WATER LEVEL INDICATOR USING ARDUINO-UNO,SERVO MOTOR AND ULTRASONIC SENSOR(HC-SR04).

- By Darshan Shetter

Table of content

1 ABOUT WATER LEVEL INDICATOR

1.1 ABSTRACT

- We live in a world which is moving at such a fast pace that everything if automated will help us to keep our lives going. The project on water level Indicator will help us to know when the water in our tanks is either full or empty and automatically switch on and off the pump as and when necessary. By using the basic principle of ultrasonic sensors, that is the ECHO method, we calculate the time of the ultrasonic waves travelling to and fro and after a few calculations the answer obtained will be the water level in the tank. By using this concept, the water pump is switched on or off automatically when the water level falls below a certain level.

1.2 Identifying features

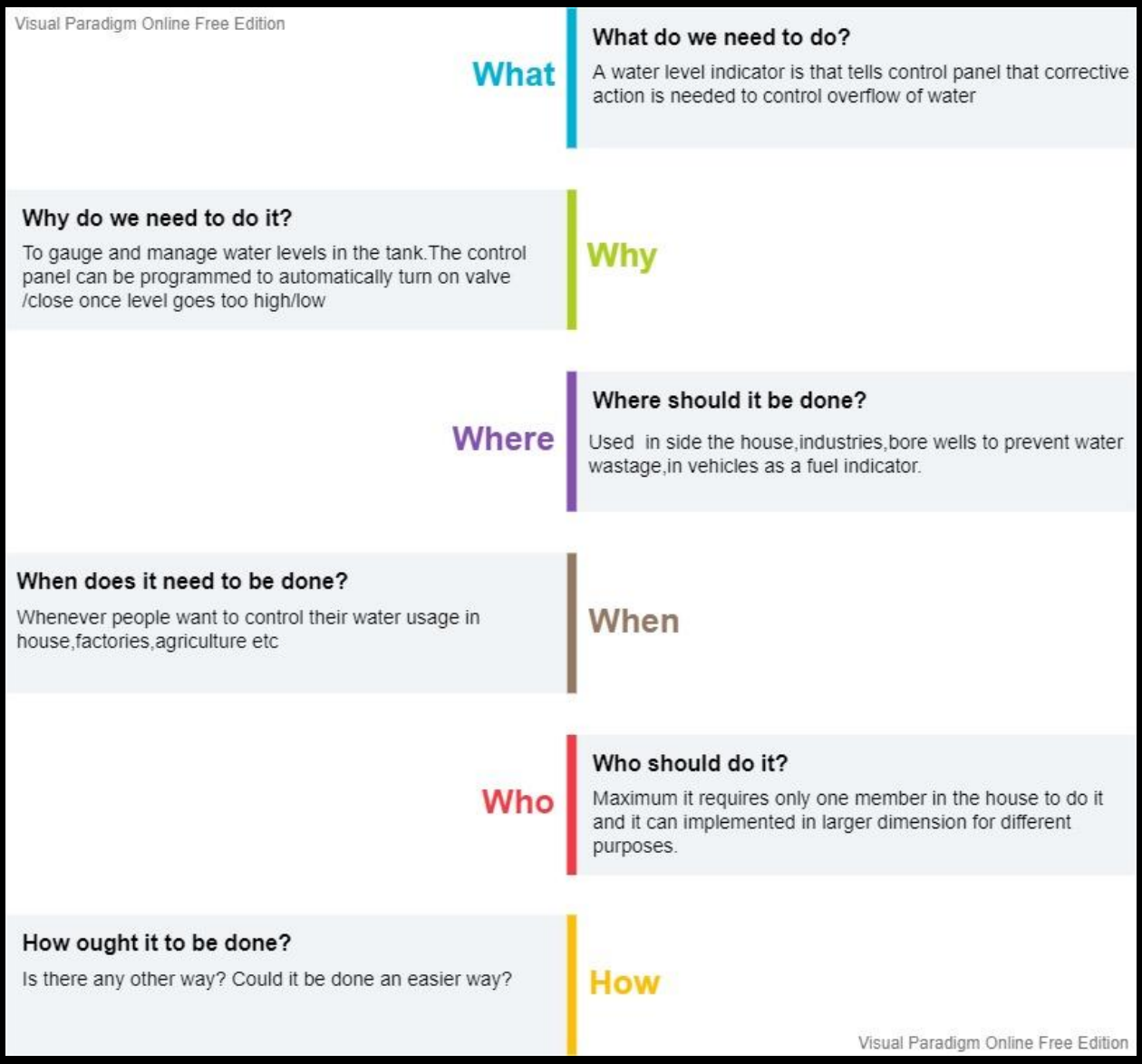
- It should be power saver.
- Money saver.
- Automatic.
- Easy Installation.
- Should monitor the level of water in the tank and simultaneously switches on the water pump whenever the water level goes low in the water tank.
- By using the water level indicator we can overcome the overflow of water from the tankers.
- Time taken to produce output is less.
- LCD display always needs to give the current water level.

1.3 State of art/Research

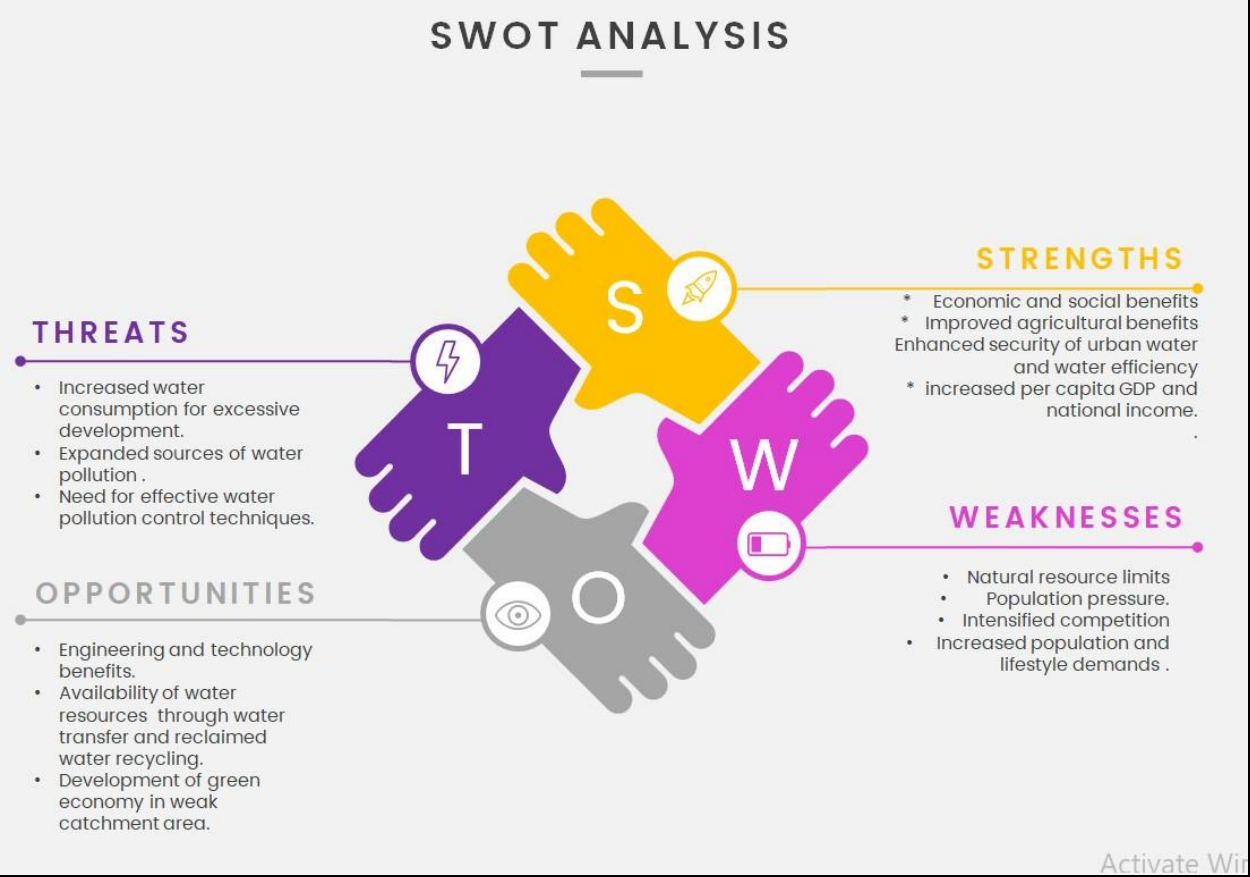
- In relation with the current framework with so much work and too less time to spare, it is very difficult to keep in touch with the water level in the tanks. Water is essential in every hour of our lives. Hardly anyone keeps in track of the level of water in the overhead tanks. The objective of the project is to measure the level of water in the tank and notify the user about the water level through an SMS alert.
- This not only helps to keep the tank full but also making it more convenient for our day-to-day chores and also avoiding water wastage. In this project, the water is being measured by using ultrasonic sensors. Initially, the tank is

- considered to be empty. When the sound waves are transmitted in environment, they are reflected back as ECHO. This same concept is applied this project.
- Waves generated by the ultrasonic sensors is sent to the water tank and their time of travelling and coming back is noted and after few calculations we can estimate the level of water in the tank.

1.4 5W's 1H



1.5 SWOT Analysis



2 Requirements

2.1 High Level Requirements

Id	High level requirements
HL1	System should control motor,LCD display,sensor using ARDUINO controller
HL2	There shall be a LCD to dispaly the current state
HL3	LED is used for open and close valve indication
HL4	Ultrasonic sensor used to measure the distance

2.2 Low Level Requirements

Id	Low level requirements for HL1
LLR 1.1	According to pin configuration LCD,motor,sensor are controlled by ARDUINO
LLR 1.2	As potentiometer valuve changes the valuve in LCD display changes and with help of ARDUINO servo motor direction changes

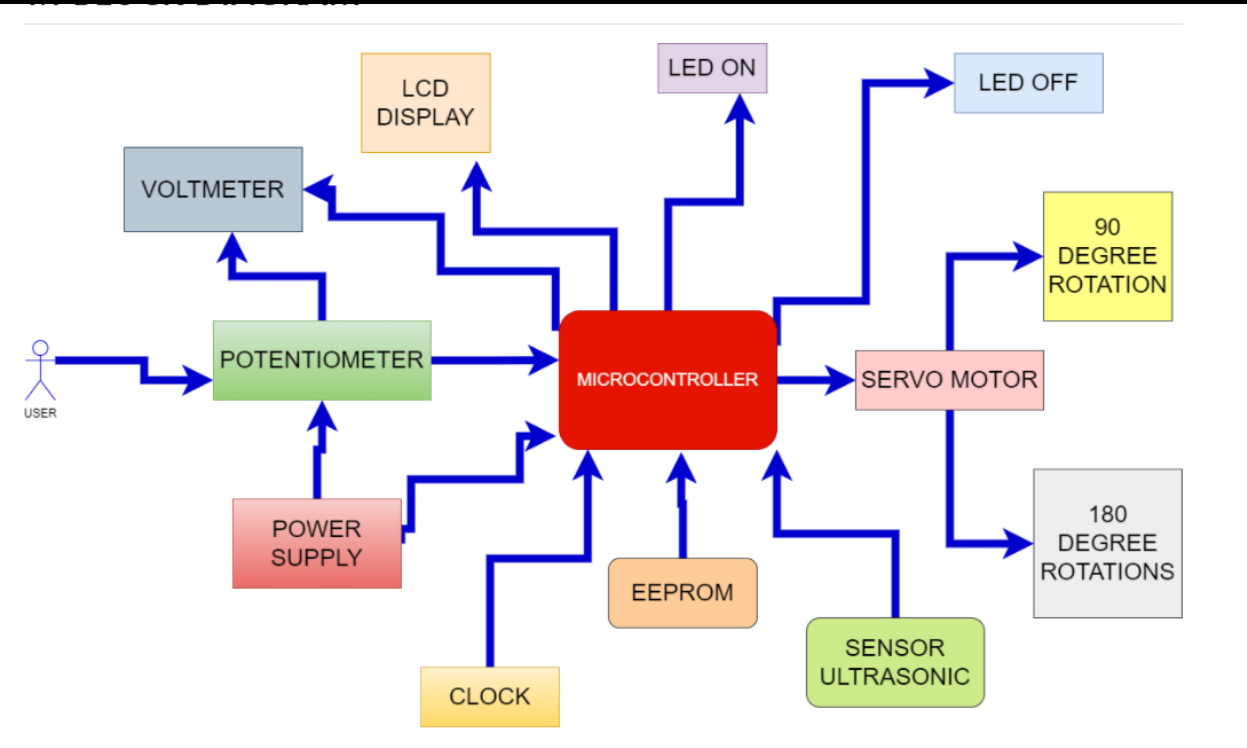
Id	Low level requirements for HL2
LLR 2.1	LCD is used to dispaly the remaining sapce in the tank
LLR 2.2	LCD also displays the message for close and open valves

Id	Low level requirements for HL3
LLR 3.1	LEDS and servo motors are synchronized
LLR 3.2	Voltmeter is used for varying vlotage at initial zero volts one LED IS OFF and other one is ON

Id	Low level requirements for HL4
LLR 4.1	when distance is < = 100 close the valve(because only 100 cm space is left in tank).
LLR 4.2	Whatever the distance is dispalyed by lcd with the help of Ultrasonic is the amount of space left in the tank

3 Block Diagram and Blocks explanation

3.1 BLOCK DIAGRAM



3.2 SENSORS

Ultrasonic

Working :

- It is basically a distance sensor and is used for detecting the distance using SONAR method. It has two ultrasonic transmitters namely the receiver and the control circuit. The transmitter emits a high frequency ultrasonic sound wave which bounces off from any solid object and 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 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.

3.3 ACTUATORS

3.3.1 LCD display

- Based on the value taken by by sensor it displays the empty space in the tank and also indicates the necessary actions .LCDs allowed displays to be much thinner than cathode ray tube (CRT) technology. LCDs consume much less power than LED and gas-display displays because they work on the principle of blocking light rather than emitting it.

3.3.2 Servo motor

- Servo motors or "servos", as they are known, are electronic devices and rotary or linear actuators that rotate and push parts of a machine with precision. Servos are mainly used on angular or linear position and for specific velocity, and acceleration. It is used to open and close the valves to control the wastage of water and based of distance value it rotates either 180 degree or 90.

3.3.3 Microcontroller and memory

- Arduino UNO has the micro-controller ATmega328 embedded in it. It has 14 digital I/O pins out of which 6 provide PWR output. It is an open-source and provides prototype platform. It also has a 16MHX crystal oscillator attached to it. In addition to the above features, it also has an USB connection, a power jack, an ICSP, header and reset button. It has everything to support a micro-controller. It can simply be connected to a computer using an USB cable power it with an AC or a DC adapter or a battery.

3.3.4 EEPROM

- Here this is actually inside the microcontroller

3.3.5 Delay

These functions are used for smooth going of project helps every functions to perform their task.

3.3.6 Microcontroller

- This is the main component which controls all the above mentioned part or thins of our embedded system. This interfaces motor and LCD and controls the sensor, light and voltage depending on the value we pressed on potentiometer

3.5 SUBSYSTEM & OTHERS

3.5.1 LED

- Light-emitting diode (LED) is a widely used standard source of light in electrical equipment. It has a wide range of applications ranging from your mobile phone to large advertising billboards. They mostly find applications in devices that show the time and display different types of data. LEDs allow the current to flow in the forward direction and block the current in the reverse direction. Here, 2 leds are used for confirmation of opening and closing of valve.

3.5.2 Resistors

- A resistor is a passive two-terminal electrical component that implements electrical resistance as a circuit element. In electronic circuits, resistors are used to reduce current flow, adjust signal levels, divide voltages, bias active elements, and
- Terminate transmission lines, among other uses. Resistors are common elements of electrical networks and electronic circuits and are ubiquitous in electronic equipment.
- Practical resistors as discrete components can be composed of various compounds and forms Resistors are also implemented within integrated circuits. Here we used 100 ohm 2 resistors that connected to 2 leds.

3.5.3 Voltmeter

- voltmeter, instrument that measures voltages of either direct or alternating electric current on a scale usually graduated in volts, millivolts (0.001 volt), or kilovolts (1,000 volts). Many voltmeters are digital, giving readings as numerical displays. Here, voltmeter is used to change the voltage levels.

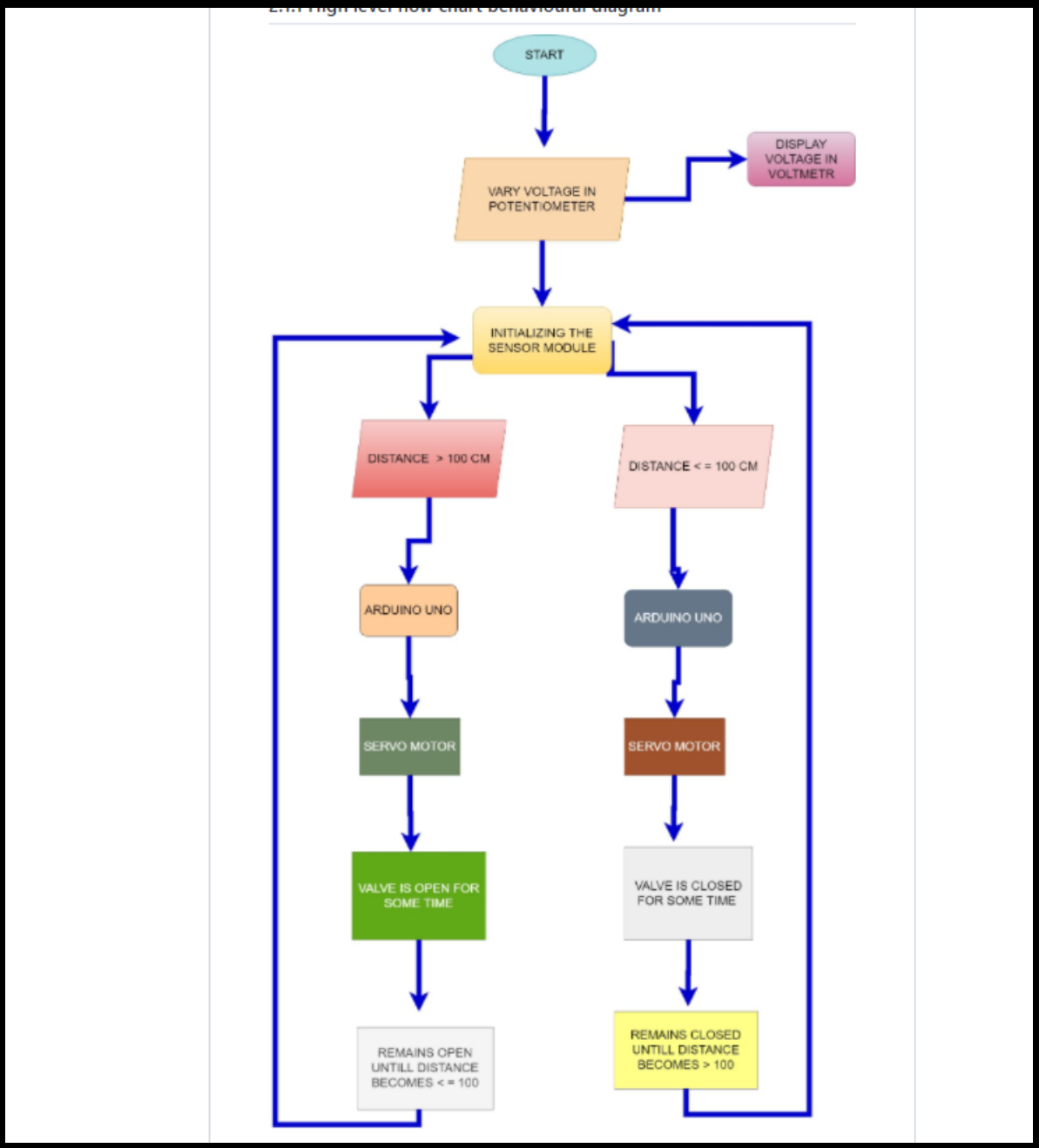
3.5.4 Potentiometer

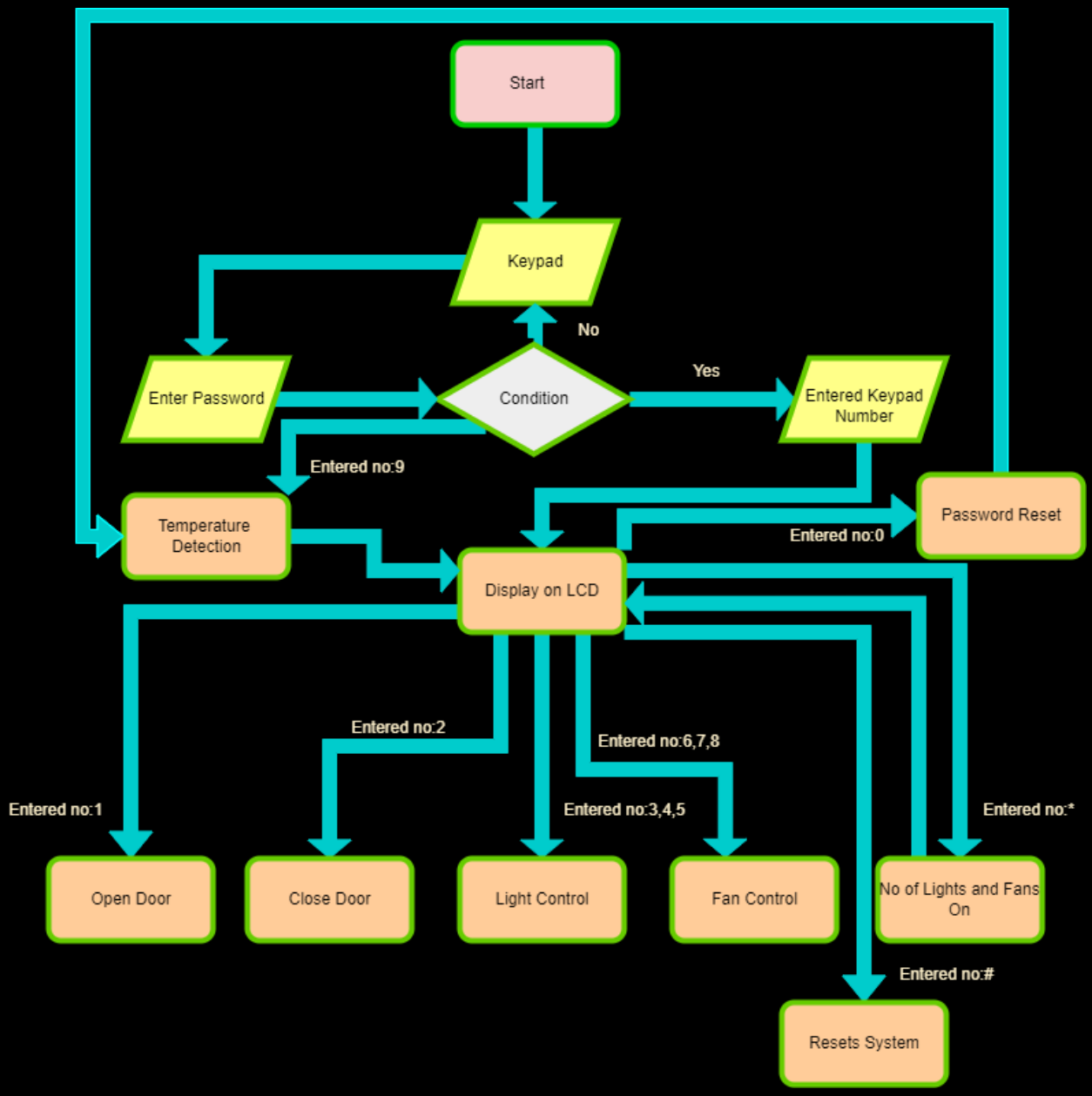
- A potentiometer is a three-terminal resistor with a sliding or rotating contact that forms an adjustable voltage divider. If only two terminals are used, one end and the wiper, it acts as a variable resistor or rheostat. Here, they are used to measure

displacement in any direction. Linear potentiometers linearly measure displacement and rotary potentiometers measure rotational displacement

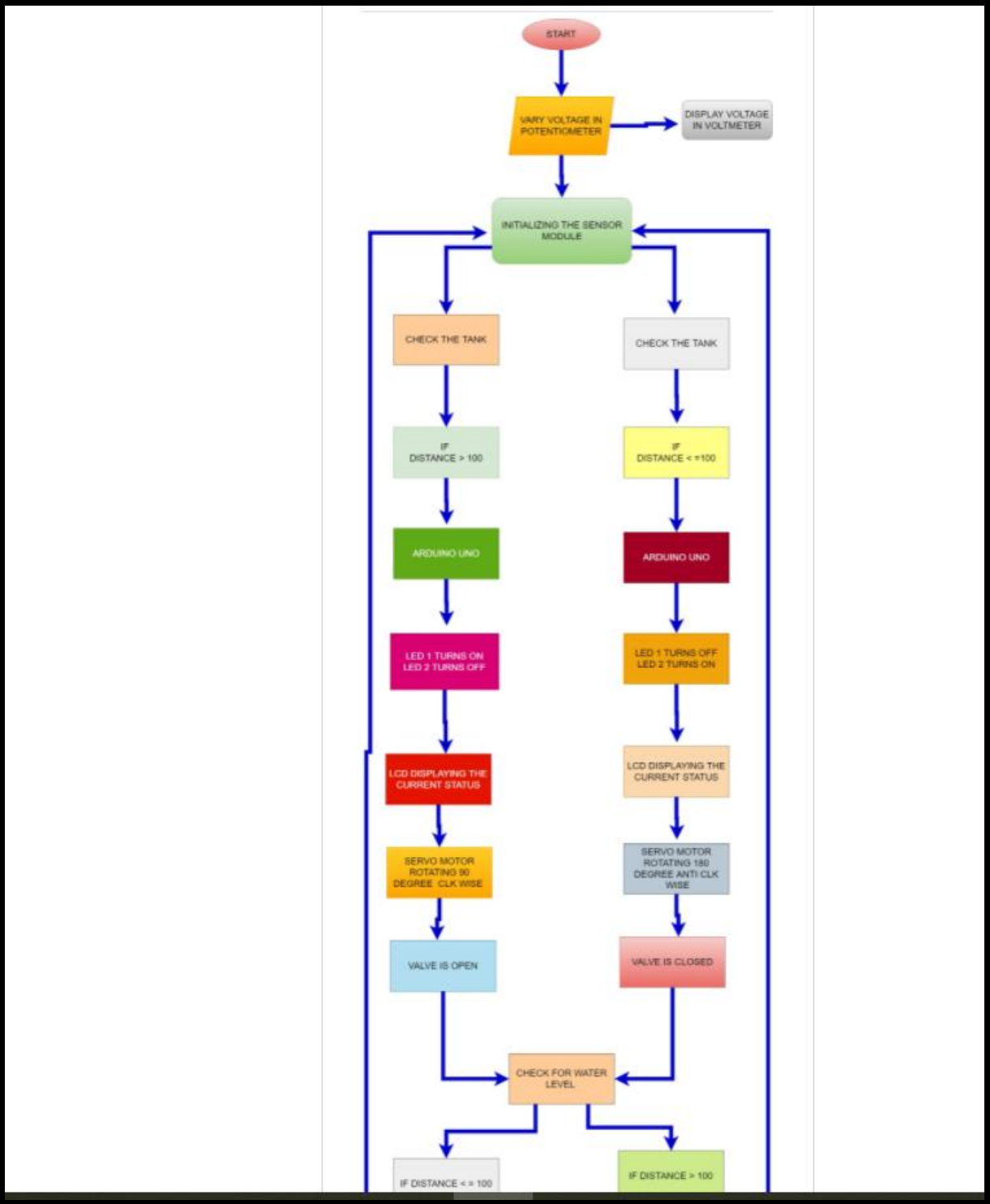
4 Architecture

- ## 4.1 Behavioral Diagram
  - ### 4.1.1 High Level Flow chart Behavioral Diagram



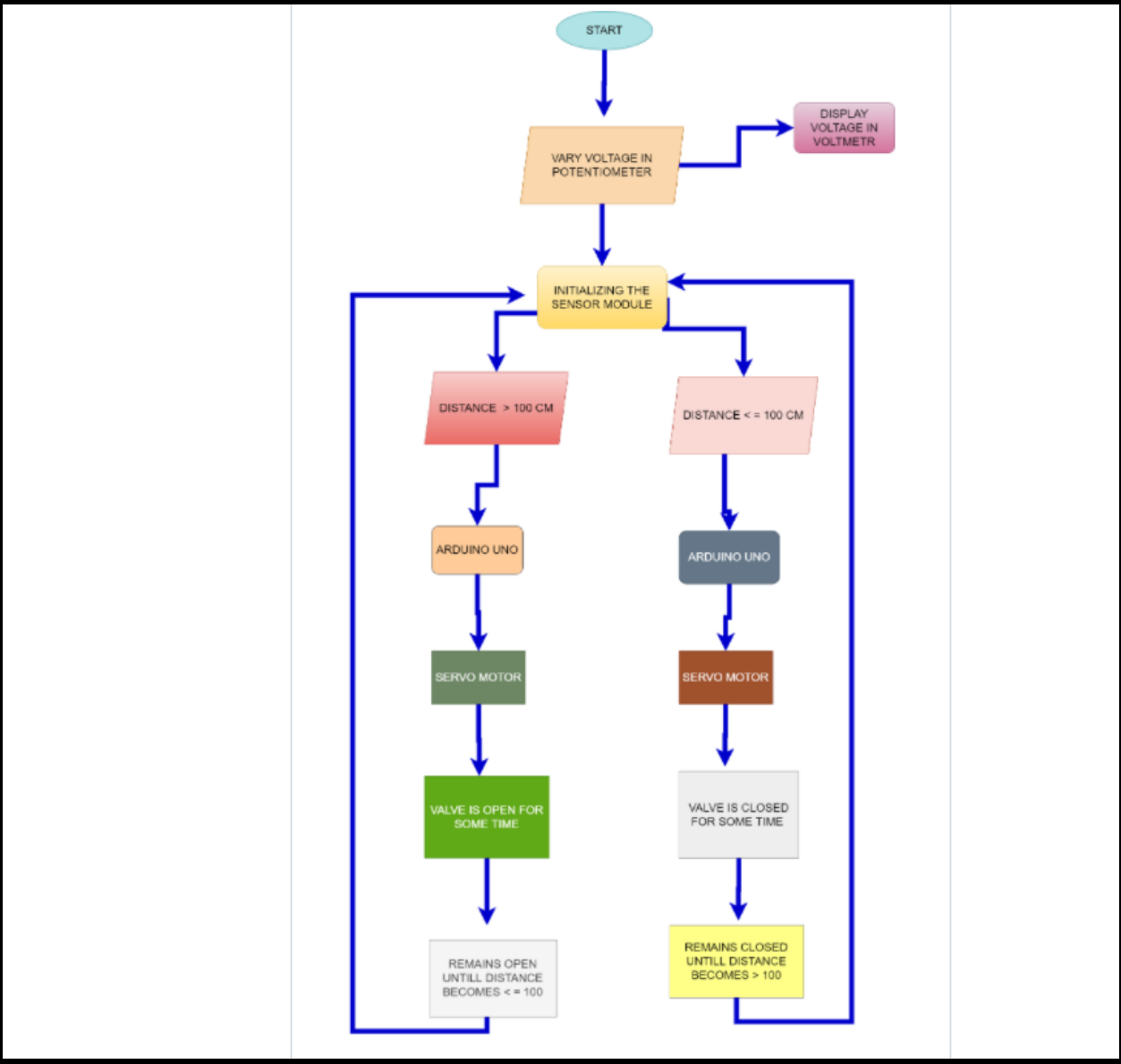

Start
Keypad
No
Yes
Enter Password
Condition
Entered Keypad Number
Entered no:9
Temperature Detection
Password Reset
Entered no:0
Display on LCD
Entered no:2
Entered no:6,7,8
Entered no:1
Entered no:3,4,5
Entered no:*
Open Door
Close Door
Light Control
Fan Control
No of Lights and Fans On
Entered no:#
Resets System

- ### 4.1.2 Low Level Flow chart Behavioural Diagram

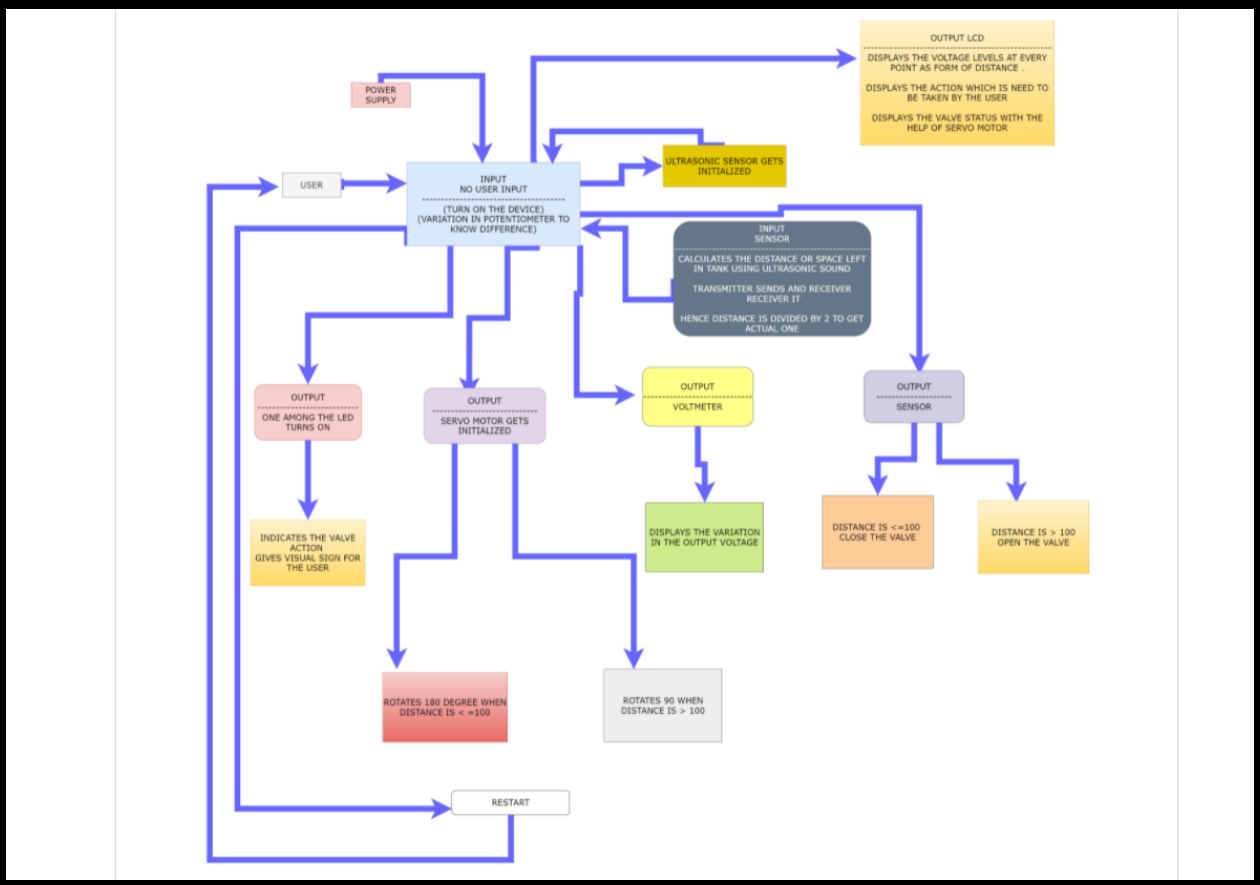


- ## 4.2 Structural Diagram

  - ### 4.2.1 High Level UML Use Case Structural Diagram



  - ### 4.2.2 Low Level UML Use Case Structural Diagram


OUTPUT LCD
DISPLAYS THE VOLTAGE LEVELS AT EVERY POINT AS FORM OF DISTANCE .
DISPLAYS THE ACTION WHICH IS NEED TO BE TAKEN BY THE USER
DISPLAYS THE VALVE STATUS WITH THE HELP OF SERVO MOTOR
POWER SUPPLY
USER
INPUT
NO USER INPUT
(TURN ON THE DEVICE)
(VARIATION IN POTENTIOMETER TO KNOW DIFFERENCE)
ULTRASONIC SENSOR GETS INITIALIZED
INPUT
SENSOR
CALCULATES THE DISTANCE OR SPACE LEFT IN TANK USING ULTRASONIC SOUND
TRANSMITTER SENDS AND RECEIVER RECEIVER IT
HENCE DISTANCE IS DIVIDED BY 2 TO GET ACTUAL ONE
OUTPUT
ONE AMONG THE LED TURNS ON
OUTPUT
SERVO MOTOR GETS INITIALIZED
OUTPUT
VOLTMETER
OUTPUT
SENSOR
INDICATES THE VALVE ACTION
GIVES VISUAL SIGN FOR THE USER
DISPLAYS THE VARIATION IN THE OUTPUT VOLTAGE
DISTANCE IS <=100
CLOSE THE VALVE
DISTANCE IS > 100
OPEN THE VALVE
ROTATES 180 DEGREE WHEN DISTANCE IS < =100
ROTATES 90 WHEN DISTANCE IS > 100
RESTART

5 Test plan and output

5.1 HIGH LEVEL TEST PLAN

Test Id	Discription	Input	Expected Output	Actual Output	Passed or Not
01	Potentiometer(voltage)	250mv(convetring volts to cm)	LCD should give the exact voltage in display as 24 v	LCD shows the exact value	PASSED
02	LED	250 mv	LED 1 should turn On	LED 1 is turned ON	PASSED
03	LCD	250 mv	LCD needs to display as OPEN the tap	LCD displays the same way	PASSED
04	Servo motor	250 mv	Needs to rotate in 180 degree antoclockwise	Servo motor rotates in the same way	PASSED
05	Maximum input value	300mv	LCD needs to display as tank is full	LCD displays in the same manner	PASSED

Test Id	discription	Input	Expected Output	Actual Output	Passed or Not
01	Servo motor rotation	90 or 180 degree based on distance value	shall send 1 to LED circuit	shall send 1 to LED circuit	PASSED
02	LCD display	Amount of distance at every itration	Needs to display distance	Needs to display distance	PASSED
03	Motor control	Data from Micro controller(shall sends values from sig port to controller)	Data from Micro controller(shall sends values from sig port to controller)	Data from Micro controller(shall sends values from sig port to controller)	PASSED
04	Sensor control	Data from senor is controlled by controller and it is displayed by LCD	Data from senor is controlled by controller and it is displayed by LCD	Data from senor is controlled by controller and it is displayed by LCD	PASSED

5.2 LOW LEVEL TEST PLAN

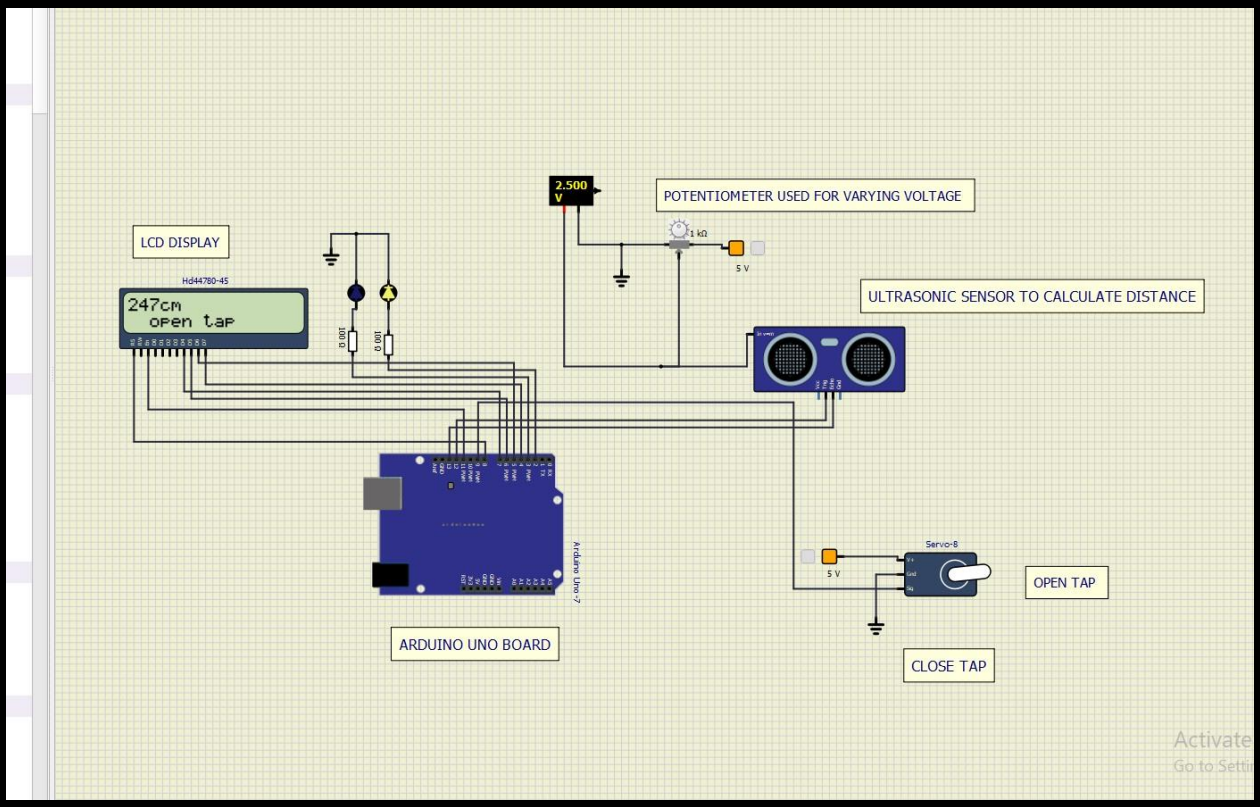
LOW LEVEL TEST PLAN

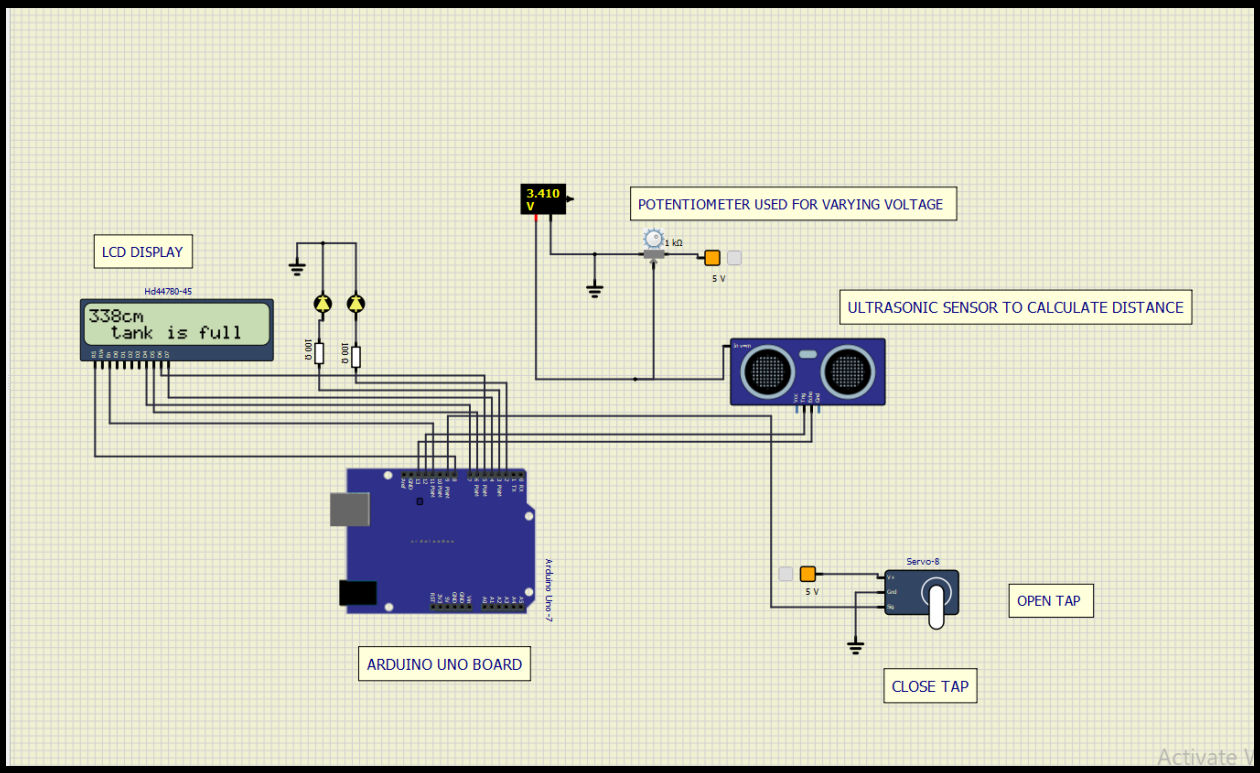
Test Id(FOR LCD)	Discription	Input	Expected Output	Actual Output	Passed or Not
01	Checks for LCD	25 mv	25 cm	~=25cm	PASSED
02	Checks for LCD	25 mv	Display close tap	Display close tap	PASSED
03	Checks for LCD	300 mv	Display tank is full	Display tank is full	PASSED

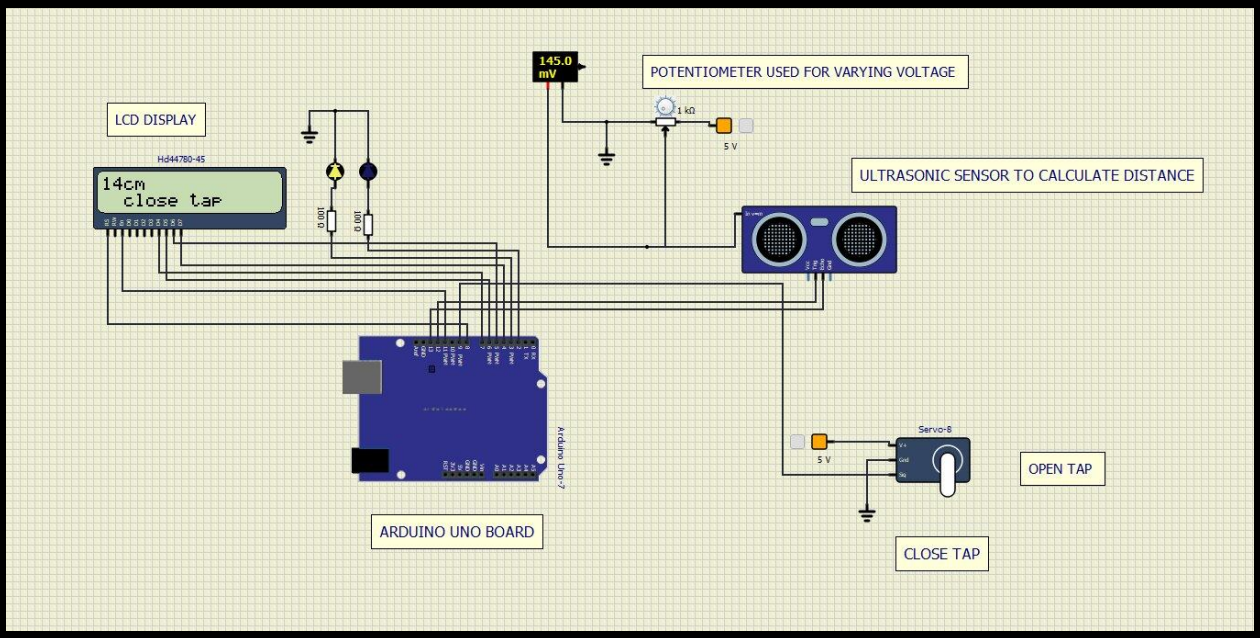
Test Id(FOR SERVO)	Discription	Input	Expected Output	Actual Output	Passed or Not
01	Checks for SERVO	250 mv	180 degree anticlk rotation	180 degree anticlk rotation	PASSED
02	Checks for SERVO	50 mv	90 degree clk rotation	90 degree clk rotation	PASSED

Test Id(FOR LED)	Discription	Input	Expected Output	Actual Output	Passed or Not
01	Checks for LED	50 mv	LED 1 turns ON	LED 1 turns ON	PASSED
02	Checks for LED	250 mv	LED 2 turns ON	LED 2 turns ON	PASSED
03	Checks for LED	400 mv	Both LEDS turns ON	Both LEDS turns ON	PASSED

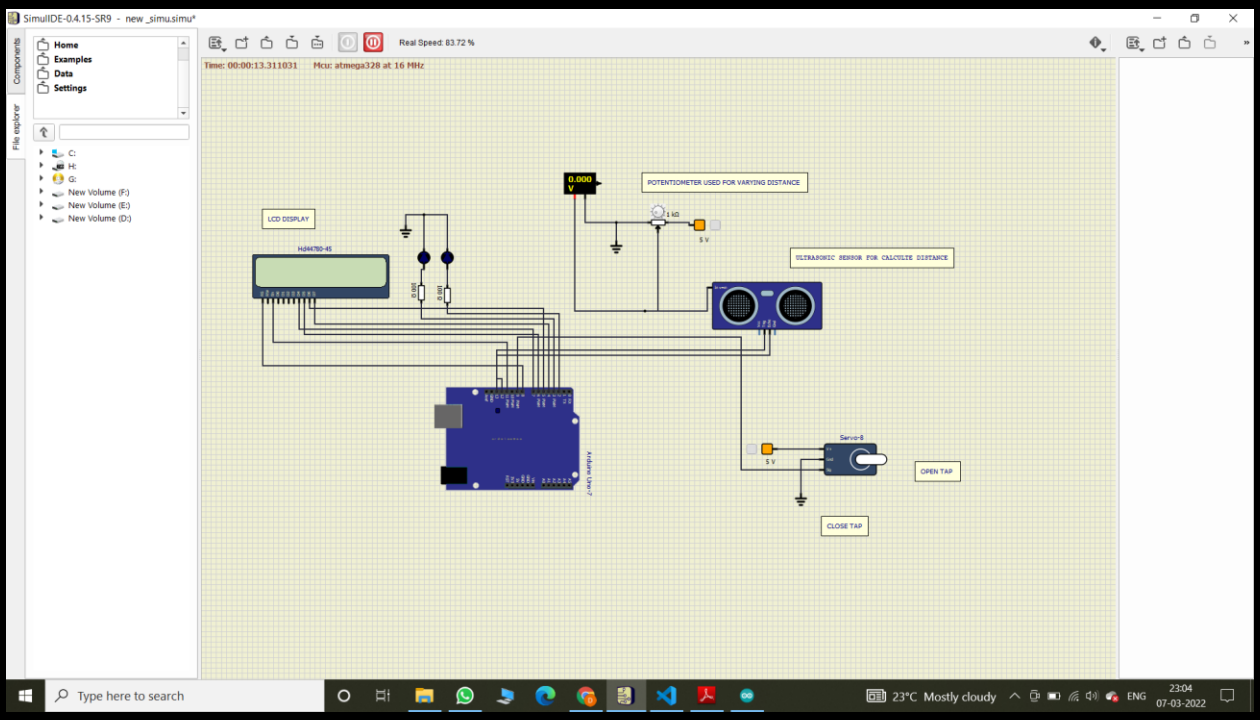
6 Images and videos(output)




LCD DISPLAY
Hd44780-45
338cm
tank is full
100 Ω
100 Ω
3.410 V
POTENTIOMETER USED FOR VARYING VOLTAGE
1 kΩ
5 V
ULTRASONIC SENSOR TO CALCULATE DISTANCE
Arduino Uno-7
ARDUINO UNO BOARD
Servo-8
5 V
OPEN TAP
CLOSE TAP


145.0 mV
POTENTIOMETER USED FOR VARYING VOLTAGE
LCD DISPLAY
1 kΩ
5 V
Hd44780-45
14cm
close tap
ULTRASONIC SENSOR TO CALCULATE DISTANCE
100 Ω
100 Ω
Arduino Uno-7
Servo-8
5 V
OPEN TAP
ARDUINO UNO BOARD
CLOSE TAP

Simulation pic :



Git:

Project--- >Images and Videos or Output File

https://github.com/vsshetter/M2-EmbSys.git

7 Applications

- This system can be used in Light Control of Houses, Industries, Stadiums etc.…
- This system can be used in Fan Control of Houses, Industries, Stadiums etc.…
- This system can be used in Door Control of Houses, Industries, Stadiums etc.…
- This system can be used in Automatic Temperature Detector of Houses, Industries, Stadiums etc.…

- This system can be used to know number of appliances “On” status of Houses, Industries, Stadiums etc….

8 Future Add On

- Automatic water level monitoring system has a good scope in future especially for agriculture sector. There are any areas where we need water level controller. It could be agricultural fields, overhead tanks. We can make this project wireless by using NRF transmitter and receiver. We can also add Ethernet shield so that we can get all the information using mobile phones and control it accordingly.

9 References

- https://circuitdigest.com/