AUTOMATIC WATER PUMPING SYSTEM WITH OVERFLOW CONTROL

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Course : Design and simulation of circuits and embedded systems.

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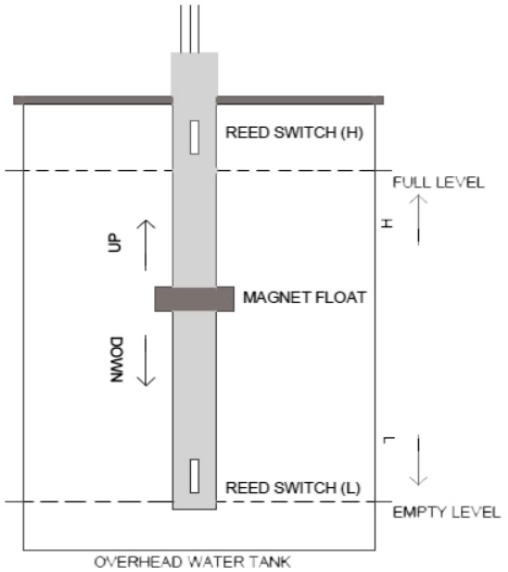
1. ABOUT AUTOMATIC WATER PUMPING SYSTEM WITH OVERFLOW CONTROL

1.1 ABSTRACT

- In our daily life, we observe lots of wastage of natural resource such as water one of the major area where the wastage of water is seen is overhead tanks at our homes. Whenever the water in the tank gets empty, we switch on the water pump to fill up the tank. Once the water in the tank fills up, it starts to overflow without any indication to us. In addition, we need to manually switch on/off the water pump in a timely manner. So in order to prevent the overflow of the tank and make the whole process of pumping up the water automated an Automatic Water Pumping System with Overflow and Water Level Indicator can be great solution.

1.2 DESCRIPTION

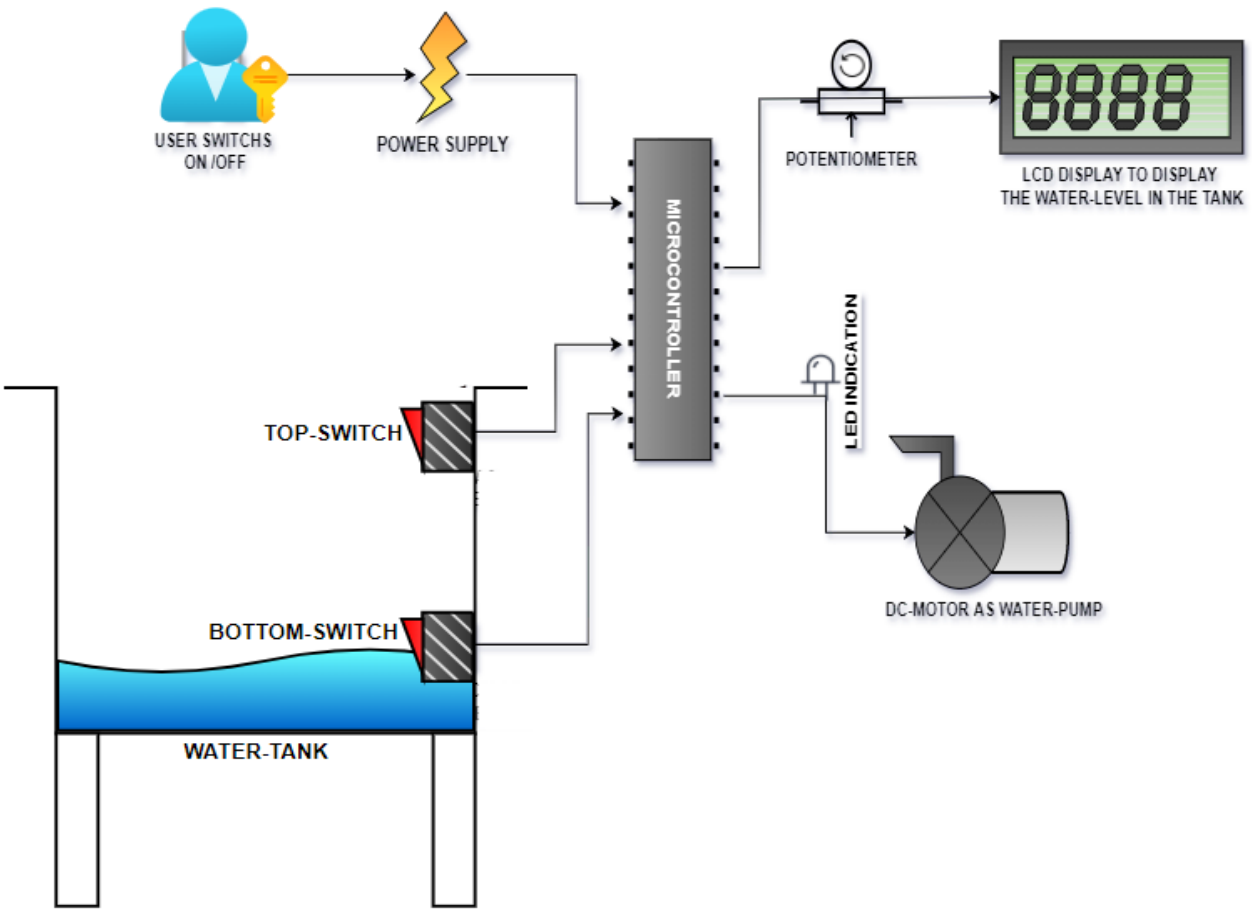
- This automated system has two water level sensor, which is to be attached at top x1 and bottom x1 surface of the water tank, which detects the water level in the tank and switches on/off the water pump and displays the water level. To read the water level of the overhead water tank there are two reed sensors, one for low level (L) and the other for high level (H). A magnetic float switch that activates two reed sensors so that the magnetic float travels from low level (L) to high level (H) and vice-versa according to water level in the water tank. If the L reed sensor triggers its microcontroller input, the water pump is activated with indicator LED on. When H level is reached, ie the H reed sensor triggers its microcontroller input, water pump is deactivated with indicator LED off. Water pump is reactivated only when water drops back to L level.



1.3 IDENTIFYNG FEATURES

- It must detect the water level and display the water level.
- It must detect the low water-level and start the water-pump immediately with an indication.
- It must detect the high water-level and stop the water-pump immediately with an indication.

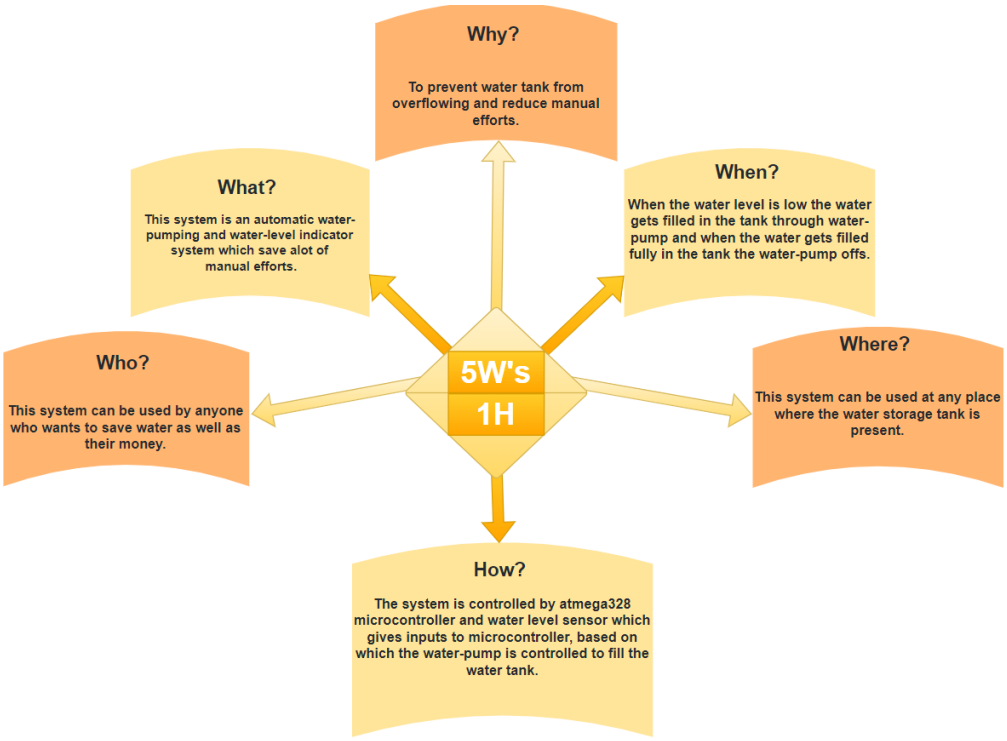
1.4 BLOCK DIAGRAM



1.5 SWOT ANALYSIS

SWOT ANALYSIS	
Strengths: ➢ Prevents the wastage of water. ➢ Totally automated water-pumping system, which reduces manual efforts of the user. ➢ Saves the electricity and water bill money of the user.	**Weaknesses:** ➢ Maintenance or servicing of the system is required. ➢ Risk of short-circuit is present.
Opportunities: ➢ Additional features can be added to the system. ➢ Improvements in the design can be can be made in order to make it the safest system.	**Threats:** ➢ Short-circuit can occur as the electronic components has the attached in moist/liquid environment.

1.6 5W'S AND 1H



2. REQUIREMENTS

2.1 HIGH LEVEL REQUIREMENTS

Test-ID	Description
HLR1	Display the water-level present in the tank
HLR2	Switch on the water-pump when water-level is low in the tank
HLR3	Switch off the water-pump when water is fully filled in the tank

2.2 LOW LEVEL REQUIREMENTS

Test-ID	Description	HLR-ID
LLR1	Display the water-level in terms of liters	HLR1
LLR2	Display the water-level based on sensor's input	HLR1
LLR3	Switch on the water-pump when both the water-level sensors are open	HLR2
LLR4	Switch on the water-pump when bottom sensor is closed and top sensors is open	HLR2
LLR5	Switch off the water-pump when both the water-level sensors are closed	HLR3
LLR6	Switch off the water-pump when bottom sensor is open and top sensor is closed	HLR3

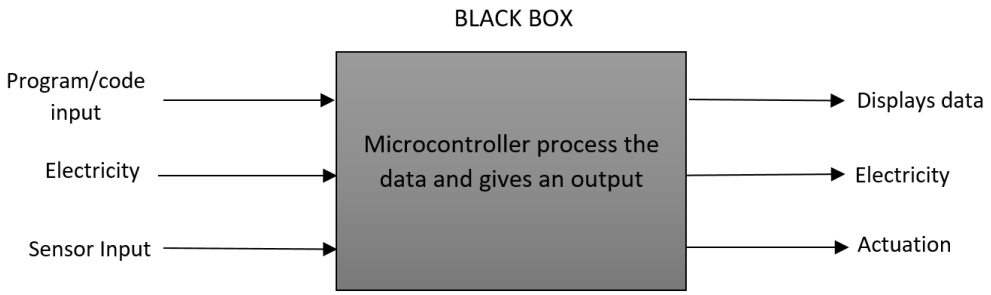
3. COMPONENT DETAILES

3.1 TABLE OF COMPONENTS

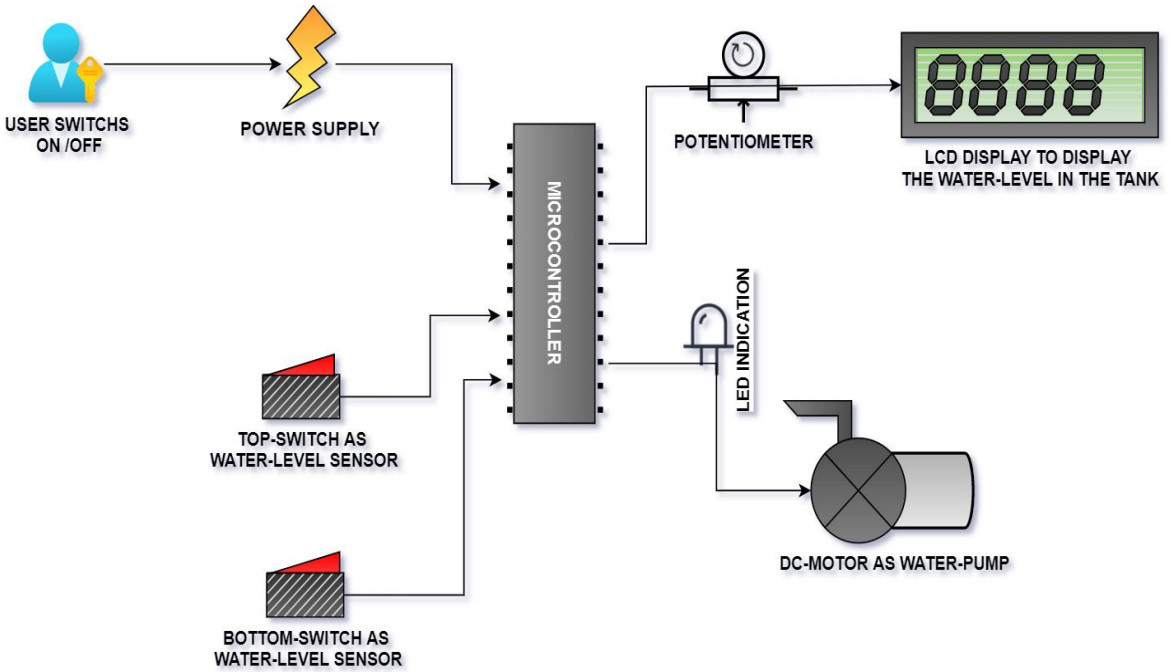
Components Used	Working As	Component Discription	Quantity
Atmega328 microcontroller	Microprocessor	ATmega328 is a single-chip microcontroller created by Atmel in the megaAVR family which has a modified harvard architecture 8-bit RISC processor core. Atmega328 has 28 pins in total which is divided into 3 Ports in total which are named as Port B, Port C and Port D. It has EPROM and clock built internally.	x1
16x2 LCD	Display	Liquid Crystal Display or LCD is used to display character digitally. A 16x2 LCD display can display 16 characters per line and there are 2 such lines.	x1
DCmotor	Water-pump	It has a set of magnets in a metal cover, and a coil of wire in which current passes in order to generate an electromagnetic field. Due to which the axel of the foter rotates.	x1
LED	Indication	A light emitting diode(LED) is a semiconductor light which emits light when current flows through it.	x1
1kΩ Potentiometer	Water-level detector	A 1KΩ potentiometer hass a 3-I/O pins with 15mm shaft. This is used for adjusting various parameters such as voltage and current in an electronic circuit.	x1
100Ω Resistor	Resistance	A resistor is a passive two-terminal electrical component that implements electrical resistance in an electronic circuit. An 100Ω resistor can make excellent pull-ups, pull-downs and are a good current limiters.	x1
Switch	Water-level sensors	Switch make or breaks the circuit by switch on/off condition, whivh is opening or closing of the electrical line or circuit.	x2

4. ARCHITECTURE

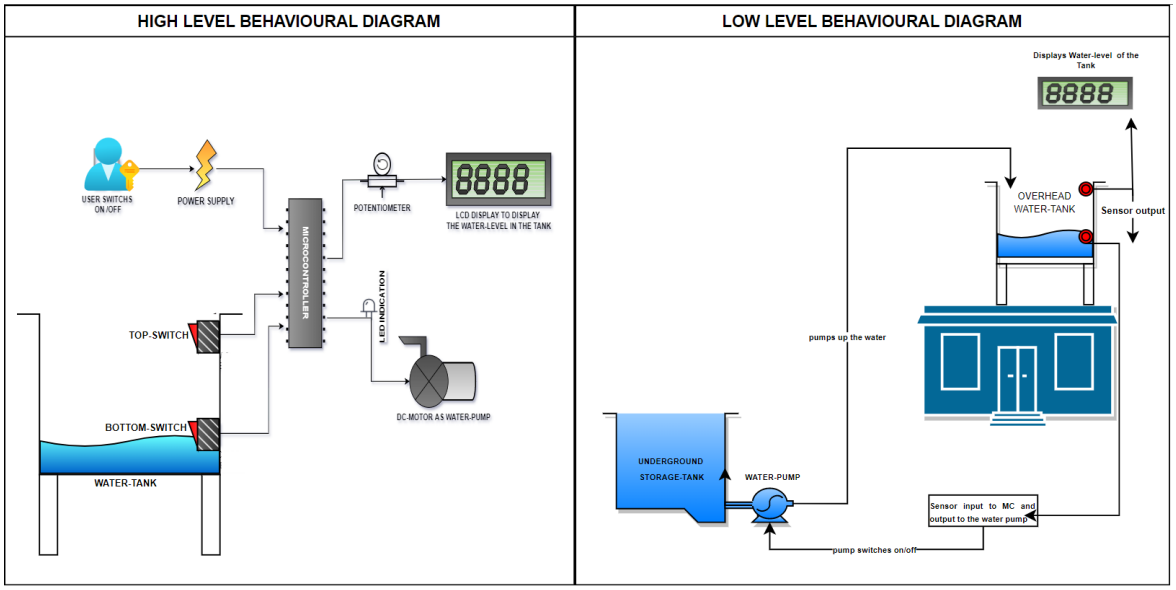
4.1 BLACK BOX



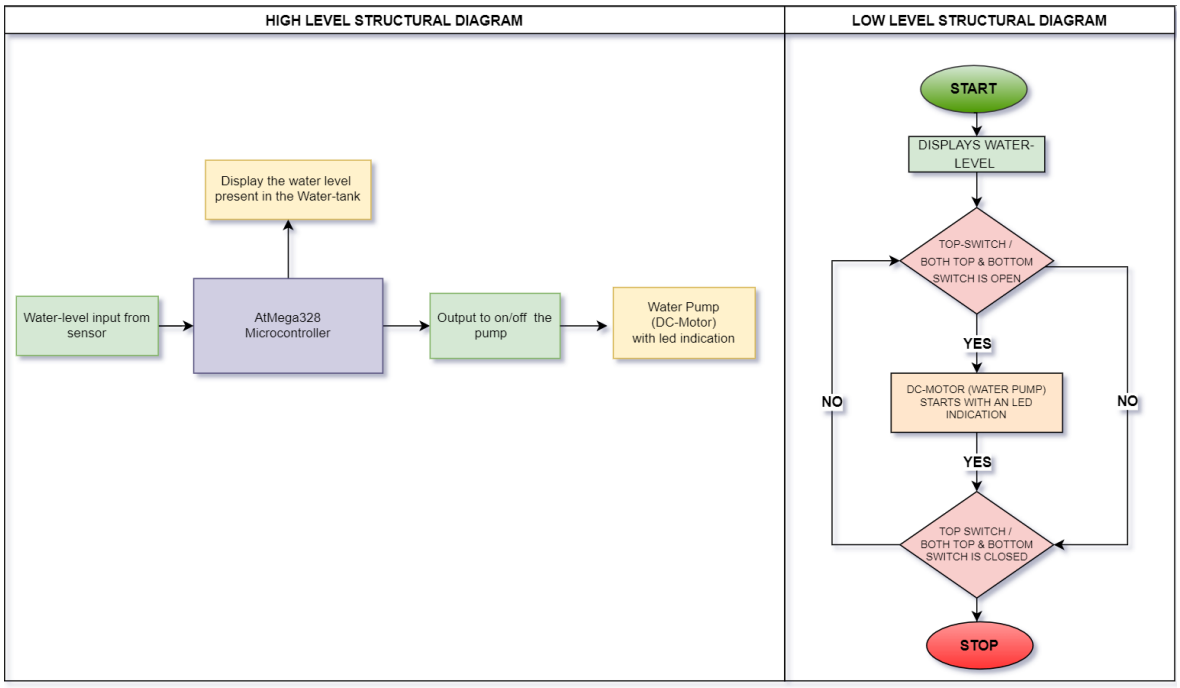
4.2 BLOCK DIAGRAM



4.3 BEHAVIOURAL DIAGRAM



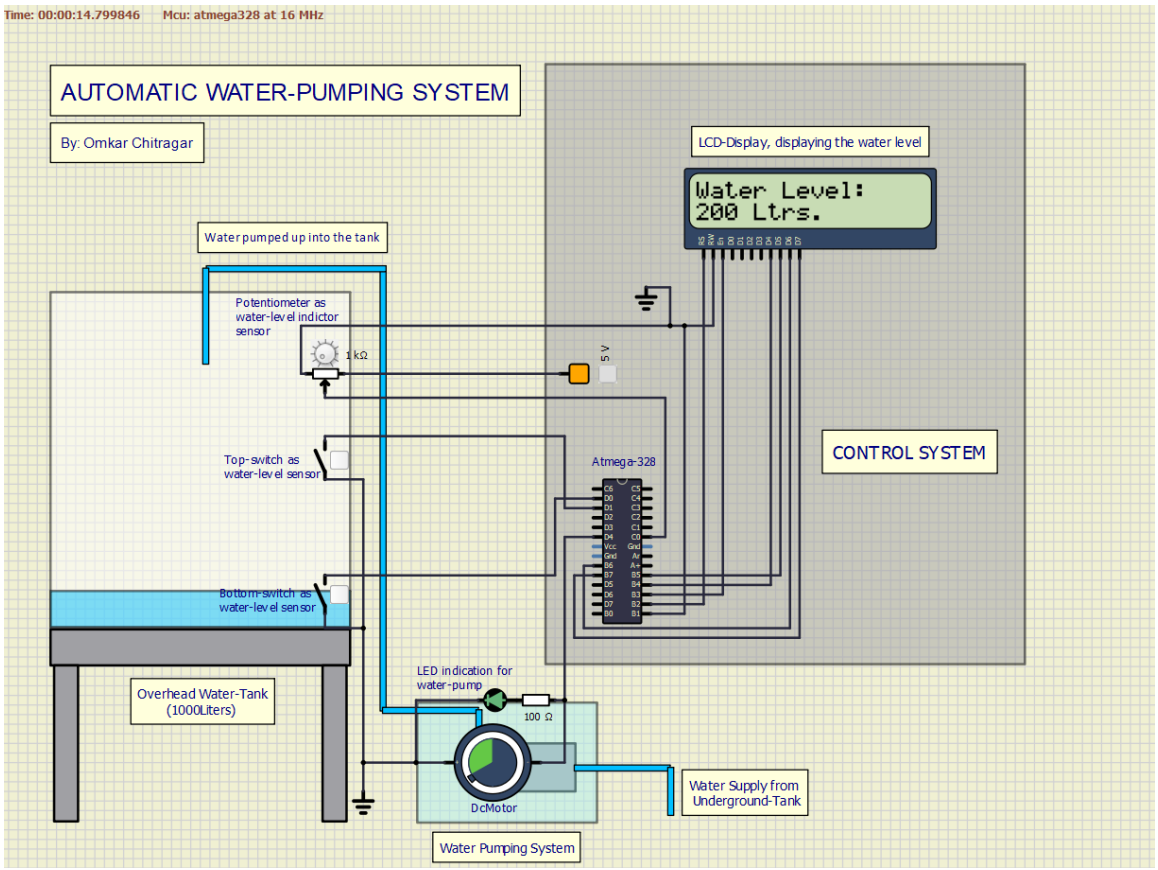
4.4 STRUCTURAL DIAGRAM/ FLOWCHART



4.5 BEST METHOD FOLLOWED

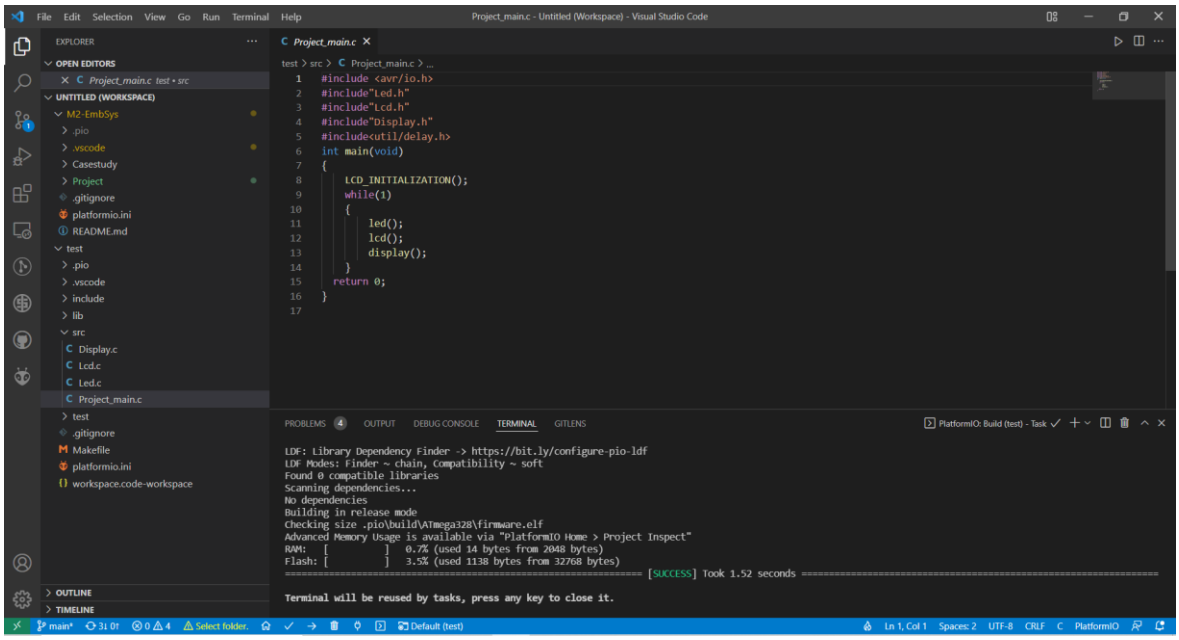
- The best of the best diagrams are considered.
- With the use of all the diagrams code is built.
- Low-level and high-level requirements is implemented.

5. CIRCUIT DESIGN AND SIMULATION



- The circuit is designed in Simul-IDE software.
- The simulation is carried out using .hex file.

- The code for simulation is designed in VS-studio code using Platform.io extension.



- The .hex file was generated after successfully building and running of the code.
- The generated .hex file is the loaded in the Atmega328 microcontroller and the simulation was carried out successfully.

6. TEST PLAN AND OUTPUT

6.1 HIGH LEVEL TEST PLAN

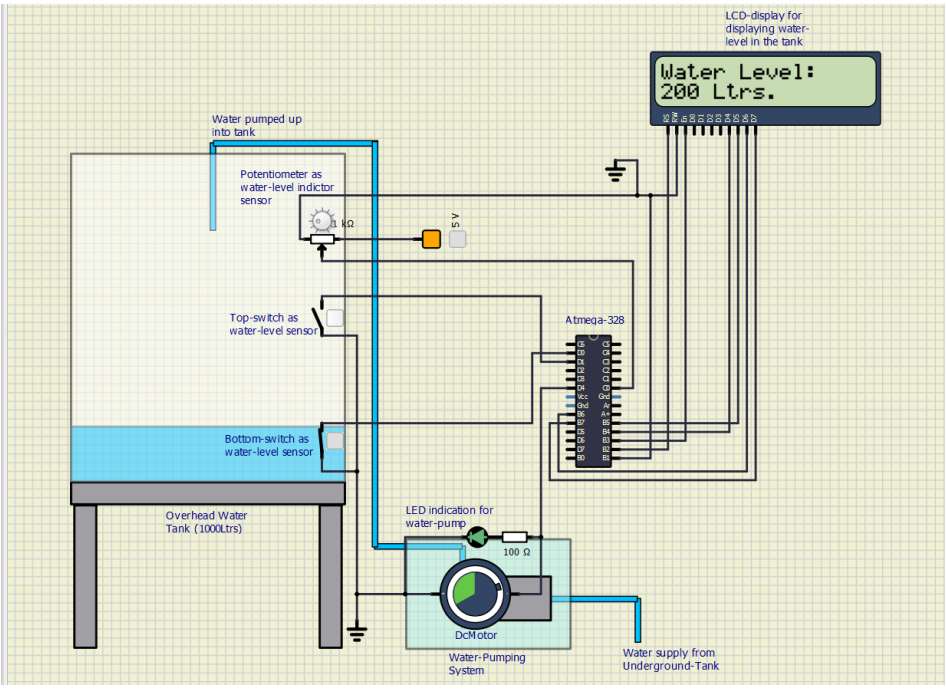
Test-ID	Description	Input	Expexted Output	Actual Output	Status
HLTP1	Display the water-level present in the tank	Potentiometer value	Water-level will be displayed accordingly	Water-level displayed accordingly	Pass
HLTP2	Switch on the water-pump when water-level is low in the tank	Top and bottom switchs(as water-level sensor)	DcMotor(as water-pump) must switch on	DcMotor(as water-pump) switches on	Pass
HLTP3	Switch off the water-pump when water is fully filled in the tank	Top and bottom switchs(as water-level sensor)	DcMotor(as water-pump) must switch off	DcMotor(as water-pump) switches off	Pass

6.2 LOW LEVEL TEST PLAN

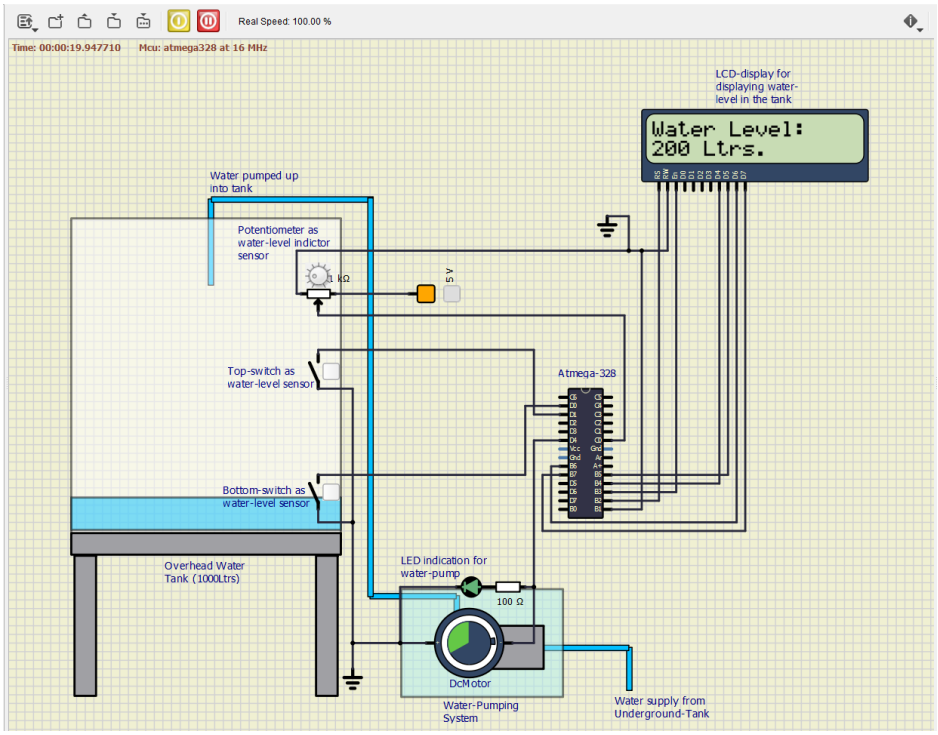
Test-ID	Description	Input	Expexted Output	Actual Output	Status	HLTP-ID
LLTP1	Display the water-level in terms of liters	Potentiometer(as water-leveldetector) value	must display in terms of liters	Displayed in terms of liters	Pass	HLTP1
LLTP2	Display the water-level based on sensor's input	Potentiometer value ranging:_____ 1) >=000 to <=200 ; 2) >=200 to <=400 ; 3) >=400 to <=600 ; 4) >=600 to <=800 ; 5) >=800 to <=1000 ;	Output according to potentiometer value input_____ 1) =200Ltrs. 2) =400Ltrs. 3) =600Ltrs. 4) =800Ltrs. 5) =1000Ltrs.	Output according to potentiometer value input_____ 1) =200Ltrs. 2) =400Ltrs. 3) =600Ltrs. 4) =800Ltrs. 5) =1000Ltrs.	Pass	HLTP1
LLTP3	Switch on the water-pump when both the water-level sensors are open	Top and Bottom switches(as water-level sensor) are open	DcMotor(as water-pump) must on	DcMotor(as water-pump) on	Pass	HLTP2
LLTP4	Switch on the water-pump when bottom sensor is closed and top sensors is open	Top switch open and Bottom switch closed	DcMotor(as water-pump) must on	DcMotor(as water-pump) on	Pass	HLR2
LLTP5	Switch off the water-pump when both the water-level sensors are closed	Top switch and Bottom switch(as water-level sensor) are closed	DcMotor(as water-pump) must off	DcMotor(as water-pump) off	Pass	HLR3

6.3 TESTPLAN OUTPUT IMAGES

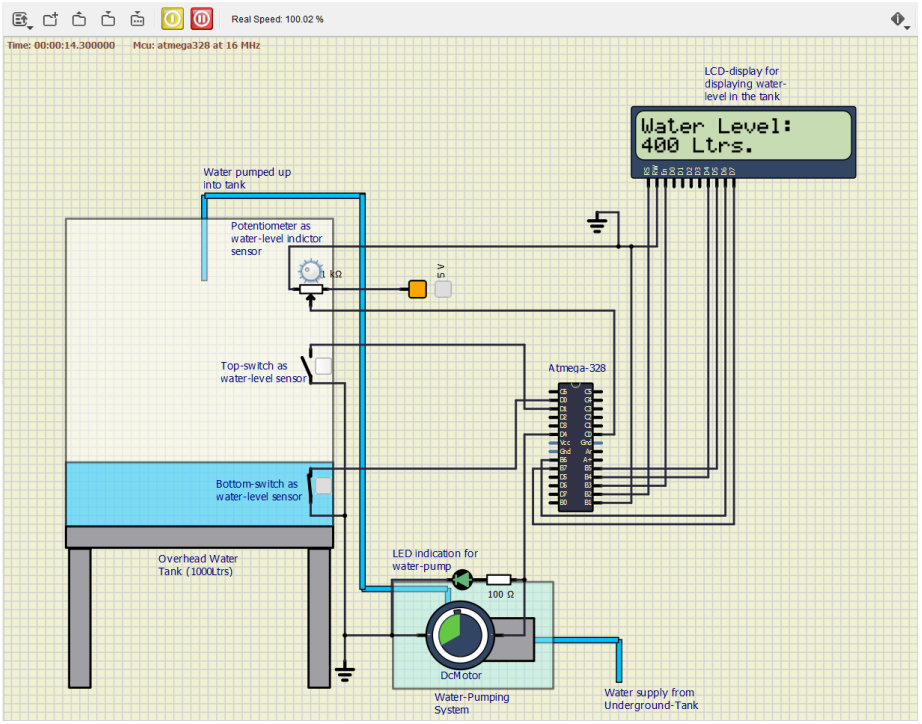
Displaying the water-level present in the tank in terms of litres based on potentiometer input :



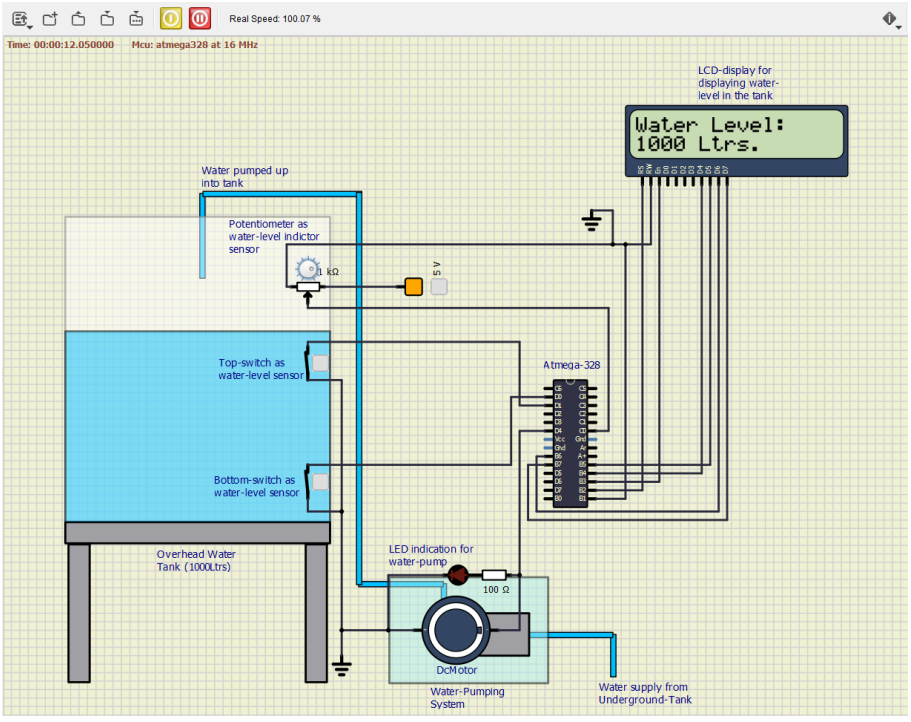
Switches on the water-pump when both the water-level sensors are open :



Switches on the water-pump when bottom sensor is closed and top sensors is open :



Switches off the water-pump when both the water-level sensors are closed :



7. APPLICATIONS

- This system can be used in overhead water tanks in house.
- This system can be used in offices and industries.
- This system can be used in other liquid tanks such as oil, milk. .etc, other than water.

8. LEARNINGS

- Learnt to design circuits effectively in simul-IDE software.
- Learnt to code embedded-c in platform.io in visual studio code.
- Conducted researches on case study.

9. CHALLENGES FACED

- Due to limitations of sensors in simul-IDE software it was bit difficult to design a circuit and build code. The challenge was overcome by replacing the water-level sensor with on/off switch and water-level indicator sensor with potentiometer.

Thank You!