School of Engineering and Applied Science (SEAS), Ahmedabad University

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B.Tech(ICT) Semester I : Electronic System Design(EVD103)

Project Title: Liquid Level Control

Project Report

Submitted in partial fulfillment of the requirements for the completion of course

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ABSTRACT

The system in the project works by taking input values from capacitor as a sensor. The capacitor is placed inside the tank and as the liquid level rises or decreases, the input values from the capacitor change. By calibrating according to user needs, we can set a LOW level, a MID level and a HIGH level. When the level reaches LOW or empty initially, the pump in the main tank will start up and the liquid will flow into the previous tank. User can give input using a switch to decide if he/she wants the tank to be half-full (MID). By default the pump will turn off once the level is HIGH. At some point if user wishes to turn this cycle off, there is a switch which can turn the entire system off. In case of system failure because of faulty components, if the liquid level goes above HIGH, a buzzer will go off as an alarm to the user. For better visual indication, a LED will give respective colors to indicate different levels. Red for LOW, Green for MID and Blue for HIGH. This system can work with any type of liquid as it works on the concept of dielectric medium.

ACKNOWLEDGEMENT

We thank our mentor, Mr. Parth Shah, for his constant guidance and suggestions during the preparation of this project. We extend our gratitude towards Prof. Ashok Ranade and Pratik Trivedi for sharing academic knowledge related to majority of the components which proves to be a vital part in this project. Special thanks to the faculty of Chemical Lab for lending us the lab for recording the project on video. We thank our classmates for lending us components from time to time. Thank you to the ELSD Team for allowing access to lab for several hours and throughout the day.

1. Background and Motivation

1.1 Background

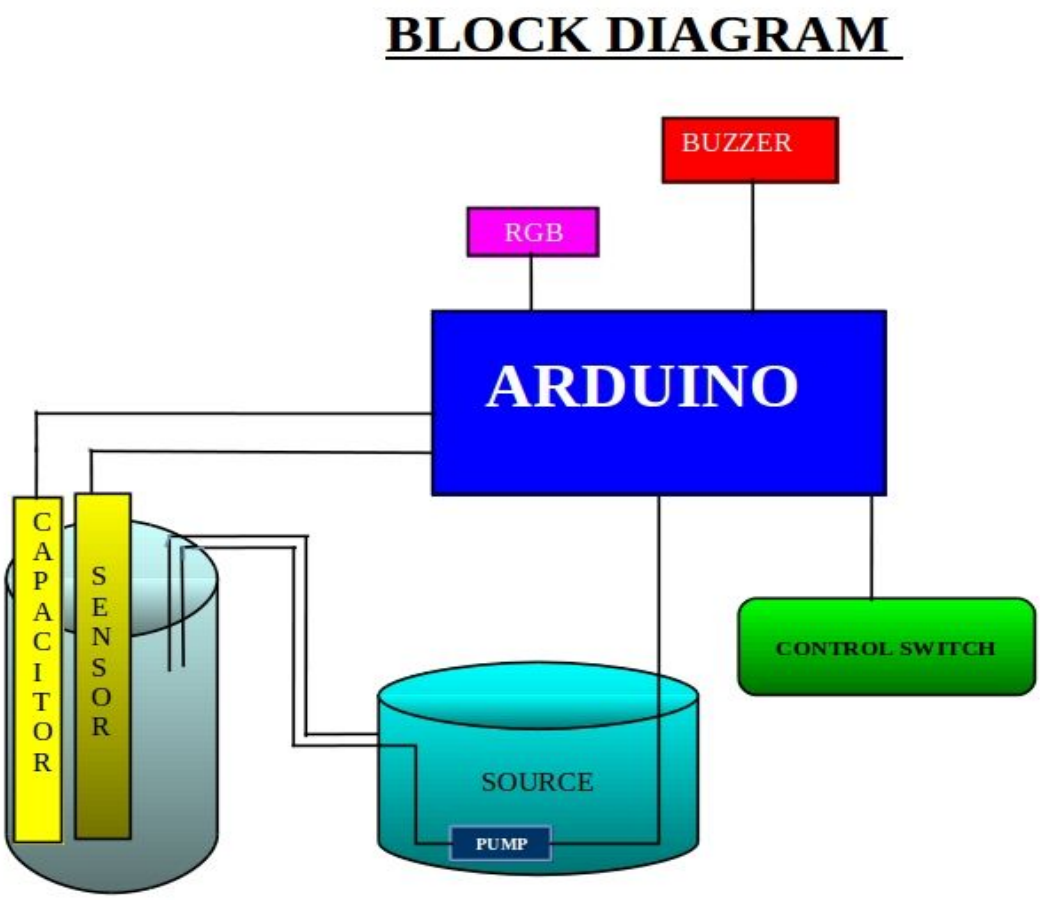
- This type of system based on concept of capacitive sensor is already in use in certain industries in different forms. [1][2].
- There are even other systems to control water pump, which are used in households and also in industry like balloon system and float switch [3].
- These systems are water specific and cannot operate with other liquids.

1.2 Motivation

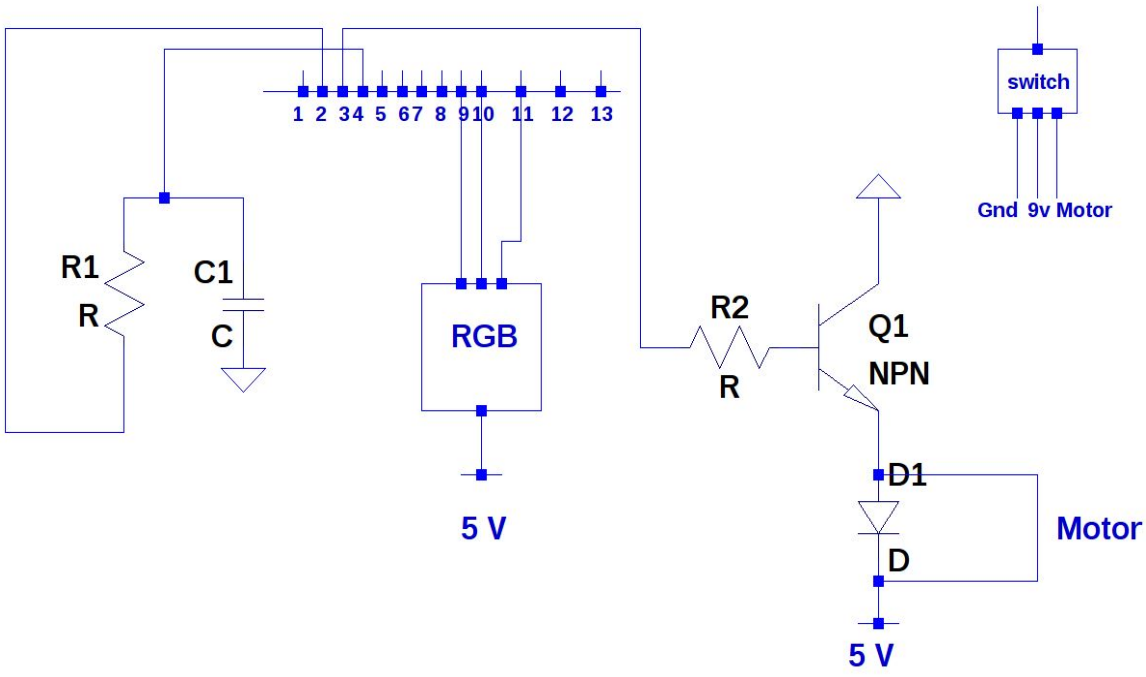
The capacitive sensor technique is liquid independent and can also work with non-metallic liquids. The calibration is not vessel dependent and can be recalibrated for different liquids, based on their dielectric constant. The problem of liquid (water overflow) persists in household and even in industry. This technique is easy to use and maintain even in household, unlike equipment used in industries.

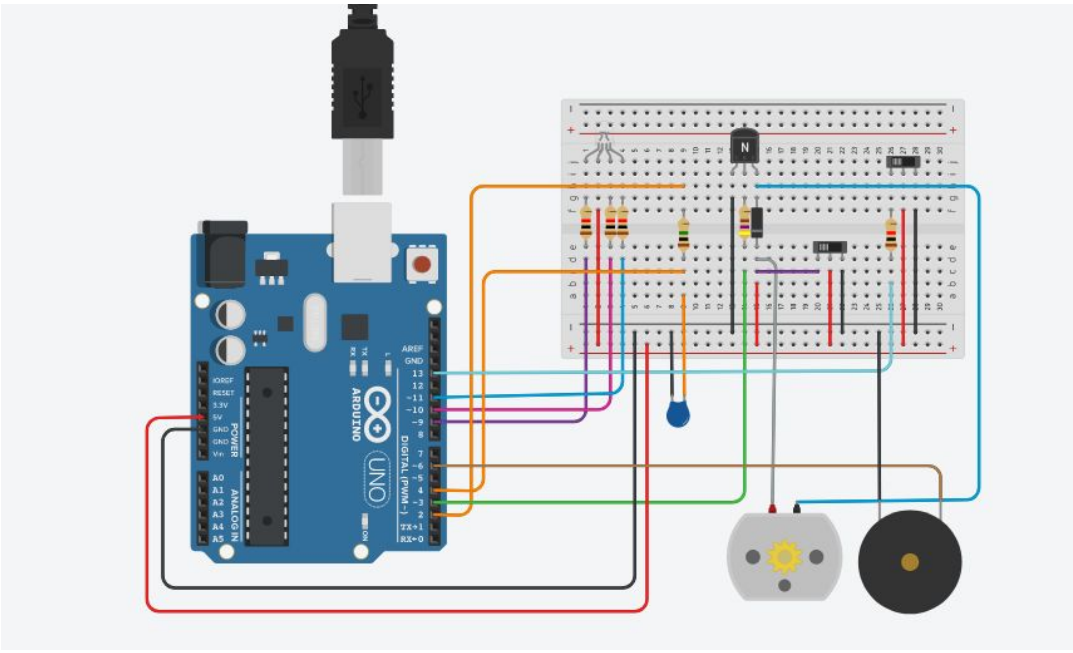
2. System Architecture

2.1 Block Diagram



2.2 Circuit Diagram





3. System Requirements

3.1 Hardware Requirements

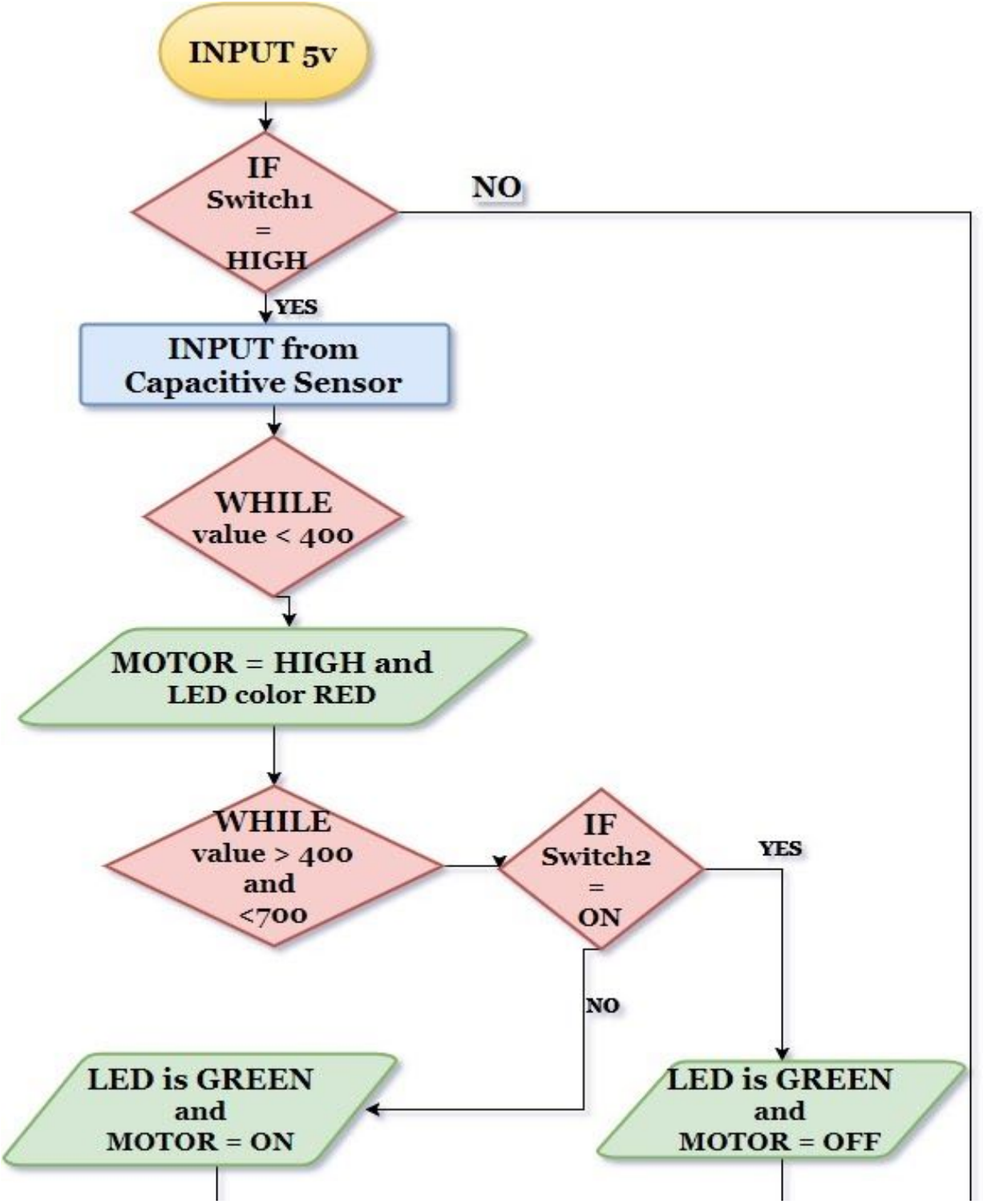
- Arduino UNO
- Capacitor made with plates
- DC Motor Pump
- BC547 NPN Transistor
- Diode
- RGB LED
- SPDT Switches
- Buzzer
- Various Resistors
- USB cable to upload new code

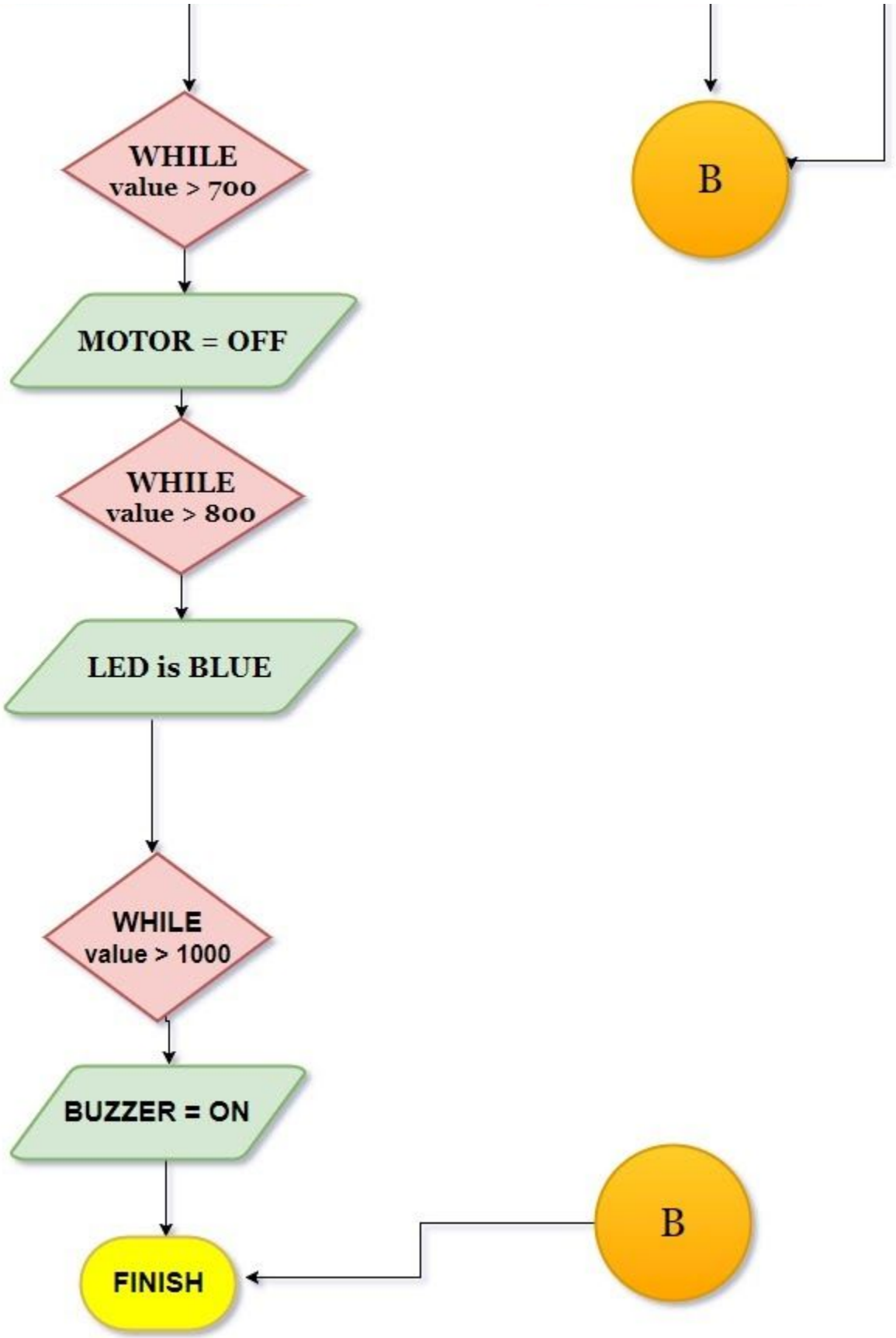
3.2 Software Requirements

- Arduino CC to edit and upload new code
- Serial Monitor facility for calibration

4. System Design

4.1 Flowchart




WHILE
value > 700
MOTOR = OFF
WHILE
value > 800
LED is BLUE
WHILE
value > 1000
BUZZER = ON
FINISH
B
B

4.2 Design Steps

- Statement: Sensing water level and turning motor on or off accordingly
- The Arduino gets input from the capacitor via the CapSense library
- The capacitive Sensor method toggles a microcontroller send pin to a new state and then waits for the receive pin to change to the same state as the send pin.
- The capacitor plates are coated with copper so it acts like an electrode. Coating it with Aluminium foil stabilises the value with less immediate variations.
- The delay between the send pin changing and the receive pin changing is determined by an RC time constant, defined by R * C, where R is the value of the resistor and C is the capacitance at the receive pin.
- Depending on the value returned by the sensor, the pump will turn off or on.
- The switch connected between 5V and Ground can turn system on or off.
- The transistor drives current to the pump through the diode. 5V input and pump are connected across the diode. Thus, the diode can control current and transistor drives the pump.
- The second switch connected to independent 3.3V power and pin 13, can turn off pump at MID level if 13 is HIGH. This, is included in the code.
- The RGB LED works independently based on the code and PWM inputs through pins 9,10 and 11.
- The successful outcome is the pump being turned off at desired level.

5 . Project Outcomes and Challenges Faced

The project is successful in turning pump off at desired level. The desired level is taken from the user.

Challenges like unsure working of components, loose connections and other such component faults were faced. The accurate calibration of the capacitive sensor proved to be a major issue, as charging time of capacitor varied and so did the returned values. Supplying and controlling enough power to the pump is still an issue in the project, which does not allow pump to work up to its full potential.

What we have learned is the necessity of exploring and surveying more to make a project as relevant as possible.

6. Project Cost

Sr. No	Name of Component	Detailed Specifications	Web-link for Price and Specification (If you have)	No of Quantity	Cost per Quantity (Approx.)	Total
1	DC Motor	12V	https://www.amazon.in/SHOPEE-BRANDED-Multipurpose-Brushed-applications/dp/B0714CHK4H/ref=sr_1_1?ie=UTF8&qid=1508748137&sr=8-1&keywords=dc+12+volt+motor	**1**	**200**	**200**
2	Piezo Buzzer	Operating Voltage 3-12V	https://www.amazon.in/pke-Piezo-Buzzer-5-Pieces/dp/B0757KKRC6/ref=sr_1_sc_12?ie=UTF8&qid=1508748243&sr=8-12-spell&keywords=piezzo+buzzer	**1**	**40**	**40**
3	Copper Plate	20cm length*4cm breadth(to be used as electrode)		**2**	**TBD**	**TBD**
4	On/Off Push Button-Switch	12V capacity	http://www.ebay.in/itm/222555884979?aff_source=Sok-Google	**3**	**3**	**9**
5	Resistors	1M ohm	https://www.tanotis.com/products/multicomp-mcmf0w4ff1004a50-metal-film-resistor-1mohm-250mw-1-full-reel?gclid=EAIaIQobChMIgLWL0KmG1wIVQiRoCh1Jkwe4EAQYBSABEgJeWvD_BwE&variant=40452265808	**2**	**1**	**2**
6	Resistor	10M ohm	http://www.electroncomponents.com/10M-Ohm-Resistors	**1**	**3**	**3**
7	RGB LED	5-12V	https://www.amazon.in/Generic-PZIN14016715-Anode-Color-Diffused/dp/B01EE3NJJC/ref=sr_1_5?ie=UTF8&qid=1508746862&sr=8-5&keywords=rgb+led	**1**	**110**	**110**
Total Cost						364 + Cu plate

7. Conclusion

Using Capacitive sensor as a method to check the level of any liquid in a tank and controlling the pump accordingly in order to save the liquid by preventing wastage through overflow and also, conserving energy and electricity in household.

7. References

[1]. “Proximity Sensors: Capacitor”, www.ia.omron.com.

[2]. “Industrial Sensors:Proximity Sensors: Capacitor”, www.pepperl-fuchs.com

[3]. “Float Switch”, en.wikipedia.org, Aug 7, 2017 (last edited)