2.12 below shows the model adopted as follow; Requirement analysis, software designing, implementation, verification, deployment (installation) and maintenance [2].

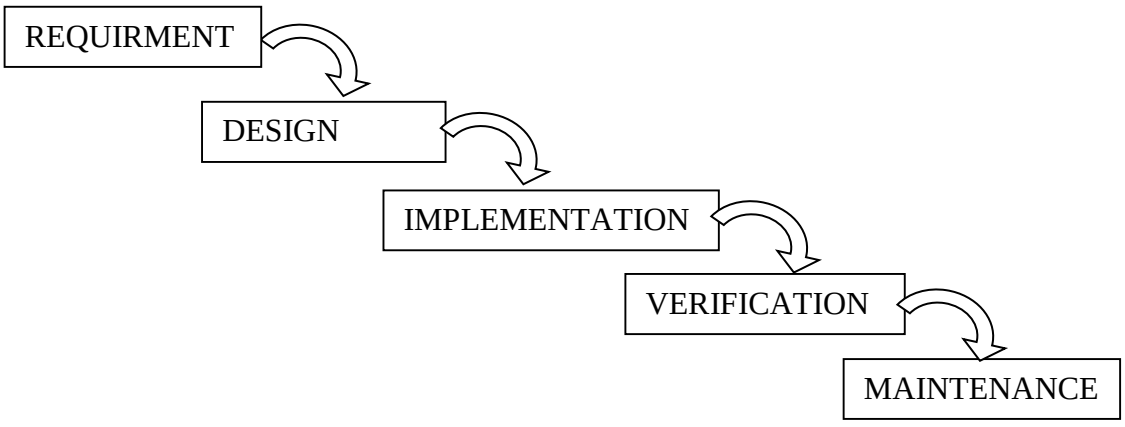

Fig.2.11: Waterfall software development process

CHAPTER THREE

DESIGN PROCEDURE AND ANALYSIS

3.1 INTRODUCTION

This chapter deals with design and analysis of the complete circuit that forms the automatic water dispenser. The project consist of six units; each unit is analysed separately and coupled together to make the complete circuit.

3.2 POWER SUPPLY UNIT

The following components are required for the power supply design:

- ✓ A step-down Transformer
- ✓ A full wave bridge rectifier
- ✓ A filter component
- ✓ Variable voltage regulator

(a) TRANSFORMER SELECTION

In considering transformer selection, the maximum and minimum values of operating voltage and current are important. The supply from the mains considered for this project is 220-240v at 50Hz.

To calculate the power rating of the transformer to be used, the maximum current that will flow in the system at full load was estimated as shown in table3.1. Hence current rating of transformer selected is 1500mA.

Table3. 1: Estimation of total current in the system

S/N	COMPONENT	QUANTITY	MAX. CURRENT(mA)	TOTAL MAX. CURRENT(mA)
1	Arduino board	1	100	100
2	Pump	1	300	300
3	Battery charging	1	300	300
4	LEDs	3	25	75
5	Ultrasound sensor	1	10	10
				Total= 785mA

(b) RECTIFIER

When selecting the rectifier, the peak inverse voltage PIV was considered. The PIV is the maximum voltage across the rectifying diode in the reverse direction.

PIV= 2Vmax (3. 1)

Vrms = 15v (3. 2)

Vmax = Vrms x $\sqrt{2}$ (3. 3)

From equ 3.3

Vmax = 15 x $\sqrt{2}$ =21.21v

From equ 3.1

PIV = 2 x 21.21= 42.43v

The peak value of current that the diode must be able to pass safely with resistance load is $I_{peak.}$

Ipeak = $\frac{\pi}{2} \times Idc = \frac{\pi}{2} \times 785 \times 10^{-3} = 1.23A \cong 1.5A$

Hence A rectifier diode of 50v/1.5A was selected, named IN4001.

(c) FILTER CAPACITOR

Using a ripple factor of 4% will result to higher capacitance value and higher capacitance value gives better filtering ripple values.

$\boldsymbol{\alpha = \frac{1}{4\sqrt{3CFR}}}$, F = 50Hz (3. 4)

Where

α is the ripple factor equal to 4%

C is the filter capacitor

F is the frequency

R is the load resistance

R =$\frac{13}{785 \times 10^{-3}} = 16.5\Omega$

$$C=\frac{1}{4\times\sqrt{3}\times0.04\times50\times16.5}=0.02508F=25081\mu F$$

Standard value of 4700uf capacitor was selected.

The voltage across the capacitor is

Vc = Vdc - voltage drop across diode

Diode voltage drop is 0.7v for silicon

For a full wave rectifier we have four diodes, two are connected in series and two in parallel. Two in series drop 0.7v therefore two in parallel will drop = 0.7 x 2 = 1.4v

Vdc = 2/π x Vmax = 2/ π x 21.21

Vdc = 13.5v

Vc = 13.5 – 1.4 =12.1v

The voltage rating across the capacitor is a standard value of 4700uf/25v.

(d) VARIABLE VOLTAGE REGULATOR

$$Vo = 1.25\left(1+\frac{R2}{R1}\right)$$

The voltage across R1 is fixed at 1.25v and current was selected to be 10mA. Therefore

$$R1=\frac{E}{I}=\frac{1.25}{0.01}=125\Omega Vo = 1.25\left(1+\frac{R2}{R1}\right)$$

$$Vo=1.25\left(1+\frac{R2}{R1}\right)$$

$$15=1.25\left(1+\frac{R2}{125}\right)0$$

$$R2=1375\Omega$$

Therefor lm338 variable voltage regulator is used with R1selected to be 220Ω and R2 selected to be 10kΩ variable resistor.

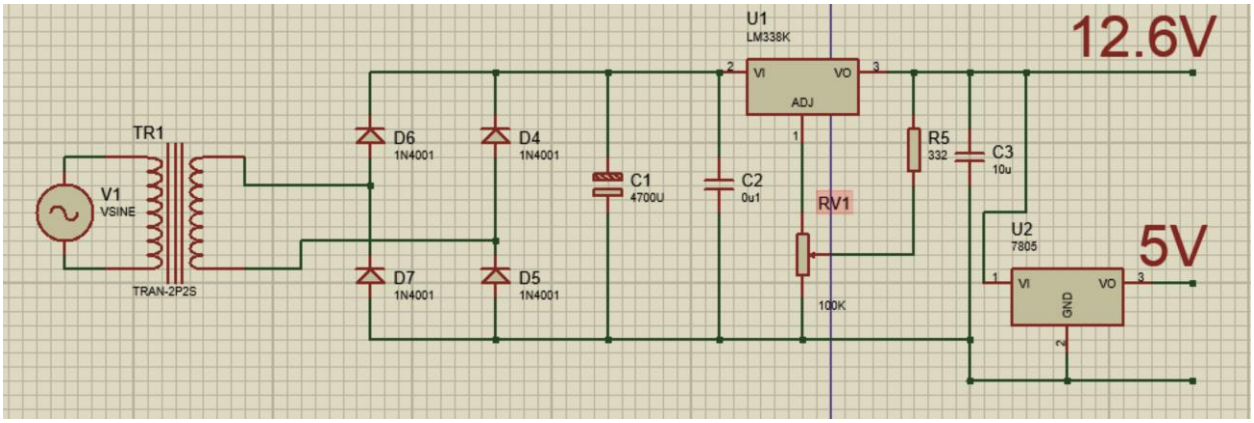

fig3. 1: Power supply circuit

Fig3.1 above show power supply circuit with two different output as 12.6v and 5v. 12.6v output is met for charging of the battery while the 5v output is met for the components require 5v in the system.

3.3 SENSING UNIT

The ultrasonic HC-SR04 emits ultrasound at 40,000Hz that travels in the air. If there is an object or obstacle in its path, then it collides and bounces back to the Ultra sonic module. Fig3.2 below shows the pin configuration and the working principle of ultrasonic sensor.

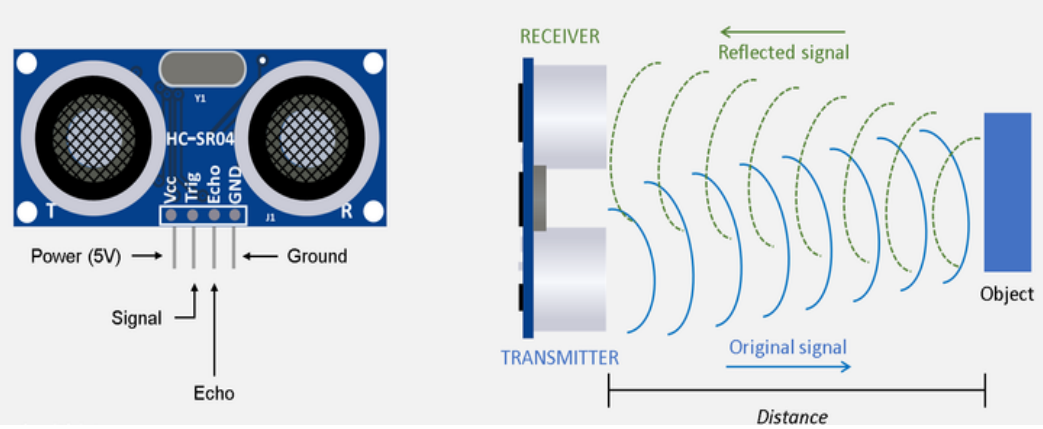

fig3. 2: Ultrasonic sensor radiation picture

The formula for distance = speed * time is used to calculate the distance.

Suppose an object is placed at a distance of 10cm away from the sensor. The speed of sound in air is 340m/s or 0.034cm/µs. this means the sound wave needs to travel in 294 µs. but the echo pin double the distance (forward and bounce backward distance). So, to get the distance in cm multiply the received travel time value with echo pin by 0.034 and divide it by 2.

Distance = $\frac{speed \times Time}{2}$

Speed of sound

Speed = 340m/s = 0.034cm/ µs

Time = distance/speed

Time = $\frac{10}{0.034}$ µs = 294µs

Distance = $\frac{speed \times Time}{2}$

Distance = $\frac{0.034 \times 294}{2}$

Distance = 4.998cm

3.4 MICROCONTROLLER UNIT

This unit is achieved by developing a program code in Arduino IDE. The software design is based on the standard software development.

1. **Creation of project file:** After successfully downloaded arduino IDE (named arduino.exe) online through any browser and then install as administrator. Thereafter, there will be an icon on the desktop representing the software. Which u can lunch to begin the development of program code. lunch the software by double click the arduino icon then a pop up window will be display, click on file to create a new project and safe it with appropriate name to a desired location on the system. Now proceed with the typing of code after which the code need to be validated before uploading
2. **Validation and uploading of program code:** after finished typing the code then the program code need to be verified to avoid misused of syntax, undefined variable, missing of semi-column ete. After successful validation then the code is ready to be uploaded.
3. **Port and board configuration:** before code can be uploaded to the arduino microcontroller board then there is a need to select a particular microcontroller board we are using as arduino ide support all the types of arduino board. such as, arduino UNO, arduino NANO, Arduino mega, ESP32 etc. click on Tools to select a particular board and select port e.g com5, com-mega.

3.4.1 ARDUINO WINDOW SECTION

Arduino window has three main sections which are used to write the program code. The sections are as follow; variable declaration section, input/output pin setup and lastly loop section.

- ✓ Variable declaration section this section is used to declare the entire variable that is require within the program with their pin number if required. This section is also use to include a library if necessary.

- ✓ Input/output pin setup, the variable declared above will be specify here either it is an input variable that is the pin is to receive communication from outside world or the pin is an output pin that is to communicate with the outside world.
- ✓ Loop section, any repeated line of code will be in this section it is consider as the main section of the whole program code.

3.4.2 PROGRAM FLOW CHART

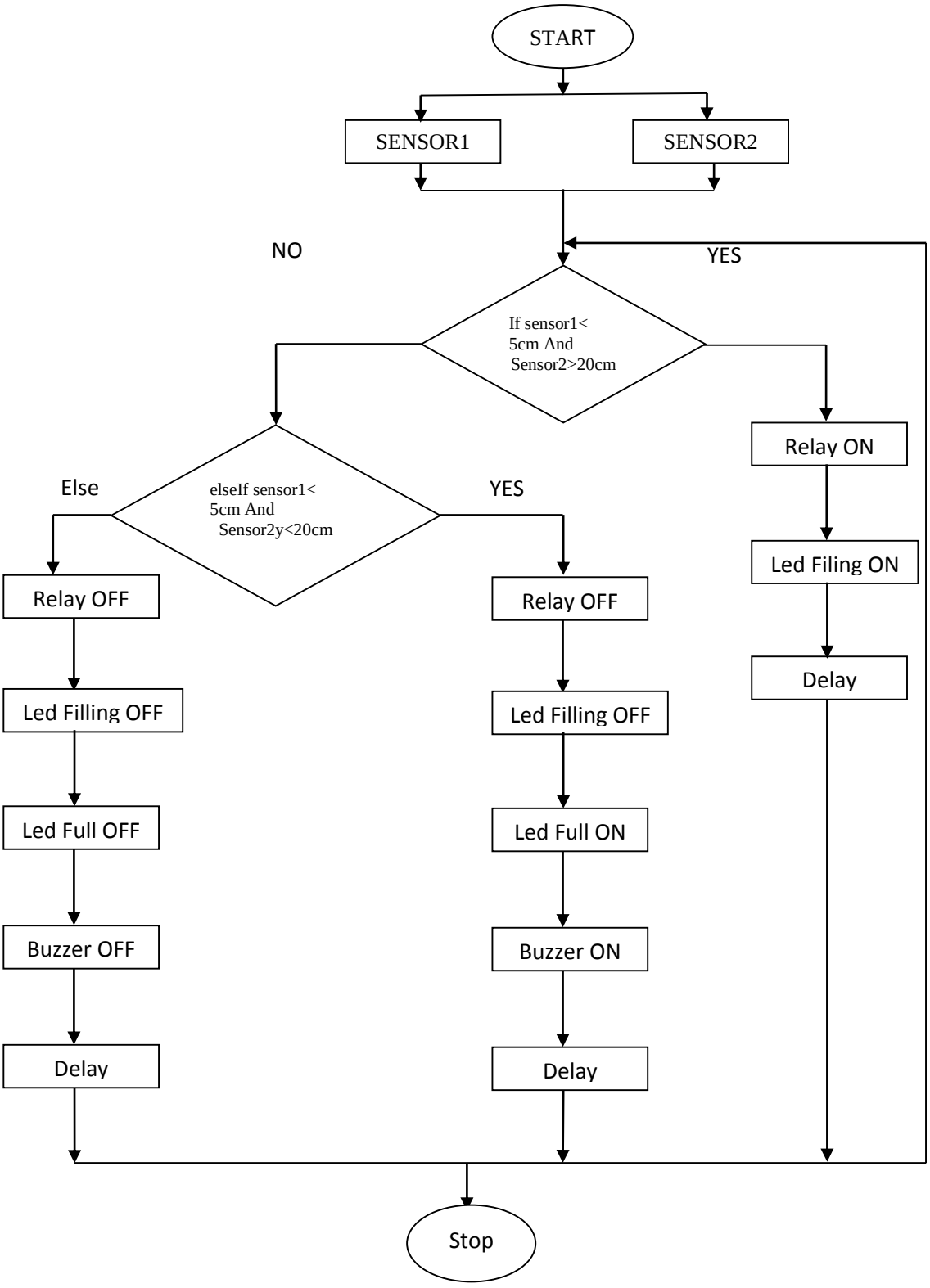

fig3. 3: Program Flow chart

Fig3.3 Above shows a program flow chart. Operation of this project make use of the flow chart above. When the program start it will check if there is an object at the front of the sensor1 at a distance less than 5cm and same object at the front of sensor2 at a distance greater than 20cm, then water will start dispensing. If not it will check the second condition if it met then it will execute the flowing line of codes, which among of them stop dispensing of water. If the condition is false, it will execute the following line of codes, which put everything OFF, as shown in the chart above.

3.5 NOTIFICATION UNIT

This consist of three LEDs and a buzzer for notifications. One led is used for power the second LED is used to indicate the filling of cup that is during the period of water dispensing while the third led light up when the cup has filled up. Buzzer is used to notify when cup filled up by beeping of sound. Calculations below show how to get the resistance value to resist the flow of current to the LEDs.

Voltage drop across each LED of 5mm is 1.8v

Output voltage Vo = 5v

$$R \geq \frac{Vo - Vdrop}{I}$$

$$R \geq \frac{5 - 1.8}{20 \times 10^{-3}}$$

$$R \geq 160$$

Hence R1, R2, R3=220Ω standard value

3.6 INTERFACING UNIT

A 5v relay is used as an interface between the arduino microcontroller and the pump. It has a power terminal that works with 5v power and it has a signal line connected to the microcontroller board and it has COM line that received positive power from the battery, NC line from the relay with the battery negative power goes to the pump. Once the relay is powered and signal line received signal from the microcontroller then it will switch ON

solenoid valve (pump). Fig3.4 below shows the pin name of the relay used. The wiring diagram is shown in the main circuit diagram.

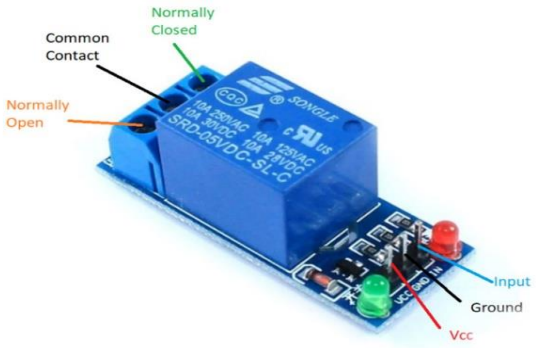

fig3. 4: Single channel relay module

3.7 COMPLETE CIRCUIT DIAGRAM OF THIS AUTOMATIC WATER DISPENSER

The complete circuit diagram of the system is shown below in fig3.5 which consists of power supply unit, microcontroller unit, relay unit, sensing unit and notification unit.

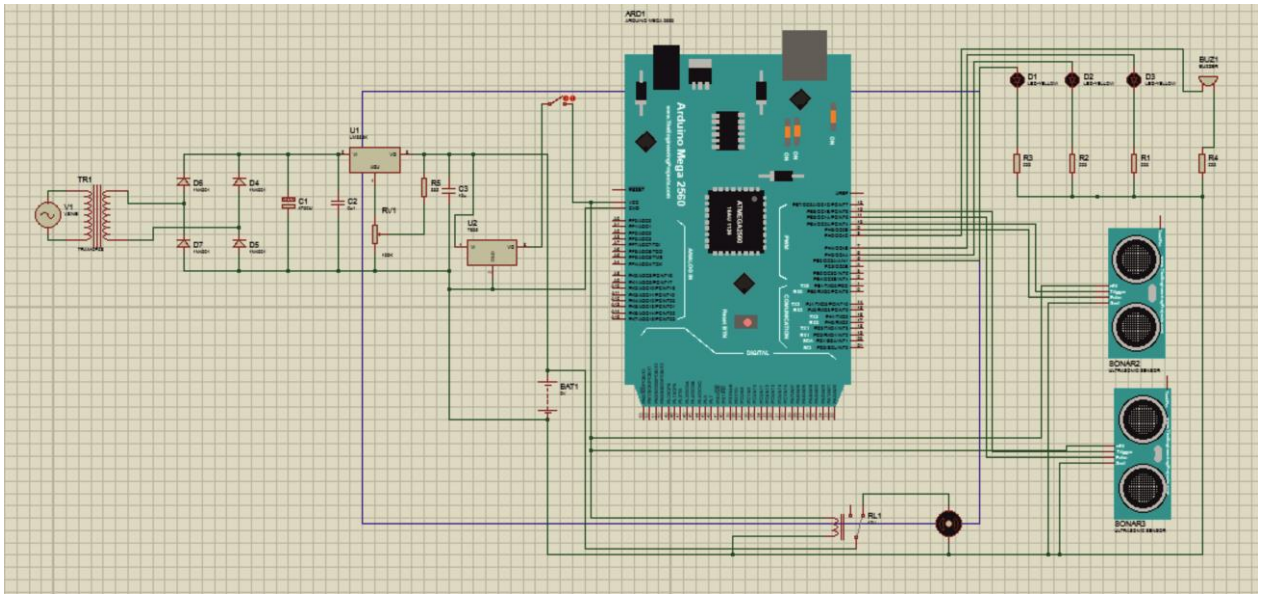

fig3. 5: Automatic water dispenser circuit diagram

Fig3.5 above shows the wiring diagram of the system circuit. From the power supply unit we have a variable voltage regulator that gives 12.6v to charge the battery. Also, from the power supply unit we have a fixed voltage regulator that gives 5v to the microcontroller board, ultrasonic sensors and relay. Ultrasonic sensors has four pins, which are VCC, GND,

ECHO and TRIG. VCC and GND connected to 5v supply while ECHO and TRIG connected to the microcontroller board. The relay has 6 terminals; Positive, Negative, Signal, NC, NO, COM. The positive and negative are connected to 5v supply, the Signal is connected to microcontroller board, COM is connected to the positive terminal of the battery and NO is connected to the positive terminal of solenoid valve (pump). While the negative terminal of the solenoid valve is connected to the negative terminal of the battery. The LEDs and buzzer is connected to the microcontroller.

CHAPTER FOUR

SYSTEM CONSTRUCTION AND TESTING

4.1 INTRODUCTION

This chapter describes the construction and implementation of the project, which include construction of wooden body, simulation, breadboard, testing, soldering and final program testing.

4.2 SIMULATION

The simulation were carried out on Arduino IDE software and Proteus software.

4.2.1 PROGRAM DEVELOPMENT

The following steps were carried out for developing the program.

- ✓ Designing the project
- ✓ Writing the program
- ✓ Compiling and uploading

Designing the Program

Arduino IDE was used in developing the programs, after all necessary setting i.e selecting microcontroller board name, and the required port are shown below.

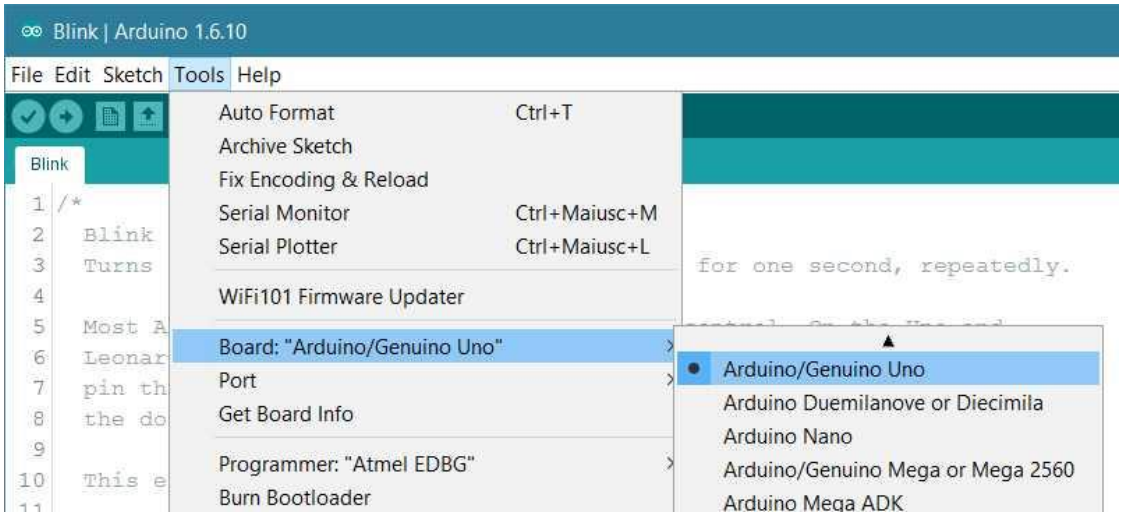

fig4. 1: Arduino Board Selection

Fig4.1 above shows the steps on how to select a particular microcontroller board on an Arduino IDE window. By clicking on Tools - Board: - select a board.

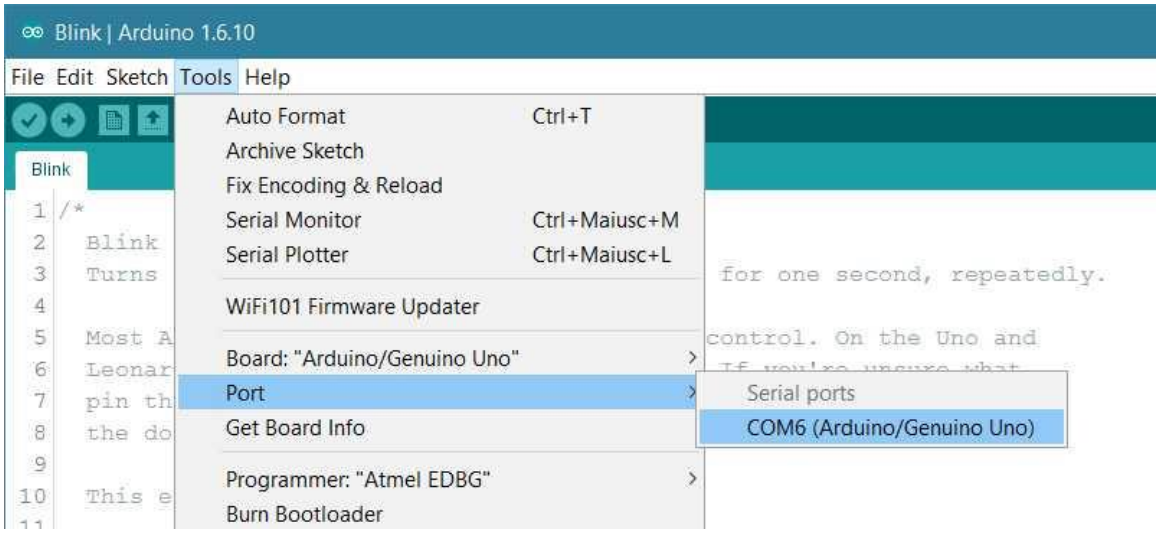

fig4. 2: Arduino port selection

Fig4.2 above shows an arduino window that display steps to follow to select a particular port for a particular board.

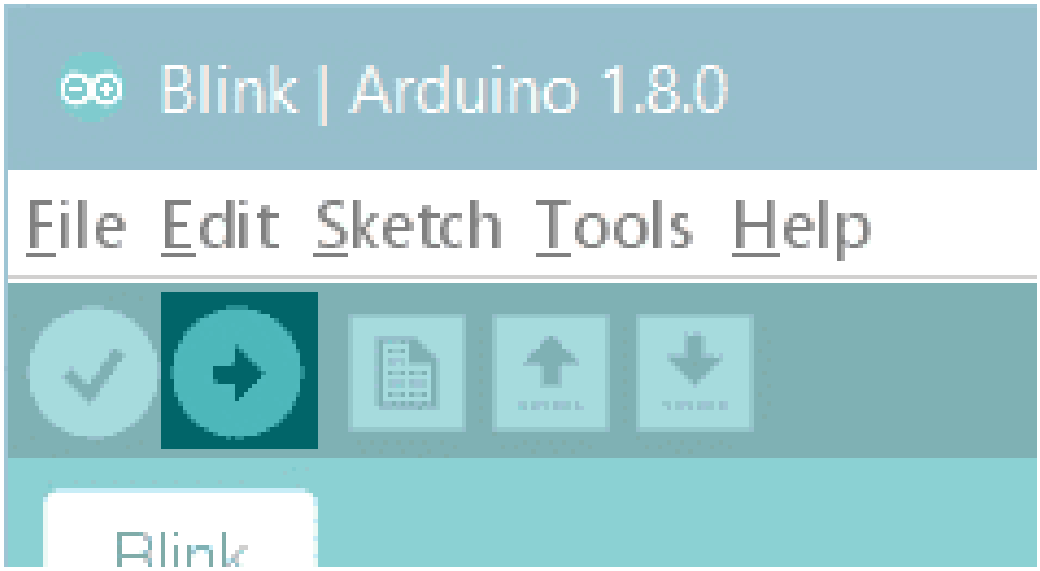

fig4. 3: Upload Button

Fig4.3 above shows the butting used for uploading the program code unto the microcontroller board after verification successful

4.2.2 CIRCUIT SIMULATION

This section is divided into two; Bread boarding and proteus simulation after developed the program the next stage is to simulate the circuit using software called proteus and bread boarding this is done to ensure that the circuit is working properly before transferring to real circuit(Vero-Board)

Bread Boarding

Bread boarding is done to actualize working performance and make adjustment for the program code, after compilation of the program code on arduino ide.

Proteus Simulation

Proteus simulation is mainly used for the design of power supply after which bread boarding was used to verify the circuit before taking to Vero-board for final soldering. Fig4.5 below shows the design of power supply using proteus.

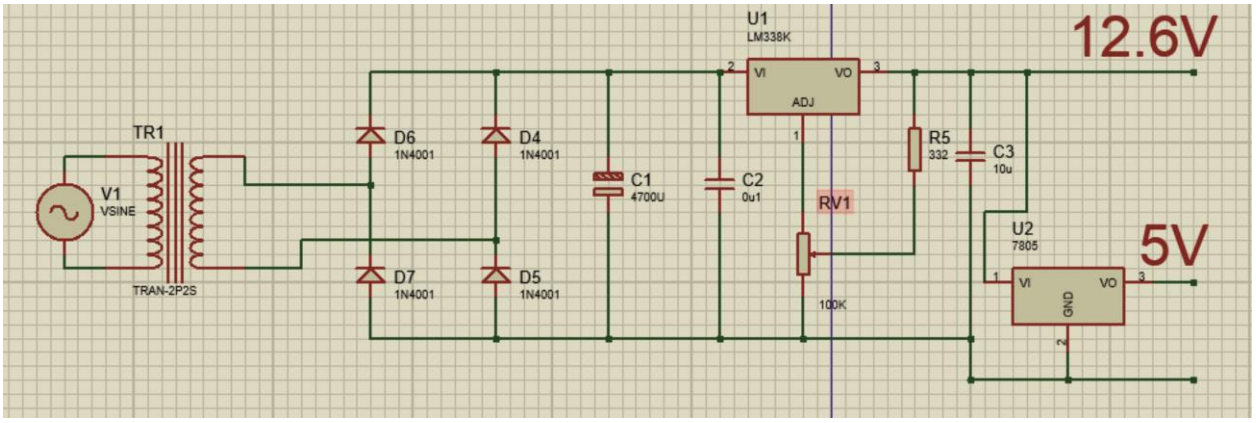

fig4. 5: Power supply circuit

4.3 HARDWARE CONSTRUCTION

Having chosen our components and their values, the next stage is how to put them together according to the circuit diagram which had been designed and see how the performance will look like. In order to accomplish our task, the construction and the assembly stage is divided into sections.

4.3.1 CONSTRUCTION EQUIPMENT

The following equipment and tools used during the construction:

i. Breadboard
ii. Connecting wires
iii. Soldering iron
iv. Cutters
v. Saw blade
vi. Hack saw
vii. Hammer
viii. Screwdriver
ix. Measuring tape
x. Markers
xi. Clamp meter

4.3.2 BREAD BOARDING

It is a good design practice to always implement electronics circuit on a temporary board (bread board) and observe the difference between the ideal response, before taking it to a permanent board (Vero board). Each of the various unit in the block diagram were separately built and tested on a breadboard before transferring them to Vero board. A breadboard has an internal connection which makes it easy for use. It does not need any soldering on the board. Fig4.6 below shows bread board.

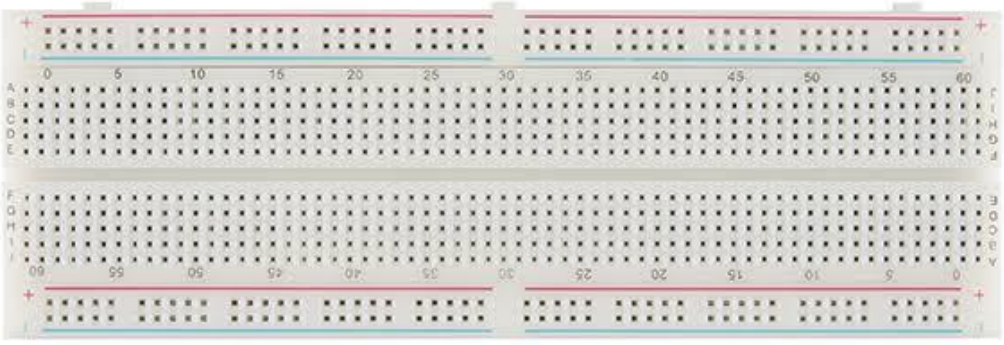

fig4. 6: Breadboard

4.3.3 VERO BOARD

Vero board is the panel on which all the components are mounted. There are various sizes used depending on how complex the circuit is. The board consist of holes which are arranged in a matrix format, the small size consist of 25rows and 55 columns i.e row one is connected to all the column and row two is also connected to entire column but separated from row one in the case of continuous vero board we also have discontinuous

The row is connected by a metallic sheath which makes it possible for easy soldering of components on the vero board. With proper design knowledge, this layout of continuous Vero board makes assembling easy and it reduce the use of jumper wires and it also make the work look neat. Fig4.7 below shows vero-board.

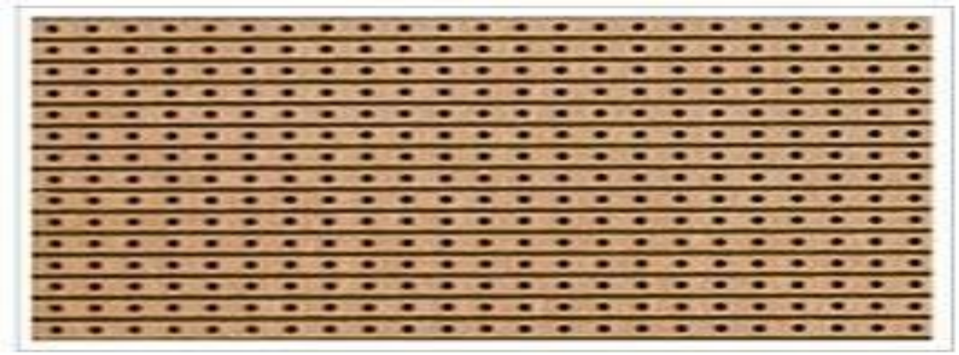

fig4. 7: Vero-board

4.3.4 SOLDERING

As with the bread board, each block is soldered at a time and certified before the next stage is soldered. Soldering is a process of joining two or more metals together by the application of heat and soldering iron and solder to the joint. A correctly joint posses a low resistance which give good electrical continuity and has a fair degree of mechanical strength in a soundly made joint. The parts to be joined are linked by a thin film of solder which binds the component lead and the connector on the vero board.

4.3.5 ASSEMBLY AND CASING

This is an important aspect of the design work. It is the appearance given to the final work after soldering on the Vero board. We do not leave it like that so it has to be given a wooden body that housing the panel section, water thank section and space for the placement of the cup. A wooden body was design to housing every section of the system and makes it look attractive. The dimension of the body was arrived after considering various factors such as width and length of the various sections. Fig4.8. Below shows, the wooden body constructed for housing entire system.

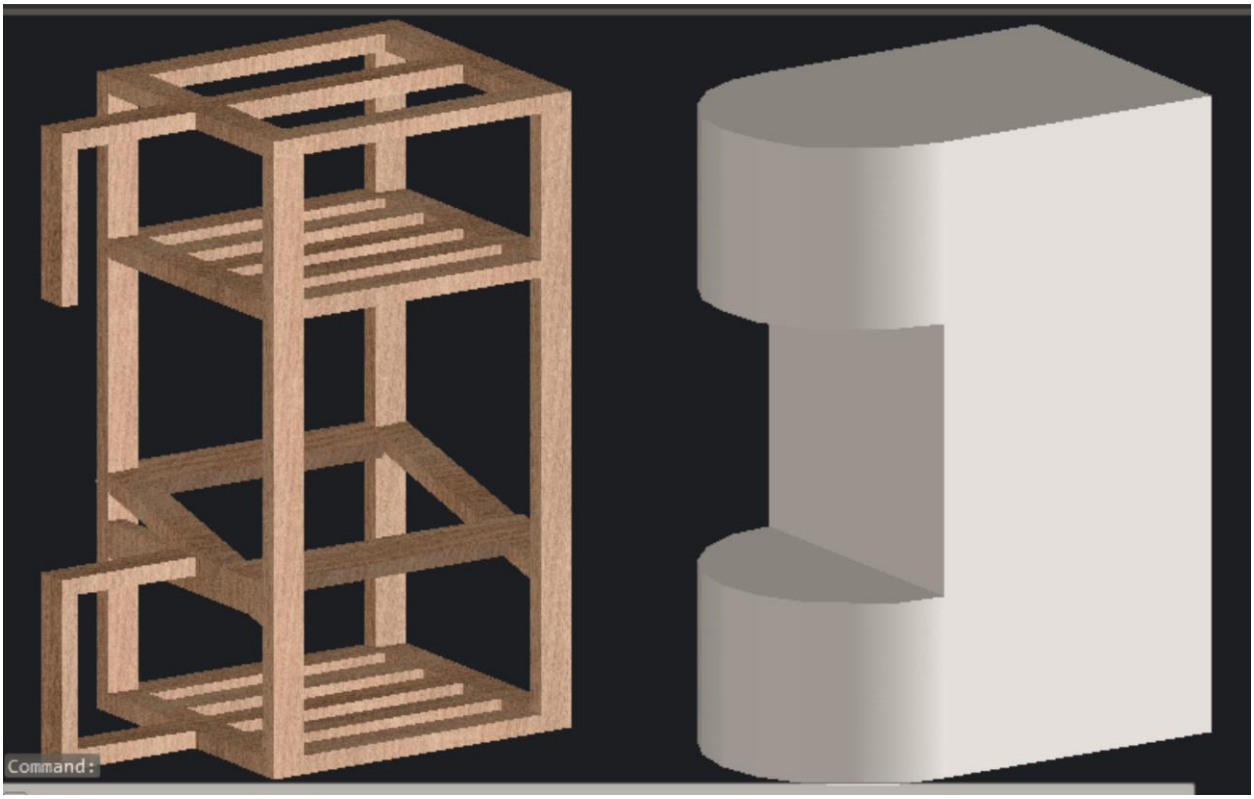

fig4. 8: wooden body

4.4 TESTING

Before soldering the components permanently on the vero boar, a general test was conducted on each individual component using a clamp meter to ensure that there are all in proper working condition and to know their actual working condition and also to verify the actual rating of each component. Therefore, after finishing the construction, the testing of the project was done after all safety precaution was observed.

4.5 SYSTEM TEST

The overall system test of the of this project was carried out after construction and the system performed it function as expected.

4.6 DISCUSSION OF RESULTS

Table4. 1: System Test Results

s/n	Cup height	Result
1	Below 10cm	Water dispensed but spilled out
2	10-12cm	Water dispensed and stopped when it got to at least 70% level
3	12-13cm	Water dispensed but not up to 70% level
4	Above 13cm	Water does not dispense

Table4.1 Above shows the results obtained when performed a general system testing. After performed system testing with different size of cups, we arrived at these results. A cup that has a height less than 10cm, water will dispense but it will not stop when it get to 70% or full. A cup that has a height in the range of 10-12cm, water will dispense and stop when it get to 70% level and these are the specific cup that this system is required for it to perform it required functions. A cup that has a height in the range of 12-13cm, water will dispense but not up to 70% level. Lastly, any cup has a height above 13cm, water will not dispense.

CHAPTER FIVE

CONCLUSION AND RECOMMENDATION

5.1 INRODUCTION

This chapter discusses the general objective of the project and it discuss the success recorded in this work, also to offer recommendation for further improvement of the design.

5.2 CONCLUSION

The aim of this project was to design and construct an automatic water dispenser system that senses the present of cup in the place provided and dispense water to fill the cup and stop filling when it get to at least 70% of cup volume with the help of ultrasonic sensor and this aim as been achieved. The system has been tested and was found to give the expected result.

This system designed can be used in many places such as home, office, school etc has it improved personal hygiene

5.3 RECOMMENDATIONS

The following recommendation is offered for those who might intend to further improve on the significant work carried out in this project.

1. The use of different sensing component if possible, for the system to be able to differentiate between a cup and a cap.
2. The use of printed circuit board (PCB) board might be more presentable and neater.
3. Improve the system to have choice of dispensing cold or hut water.

References

[1] Mr. Akash Chowdry, Mr. Prathap S Gautham, Dwarakanah S K, "Automatic water dispenser," *journal of control and instrumentation engineering,* vol. 4, no. 3, pp. 5-9, 2018.

[2] Abhishek Srivastava, Shubhan Dwivedu, "Study of Automatic Water Dispenser," *international Journal on Emergin Technologies,* vol. 8, no. 1, pp. 88-91, 2017.

[3] Aung San Min,Soe Thandra,Yin Mar Hlaing, "construction of Automatic water dispenser for corona virus prevention," *university journal of creativity and innovative research 2020,* vol. 01, no. 01, p. 2, 2020.

[4] H. c. project, "Designing Simple Power Supply Circuit," Google, 07 08 2021. [Online]. Available: www.homemade-circuits.com/how-to-design-power-supply-simplest-to/. [Accessed 07 08 2021].

[5] arduino, "arduino mega2560 REV3," Arduino, 04 August 2021. [Online]. Available: http://store.arduino.cc/arduino-mega-2560-rev3. [Accessed 04 August 2021].

[6] Arduino, "use a buzzer module(piezo speaker) using arduino uno," Arduino, 04 08 2021. [Online]. Available: http://create.arduino.cc/projecthub. [Accessed 04 08 2021].

[7] E. C. D. Search, "Electronic Components Datasheet Search1N4001 Datasheet (PDF) - Diodes Incorporated," goggle, 11 08 2021. [Online]. Available: http://www.diodes.com. [Accessed 11 08 2021].

[8] G. Series, "Electrolytic Capacitor," goggle, 11 08 2021. [Online]. Available: melopero.com. [Accessed 11 08 2021].

[9] ElecCircuit, "LM338 datasheet Adjustable poer supply 5A and 10A," goggle, 11 08 2021. [Online]. Available: ElecCircuit.com. [Accessed 11 08 2021].

[10] alldatasheet, "electronic components datasheet search," goggle, 11 08 2021. [Online]. Available: alldatasheet.com. [Accessed 11 08 2021].

Appendix I

Program codes

```
// Automatic water dispenser

// Variable declearation stage

int trigger2 = 11;

int echo2 =12;

int trigger1 = 8;

int echo1 =9;

int relay = 10;

int ledready =6;

int ledfull = 7;

int buzzer = 5;

long duration1;

long duration2;

float distance1;

float distance2;


//Pin Configuration stage

void setup() {

Serial.begin(9600);

pinMode(trigger1,OUTPUT);

pinMode(echo1,INPUT);

pinMode(trigger2,OUTPUT);

pinMode(echo2,INPUT);

pinMode(relay,OUTPUT);

pinMode(ledready,OUTPUT);

pinMode(ledfull, OUTPUT);

pinMode(buzzer, OUTPUT);
```

```
}
//ultrasonic sessor1 configuration
void measure_distance1(){
  digitalWrite(trigger1, LOW);
  delayMicroseconds(2);
  digitalWrite(trigger1, HIGH);
  delayMicroseconds(10);
  digitalWrite(trigger1, LOW);
  delayMicroseconds(2);

  duration1=pulseIn(echo1,HIGH);
  distance1=(duration1*0.034)/2;
}
//ultasonic sensor2 configuration
void measure_distance2(){
  digitalWrite(trigger2, LOW);
  delayMicroseconds(2);
  digitalWrite(trigger2, HIGH);
  delayMicroseconds(10);
  digitalWrite(trigger2, LOW);
  delayMicroseconds(2);
  duration2=pulseIn(echo2,HIGH);
  distance2=(duration2*0.034)/2;
}
// Main program
void loop() {
  measure_distance1();
  measure_distance2();
  Serial.print("sensor: ");
```

```
Serial.print(distance1);
Serial.println(" cm ");
if (distance1<5 && distance2>20){
  digitalWrite(ledready, HIGH);
  digitalWrite(relay,HIGH);
   digitalWrite(ledfull, LOW);
   digitalWrite(buzzer, LOW);
  delay(200);
}
  else if (distance1<5 && distance2<20){
    digitalWrite(relay,LOW);
    digitalWrite(ledready, LOW);
    digitalWrite(ledfull, HIGH);
    digitalWrite(buzzer, HIGH);
    delay(200);
  }
else
{
    digitalWrite(relay,LOW);
    digitalWrite(ledready, LOW);
     digitalWrite(ledfull, LOW);
     digitalWrite(buzzer, LOW);
}
}
```

Appendix II

Data Sheet

s/n	components	V_{min}(v)	V_{max}(v)	I_{min}(μA)	I_{max}(μA)	P_{min}	P_{max}	Performance	Tolerance
1	Diode Forward/ Reverse	0.5 0	1.2 1000	0.1 1.0E-9	1.0 1.0E-6	0.05 (μw)	1.2(μw)		
2	Capacitor (4700uf)	10	100	0.1	2	1(μw)	200 (μw)	-55 to +105°C	±20% (at +20°C, 120 Hz)
3	IC (LM338 regulator)	1.2	37	5	7	6.0 (μw)	259 1(μw)		0.005%V
4	IC (L7805 regulator)	7	35	10	1000	0.7 (μw)	0.035w	-65 to 150 °C	

1N4001 rectifying Diode [7]**.**

4700uf Capacitor [8].

Lm338 Variable voltage regulator [9]**.**
L7805 fixed voltage Regulator [10]