SOUTH EASTERN KENYA UNIVERSITY

SCHOOL OF SCIENCE AND COMPUTING

DEPARTMENT OF PHYSICAL SCIENCES

BACHELOR OF SCIENCE IN ELECTRONICS

ELC 400: RESEARCH PROJECT 1

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REG NO: I130/1602/2020

SUPERVISOR: DR. RIARA

TITTLE: TO DESIGN AND IMPLEMENT AUTOMATIC WATER LEVEL MONITORING SYSTEM USING AN ARDUINO UNO

A proposal submitted in partial fulfillment of the requirement for the Bachelor of Science Degree in Electronics of South Eastern Kenya University.

NOVEMBER 2023

DECLARATION

I Kipngetich Emmanuel declare that the proposed project is my original work carried out during the course of my study under supervision of Dr. Riara and has not been presented to any other institution for any other award.

STUDENT

Signature…… Date……

SUPERVISOR

Signature…… Date……

DEDICATION

I would like to dedicate this proposal to my lovely mother (Mrs Beatrice Lasoi), my lovely brother (Gibson Kiprotich), my cousin (Dan Kemboi alias Cheruthe Mirror), and Catherine Mutio Mutua for their full support during my research and making sure that my research is done according to the requirements. I also thank them, especially my mother, for ensuring that anything needed in doing my research such as finance or equipments are gotten with ease.

ACKNOWLEDGEMENT

I would like to express my gratitude to my supervisor, Dr.Riara who guided me throughout this project. I would also like to thank God for good health during my four-year academic life and during research period. I would also like to thank my friends and my fellow comrades who supported me and offered deep insight into the study.

ABSTRACT

Some of those who are involved in agriculture sector and real estate industries are having difficulties to monitor their water levels in their reservoirs or tanks. The purpose of this innovation is to help farmers and business people in real estate industries to monitor their water levels easily without the need to go directly to the reservoirs or tanks. Farmers need water in doing various agricultural activities such as irrigation and the water level must be monitored closely to prevent unplanned shortages. Also, It is important to every household or industry to determine the amount of water they will be using in day to day activities either in cooling machines as in industries or for domestic uses as in households.

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CHAPTER 1

1.1 Introduction

Water is a universal solvent which plays an important role in everyday life. The total amount of water available on earth has been estimated at 1.4 billion cubic kilometers, enough to cover the planet with a layer of about 3km. About 95% of the Earth's water is unfit for human consumption. About 4% is locked in the polar ice caps, and the rest 1% constitutes all fresh water found in rivers, streams and lakes which is suitable for our consumption. This signifies the need to preserve our freshwater resources. Many houses make use of supplementary water tanks to store water that is collected from rain water or water pumped from wells or underground. At present, water meters are used to calculate the amount of water used at homes. This doesn't provide an efficient method of monitoring water usage. The water is wasted at each and every outlet knowingly or unknowingly, which adds up to huge amounts in the end. Efficient management of the water used at homes is very much necessary as about 50% of water supplied to the cities gets wasted through improper usage. Water management is only possible if the user is aware of the quantity of water he uses and the quantity available to him. Water is essential in every hour of our lives. Hardly anyone keeps track of the level of water in the overhead tanks. Consequently, automatic control involves designing a control system to function with minimal or no human interference. The idea can be implicitly used to ascertain and control the level of water in overhead tanks and prevent wastage. In this Arduino based automatic water level indicator and controller project, the water level is being measured by using ultrasonic sensors.

1.2 Problem statement

Most households encounters difficulties in monitoring the amount of water in their reservoirs or overhead tanks before exhaustion and the right time to fill those water reservoirs. Manual systems are tiresome and cumbersome hence there is need for automatic system.

1.4 Objectives

1.4.1 Main Objectives

To develop water level monitoring system that makes it easy to determine the level of water in the tanks.

1.4.2 Specific Objectives

i. To design a circuit system detects the level of water in the storage facilities using arduino.

ii. To interface ultrasonic sensor and other components with the arduino.

iii. To test the working of the developed circuit system.

1.5 Research Questions

This research project will answer the following questions:

a. The purpose of designing water level monitoring system.

b. How to interface the ultrasonic sensor and other components with Arduino.

c. How to implement the circuit.

1.6 Justification

I came up with this project proposal that attempts to solve the problem of water level monitoring, durability of detector used and replacement of existing product. This system is simple to use since it uses a rechargeable 9v supply or normal 9v battery and Arduino UNO R3 which can support many sensors other than the ultrasonic sensor. Besides, it is easier to program and has many functions than the other Arduino boards. This helps in easy monitoring of water level.

1.7 Assumptions

The assumptions made in this project proposal are that designing of water level detector will help farmers, businesses, industries and households to monitor water level in the storage tanks easily. It will save the users time and encourage them to continue in their operation, giving an assurance of the continuous availability of water. This will reduce the cost of hiring manual workers to monitor and record the level of water in the

water storage units.

CHAPTER 2

2.0 Introduction

This chapter contains a review of the literature. The literature study resulted from going through the available secondary data sources such as journals and books with no limitation to the internet. This chapter includes previous work done by others and the areas available for improvements, including the birth of fans and history about the fans and why automation is needed.

2.1 Water Monitoring Systems

Many projects have been done regarding water level detectors for smooth operation purposes. In order to come up with this project proposal I had to compile different research and apply some of their techniques.

Ahmed (2022) designed a water level monitoring system using a mercury flow switch. The system incorporated two contacts which are energized to provide a direct online start of the motor. An over-load relay senses the presence of excess current and disconnects the supply while the mercury flow switch uses the Archimedes principle of flotation to provide electrical contact to switch ON and OFF supply to the motor when the tank is empty or full, respectively. This system is relatively cheap, affordable, and durable.

Adan. (2008) implemented a water level in tank monitoring system using sensors and PID Controller. The design was to only measure the amount of water level in the tank using different sensors positioned at certain points of the tank.

Priya J, et al (2017) Water level monitoring system using IoT. The system uses the IoT and it will detected the level of water and amount to be used daily.

Madhurima Santra et al (2017) designed a wireless water level monitoring and pump controlling System. The system measures the level of water in the tank and sends the results via bluetooth.

Although much work had been done in the area of water level monitoring and control systems, none of the developers designed a system to monitor the level of water and display it on the display screen. In this work, a system that incorporates a liquid crystal display to show the level of water in the tank and to show when the water pump is on or off will be designed and implemented.

CHAPTER 3

3.0 RESEARCH METHODOLOGY

The chapter contains materials and methods that have been used for the design of the circuit. It also includes the working of various components that make up the system. The chapter also includes the working of the circuit.

3.1 Materials

- Arduino Uno
- Breadboard
- Jumper wires
- Ultrasonic sensor
- 220-ohm Resistor
- Arduino cable
- Display screen,1602*2
- DC water pump
- Relay module

3.2. Description of Materials

3.2.1 Arduino UNO

Arduino is an open-source electronics platform based on easy-to-use hardware and software. Arduino boards are able to read inputs such as light on a sensor, a finger on a button, or a message and turn it into an output such as activating a motor, turning on an LED, publishing something online. You can tell your board what to do by sending a set of instructions to the microcontroller on the board. To do so,you use the Arduino programming language (based on Wiring), and the Arduino Software (IDE), based on Processing.

In this project, I will use Arduino Uno R3 as the project's core because it can support many sensors other than the soil moisture sensor. Besides, it easier to program and has many functions than the other UNO boards. A connection is given to the light depending on the resistor in the input pin of the Arduino and the RGB LED is connected in the output pin of the Arduino. These devices are controlled through Arduino easily.

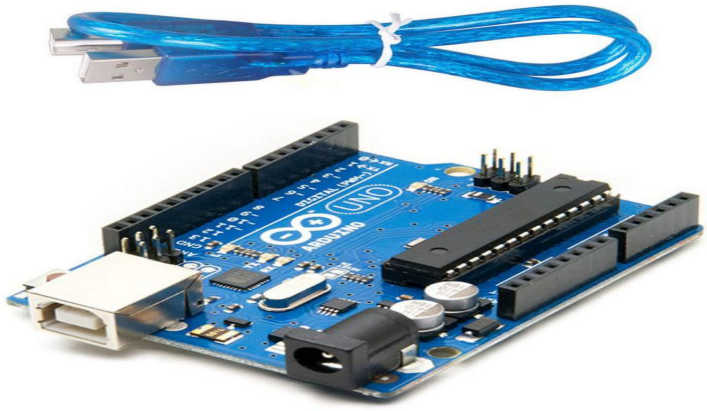


Figure 1: Arduino board

3.2.2 Ultrasonic Sensor

It is basically a distance sensor and is used for detecting distance. It has two ultrasonic

transmitters namely; the receiver and the control circuit. The transmitter emits a highfrequency ultrasonic sound wave which bounces off from any solid object and the receiver receives it as an echo. The echo is then processed by the control circuit to calculate the time and the difference between the transmitter and receiver signal. This time can subsequently be used to measure the distance between the sensor and the reflecting object. It has an ultrasonic frequency of 40 KHz and accuracy is nearest to 0.3 cm.

Fig. *2 :Utrasonic sensor*

Ultrasonic sensors emit short, high-frequency sound pulses at regular intervals. These propagate in the air at the velocity of sound. If they strike an object, then they reflected back as an echo signal to the sensor, which itself computes the distance to the target based on the time-span between emitting the signal and receiving the echo.

3.2.3 Liquid Crystal Display (LCD)

A liquid-crystal display (LCD) is a flat-panel display or other electronically modulated optical device that uses the light-modulating properties of liquid crystals combined with polarizers. Liquid crystals do not emit light directly but instead use a backlight or reflector to produce images in color or monochrome.

16X2 LCD

Figure 3: Liquid Crystal Display

3.2.4 Jumper wires

Jumper wires are used to connect two points in a circuit. All electronics shops stock jumper wires in a variety of lengths and assortments. Frequently used with breadboards and other prototyping tools in order to make it easy to change a circuit as needed. Male jumpers are designed to plug securely into the holes in a breadboard. Female jumpers are useful for connecting male header posts and pin terminals on components. Jumpers are available in female-female, male-male and male-female configurations.

Figure 4: Jumper wire

3.2.5 Breadboard

A breadboard is a simple device designed to let you create circuits without the need for soldering.

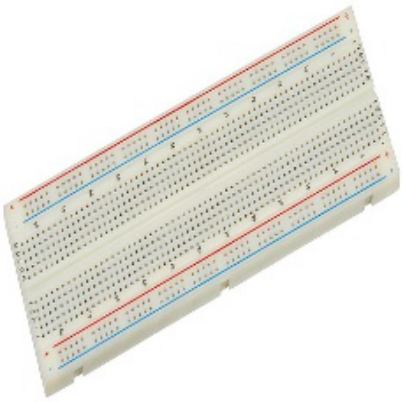


Figure 5: Breadboard

3..2.6 Relay module

In order to isolate two circuits electrically and to connect them magnetically, relays are used. They are very useful in switching from one circuit to another when they are completely separated. The relays comprise of an input and an output section. The input section has a coil which produces a magnetic field when a small voltage from an electrical circuit is applied. This applied voltage is known as the operating voltage.

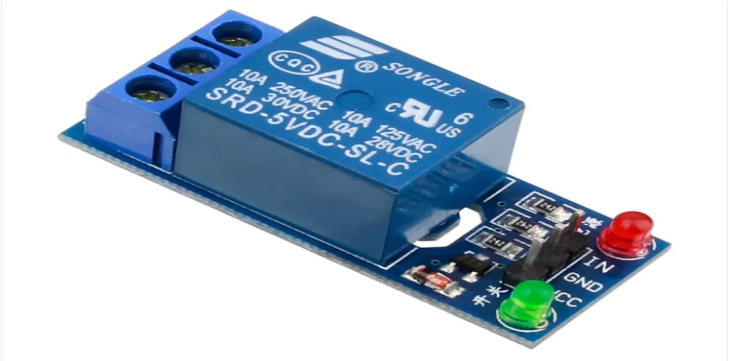


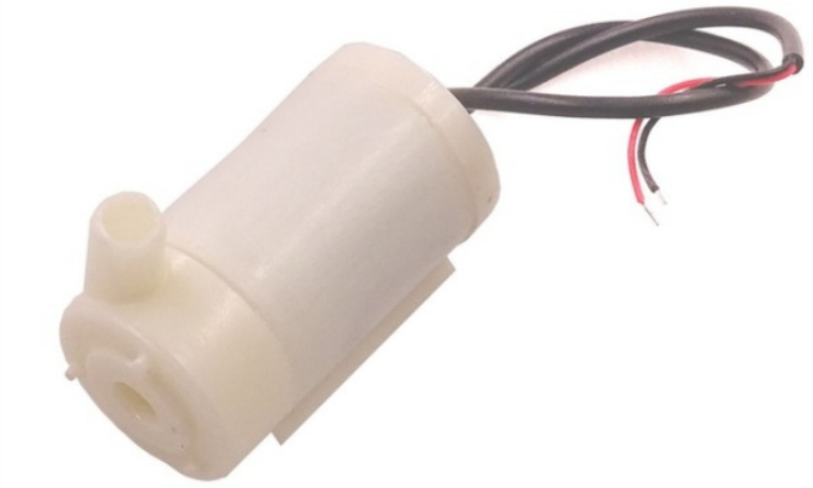
Figure 6: Relay module

3.2.7 DC Water Pump

DC water pump is a small pump powered by a battery, DC power supply, or solar panel. Its primary use is to circulate, pressurize, and emulsify liquids. It is particularly useful in

environments where water is in short supply.

Figure 7: DC water pump



3.3 Block diagram

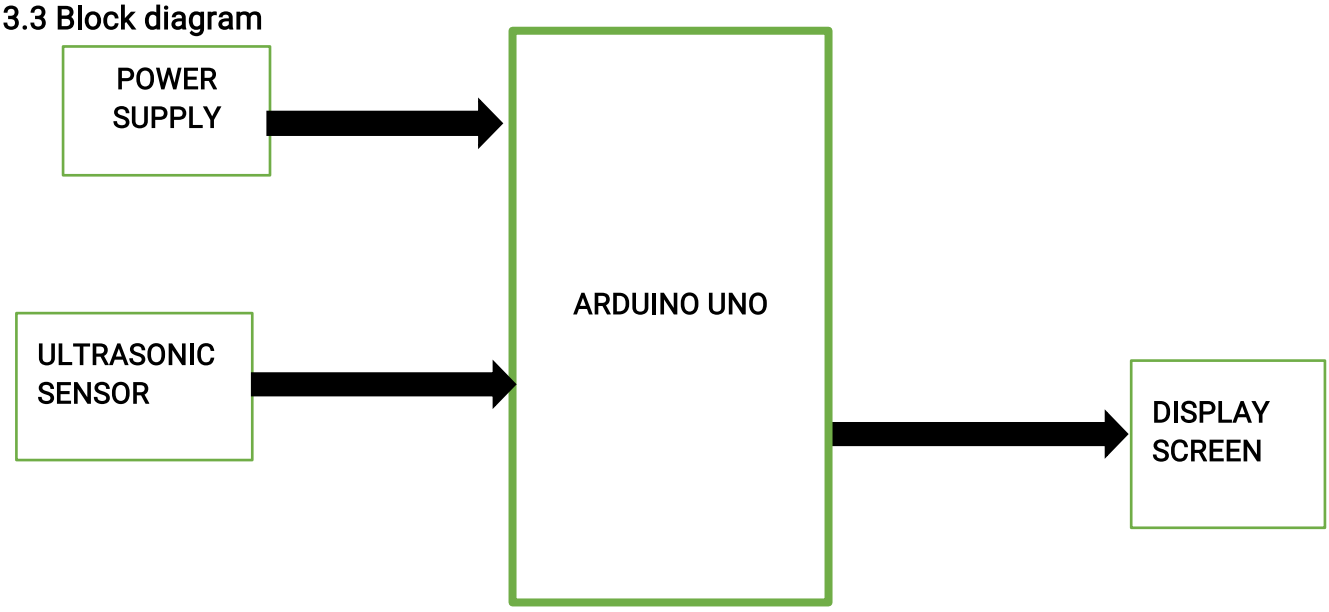


Figure 8: Block diagram.

Explanation

Power is supplied at 5v to the Arduino. Ultrasonic sensor's pins are connected to the Arduino as shown in the diagram below. DC water pump's one terminal is connected to one of the relay module terminal while the other terminal (positive) is connected to the power supply positive terminal.

The display screen is connected to the Arduino through its pins as shown in the table below. The complete circuit will have the LCD displaying the level of water with respect to the threshold values in the Arduino. The complete circuit must also trigger the DC water pump with respect to the level of water in the tank.

3.4 Circuit diagram

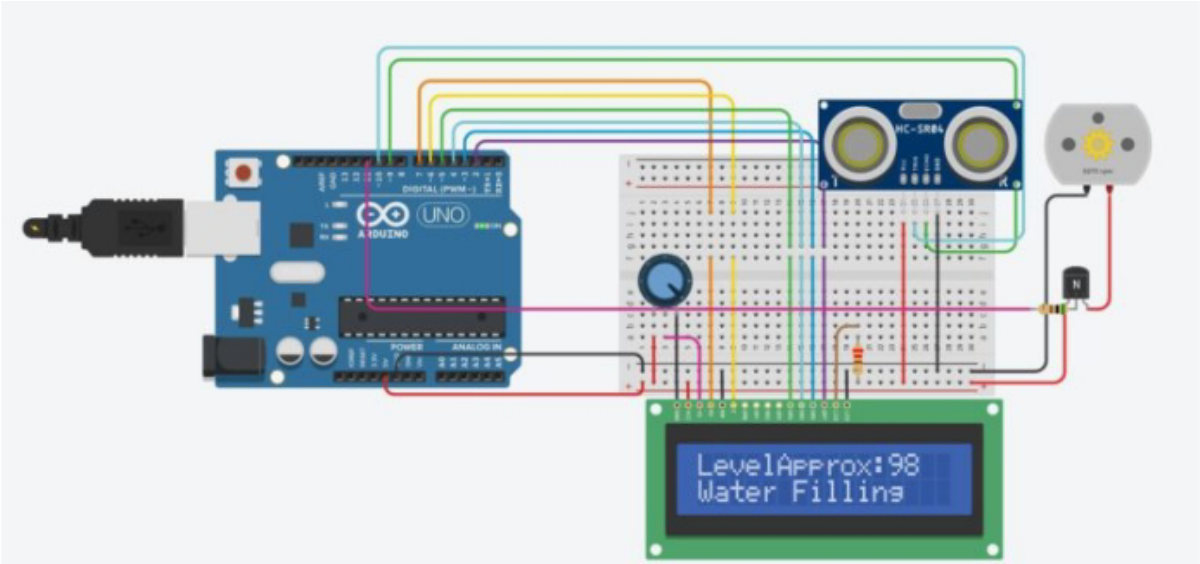


Figure 9: Circuit diagram

Working of the circuit:

The connections for connecting ultrasonic sensor, display screen, DC water pump and relay module with Arduino are as follows:

According to the connection diagram, the VCC pin of the ultrasonic sensor is connected with the 5V power supply pin of the Arduino board. GND pin of the ultrasonic sensor is connected with one of the GND pins of the Arduino board.

For analog:

ARDUINO UNO	ULTRASONIC SENSOR
+5V	VCC
GND	GND
Digital Pin 9	Trig
Digital Pin 10	Echo

ARDUINO	RELAY MODULE
+5 V	VCC
GND	GND
IN1	Digital Pin 7

DC WATER PUMP	CONNECTION
+ Terminal	One of the relay module output
- Negative terminal	- terminal of the external power supply
+ Terminal of the power supply	Other relay module output terminal

ARDUINO UNO	LCD
GND	VSS
+5 V	VDD

Middle pin of the potentiometer	V0
Digital pin 12	RS
GND	RW
Digital pin 11	E
Digital pin 5	D4
Digital pin 4	D5
Digital pin 3	D6
Digital pin 2	D7
+5V via 220 ohms	A
GND	K

GND=GROUND

VCC=POWER SUPPLY

Digital mode:

In digital mode, the display screen will output values HIGH or LOW (1 or 0). In this mode, I will operate the water pump with the help of display screen values.

Circuit Description:

According to the circuit diagram, the VCC and GND pins of the ultrasonic sensor are connected with the 5V power supply and GND pins of the Arduino Uno board respectively. Trig is connected to the digital Pin 9 of the Arduino Uno board. VCC of the relay module is connected to the Arduino's 5V. GND and IN1 of the relay module are connected to GND and digital pin 7 of the Arduino respectively. The positive terminal of the DC water pump is connected to one of the outputs of the relay module and the negative terminal connected to the external power supply negative terminal. The positive terminal of the power supply is then connected to the other output of the relay

module.

The LCD is connected with the Arduino Uno as: VSS to GND,VDD to +5V,VO to middle pin of the potentiometer, RS to Arduino digital pin 12,RW to GND,E to Arduino digital pin 11,D4 to Arduino digital pin 5,D5 to Arduino digital pin 4,D6 to Arduino digital pin 3,D7 to Arduino digital 2,A to +5V via 220 ohms and K to Arduino GND

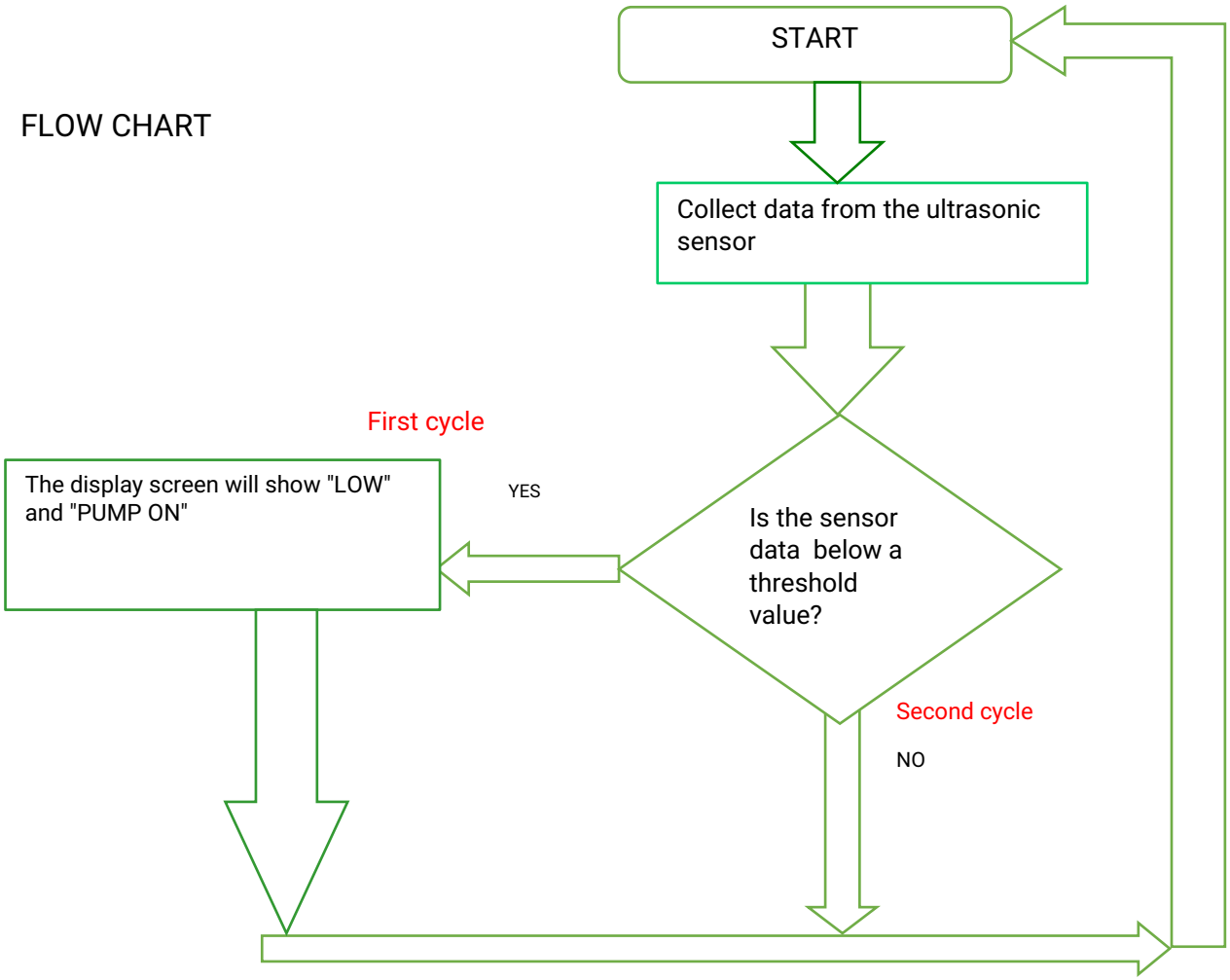
According to the code I have used the ultrasonic sensor as an input device and the LCD as the output device. Sensor values are compared with the specified threshold value. If the sensor value is below the threshold value, then the display screen will show LOW and the water pump turns on automatically. If the sensor value is above the threshold value, the display screen will show HIGH and water pump turns off automatically.

4.1 EXPECTED RESULTS:

In this proposed project, I expect that the system will work that is; Upon connection of the LCD will show LOW when the water level in the tank is below the threshold value and will display high above the threshold value.

The lower value is half the height of the tank. When the water level is below the threshold value and the display screen print LOW, the relay is triggered, and it turns on the water pump automatically. When the level is HIGH above the threshold value, the water pump turns off automatically.

FLOW CHART



CONCLUSION:

Automation of the various components around us has been widely increased to reduce human intervention and save time. The water tank overflows as the height of water in the tank cannot be randomly guessed. This leads to extra energy consumption, which is a high concern in the present. People also need to wait and stop doing their other activities until the tank is full. Hence, here is an idea which senses and indicates the water level so that the pump can be switched off on appropriate time and save water, electricity, and time as well.

WORK PLAN:

Activity	SEPT 2023	OCT. 2023	NOV. 2023	DEC. 2023	JAN. 2024	FEB. 2024	MAR. 2024	APR. 2024
Proposal topic research								
Proposal writing								
Proposal defense								
Components purchase and assembly								
Project testing								
Final project and implementation								
Presentation								

Expected Budget:

Item	Quantity	Price in Ksh.
Arduino UNO	1	1500
Bread board	1	100
Connecting wires	10	100
Ultrasonic sensor	1	200
Display screen (LCD)		810
DC water pump	1	220
Resistor	1	50
Relay module		162
TOTAL		3142

REFERENCES:

1. Asaad Ahmed Mohammed ahmed Eltaieb and Zhang Jian Min, Automatic Water Level Control System, International Journal of Science and Research (IJSR), Volume 4 Issue 12,December 2015.

2. Beza Negash Getu and Hussain A. Attia, Automatic Water Level Sensor and Controller System, Â©2016 IEEE.

3. Priya J, Sailusha Chekuri, water level monitoring system using IoT, International Research Journal of Engineering and Technology (IRJET) Volume: 04 Issue: 12, Dec-2017.

4. Madhurima Santra, Sanjoy Biswas,Sibasis Bandhapadhyay and Kaushik Palit, Smart Wireless water level monitoring &Pump controlling System, International Journal of Advances in Scientific Research and Engineering (IJASRE), Vol. 03, Issue 4, May -2017.

5. K. Santhosh Kumar, G. Mukesh, K. Deepti, Microcontroller based Automatic Water level Control System ,International Refereed Journal of Engineering and Science (IRJES) Volume 4, Issue 11, November 2015.