Level Based Automatic Water Pump Controller

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Abstract—Level Based Automatic Water Pump Controller is a control system which plays a vital role to stop this water and power waste.This device must keep track of the water levels in both the reservoir and the rooftop tank, and regulate the flow of water so that water is always accessible for the consumer. It must be totally self-contained, requiring no human involvement after the first setup. Users require a cost-effective technology that consumes little electricity to ensure low operating expense. Residents' water tanks must be able to fill as much as possible without pulling air through the pump, therefore the system must work correctly. Automatic water level monitor came into existence because of human error and inefficiency that is associated with manually operated water pumping machine.

***Index Terms*—Level Based Automatic Water Pump Controller, control system, water level, power waste, efficiency, overflow, manual water pumping machine**

I. INTRODUCTION

1.1 BACKGROUND OF STUDY AND MOTIVATION

Water is a common chemical ingredient that is most vital to man's survival since it makes up 60% of his body [1]. Despite the fact that water makes up a substantial portion of the earth's mass, it is not easily accessible to man for usage due to its composition and distance from places where it is needed. Excess water use in our planet and communities, whether for domestic or commercial purposes, is a severe problem that plans or systems, such as dams, reservoirs, wells, artificial lakes, and so on, all of which utilize the usage of an electric pump to help transportation during storage and retrieval [2,3].

Nowadays the use of electric pumps to pump to pump water is seen everywhere. But overflow of tanks by water is common because carelessness is causing valuable power waste and water waste [4]. This is because it takes time for a person manually running a water pump to turn off the pumping mechanism, which can result in water spillage, and the person may not realize the water level has dropped so low until the tank is fully empty. This is negatively effecting out society and environment. Most people manually attend to the needs of their water system effectively, many people such as the elderly face physical challenges to successfully maintain the functionality of their water pump system.

1.2 PROJECT OBJECTIVE

The Level Based Automatic Water Pump Controller is expected to achieve the goal of creating an automatic water level control with an automatic control system. The following are some of the goals:

1. To create a water monitoring system that is automated
2. To Incorporate a medium for interaction between the end user and the machine
3. To keep the pumping machine from overworking and being damaged.
4. To avoid wasting water
5. Automatic water level control saves energy because electrical consumption is so high.

1.3 A BRIEF OUTLINE OF THE REPORT

The Automatic Water Pump Controller (AWPC) system keeps track of water levels and adjusts the pump as needed to avoid pump failure and maximize water storage without overfilling the rooftop tank and waste water. This report contain brief description of methodology and technique used. It also contain the simulation, diagram, cost analysis and code which was used in Arduino Uno.

II. Literature Review

People have created techniques to make water delivery to their towns and houses more convenient throughout history. A water storage tank was designed to enable water storage for usage in a variety of applications as the demand for water expanded [5]. Overhead tanks are now used in practically all households and factories. These tanks are refilled with the help of an electric pumping motor, but they also pose a risk of overflow and water loss. To overcome the problem of water overflow in the above tank, many electronic devices have been created. A 555 timer is used in the design of a water level warning circuit. The water level in the overhead tanks is indicated via an integrated circuit. A clear sound was produced by the circuit. According to the design, if the water does not reach the level of the probe, the astable multivibrator of the circuit will not produce any oscillation. As a result, the circuit will not emit any sound. When the water level reaches the probe, current travels through the water, and the circuit produces sound. As a result, an astable multivibrator will oscillate, and the buzzer will beep to signal that the water level has reached a certain level [6].

Another technique was created based on the fact that water is an excellent conductor of electricity. The detecting probes and control circuit detect changes in the water level, and the signals are used to turn the pump motor ON or OFF, depending on the situation. The probe placed in the upper tank sends signal to the NE555 IC controller to act accordingly [7].

Another designer created a device that used an Ultrasonic sensor to monitor and activate pumping [8]. If the tank is empty when the system is turned on, the microcontroller sends a 10-second pulse to the sensor's trigger pin. The sensor then transmits an 8 x 40 kHz sound wave to enable the echo pin, which is then disabled by receiving the reflected sound wave. The distance is calculated by the microcontroller using the time it takes to transmit and receive the sound wave. The pumping machine is automatically switched on and the procedure proceeds if the calculated distance is less than or equal to the specified minimum distance.

Ishwar Chanra Murmu and Laloo Kumar Yadav [9] built an experimental arrangement that includes a motor pump that turns on when the overhead tank is near to dry out and turns off when the overhead tank is close to overflow. Sensors with metallic contacts are employed. The circuit is completed and a signal is created when water comes into touch with these sensors. To obtain the right actuator signal, this signal is passed into a logic circuit. NAND gate is the logic gate that is employed. They concluded by stating that this technique is effective in both rural and urban settings. It helps in the effective use of available water resources. If implemented on a wide scale, it has the potential to make a significant contribution to water conservation for us and future generations.

However, the related works done in the past for a better water management system have some shortcomings which this work will address.

III. Methodology and Modeling

3.1. INTRODUCTION

The level-based automatic water pump controller is a control device that helps to reduce water and electricity waste. The device must monitor the water level in cisterns and roof tanks and regulate the flow of water to ensure that it reaches the customer at all times. After the initial configuration, it should be completely self-contained, with no need for human intervention.The system must function properly in order for the resident water tank to fill as much as possible without drawing air through the pump. Automatic water level gauges were developed in response to human error and the inefficiency of manually operated water pumps.

3.2. Working principle of the proposed project

In this section of report, how the project worked it will be shown.

3.2.1. Process of Work

The pump will automatically start pulling water when the tank is and stop when the tank is full. The pump is made of a stepper motor. The water sensor senses the water level. When the water level increases, conductance also get increased as water is a good conductor. So, the resistance gets decreased. By observing this change in resistance, the water sensor can identify the water level. The motor controller is used to run the motor. Enable pin of the motor is used to control the speed and input1 and input2 pins are used for direction. When the water level is low in the tank, the motor will run and a red LED will be on. If the water level increases to its medium level in the tank, the LED will be on and the motor runs as well. After reaching the highest level of the tank the motor will stop running and the green LED will be on. That's how this automatic level-based water pump controller works.

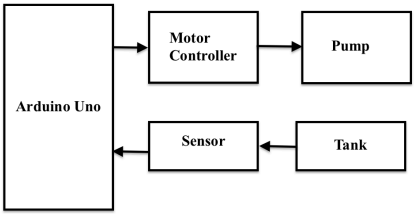

Fig- 1: Block diagram of proposed project .

3.3. Description of the important component

The following components in the constructional setup. The components along with their description is shown below

1.Pump and Adjacent Piping System :

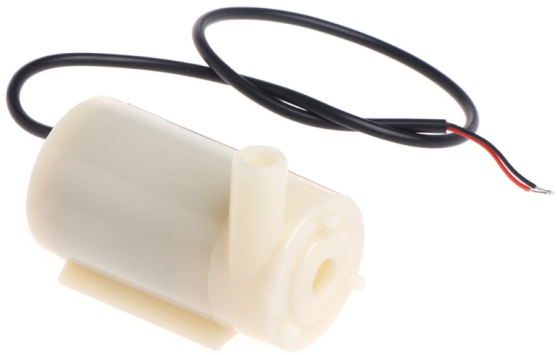

Fig-2: DC 8V 0.3A small 370 Motor Pump

This motor pump given in Fig-1, is a mechanical device that uses mechanical action to move liquids/gases from one location to another. The water pump converts the motor's energy from mechanical to fluid flow as its working principle. This is a stepper motor.

2.Motor driver:

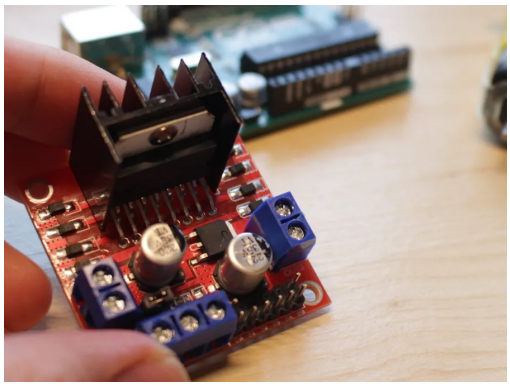

Fig-3: L298N motor driver

This motor driver in fig-2, is a dual H-Bridge motor driver that allows for simultaneous speed and direction control of two DC motors. The module can power DC motors with voltages ranging from 5 to 35V and peak currents of up to 2A. Digital pin was used instead of power pin to power our DC motor or pump. To power through digital input pin it is essential to use motor driver

3.Arduino Uno:

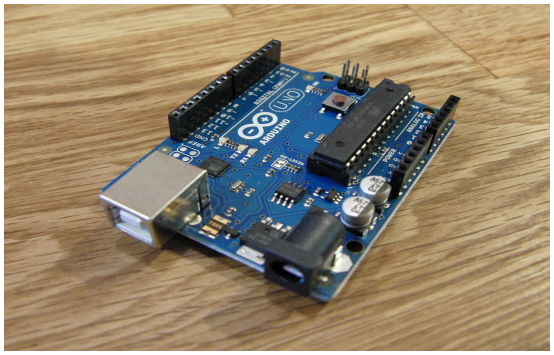

Fig-4: Arduino Uno microcontroller board

The Arduino Uno, from fig-3 is an open-source microcontroller board designed by Arduino.cc and based on the Microchip ATmega328P microprocessor. The board has digital and analog input/output (I/O) pins that can be used to connect to expansion boards (shields) and other circuits. The board features 14 digital I/O pins (six of which are capable of PWM output), 6 analog I/O pins, and is programmable through a type B USB cable using the Arduino IDE (Integrated Development Environment). It can be powered by a USB cable or an external 9-volt battery, with voltages ranging from 7 to 20 volts.

4.LED lights:

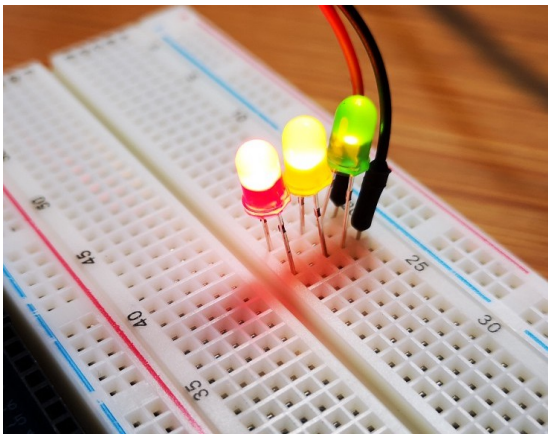

Fig-5: LED light

LED light from fig-4, is a simple light which was turn on by using digital pins on an Arduino Uno board to indicate the level of water in tank.

5. Liquid Level Sensor

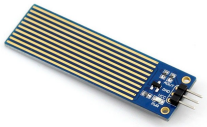

Fig-6: Liquid Level Sensor

From fig-6 when immersed in a liquid, liquid level sensors, also known as liquid level switches, are designed to alter state. They're used to see if a liquid or oil is present at a specific level in a container.

Other components are also used

6. Jumper cable

7. Resistor

8. 2 Tank(In our case 2 bottles/boxes)

9. 9V battery

10. Hose Pipe

11.USB data cable

3.4 IMPLEMENTATION:

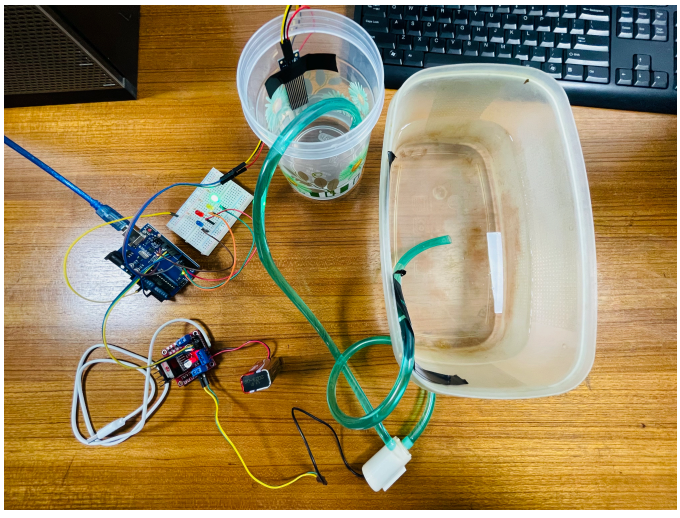

Fig-7: Green light which indicates the tank is Full and motor will automatically turned OFF.

This figure(Fig-7), represent the tank which is Full. And the light also indicates so. Green light indicates the full tank, here the motor will automatically turned off.

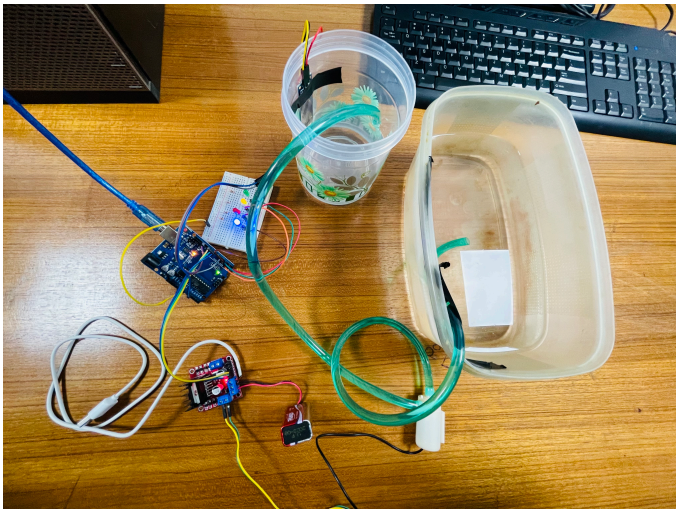

Fig-8: Yellow light which indicates the tank is half-empty and motor will be continuously on.

This figure(Fig-8), represent the tank which is empty. And the light also indicates so. Yellow light indicates the empty half empty tank, the motor will continuously on.

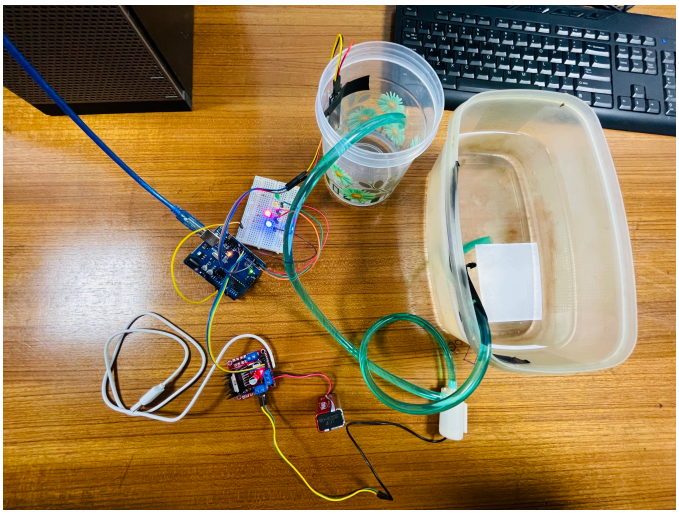

Fig-9: Red light which indicates the tank is empty and motor will be turned on.

This figure(Fig-9), represent the tank which is empty. And the light also indicates so. Red light indicates the empty tank, and the motor will automatically turned on. It will continually pump water until it reaches the condition like figure-7. It will work recursively again and again like an automated machine.

3.5 EXPERIMENTAL SETUP

Motor was connected through motor driver to Arduino Uno. 3 LED light was connected to (2,3,4) digital port. Sensor's was connector to power pin, analog pin and ground.

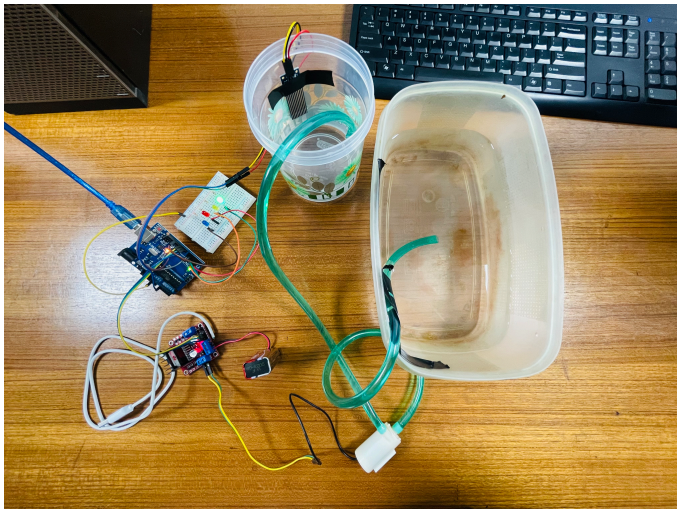

Fig-10: Implementation of the whole project

Three LED light's(Red, green, Yellow) are indicated which level are water in(like figure-7). Pump are connected to motor driver and motor driver was connected to Arduino Uno. Motor driver was powered by auxiliary power(12V). Motor controller enable pin, in1 and in2 was connected to the 9, 10, 11 pins respectively. 2 pipes represent and shows working mechanism of a real life pump which pump water in tank(in this case a box). Water level sensor was setup in tank in measured level. Which send signal to Arduino Uno when it cross given water limitation and it send signal to motor controller and motor controller turn off the motor/pump. A code was used to program our Arduino Uno through a computer which is present in appendix.

3.5 COST ANALYSIS

Here all the components as well as there price is represented in the table.

Table-1: Cost Analysis

COMPONENTS	**PRICE**
Arduino UNO R3	950
Bread Board	80
L298N Motor Controller	150
Liquid Level Sensor	380
DC 6 Volt Submersible Water Pump	95
LEDs	25
Resistors	25
USB data cable	60
Auxiliary Power Cable	40
Jumper Wires	200
9V Battery	40
Hose Pipe	20
Water Reservoirs	200
Travel	142
TOTAL	**2407/-**

IV. RESULT AND DISCUSSION

The water level sensors resentence value is the indicator of water level. Connectivity played a vital role to determine the level by sensor. Because the exposed parallel conductors operate as a variable resistor (similar to a potentiometer) whose resistance fluctuates in response to the water level.
The change in resistance is proportional to the distance between the sensor's top and the water's surface. After the implementation the waster is reduced to 0% because of the sensor. Our result is satisfied and goes as expected.

V. CONCLUSION

The experimental setup for managing the water level has been successfully designed and built. The system was successfully designed for three levels (Low, Medium, High) utilizing the Arduino Uno microcontroller. To manage the water level (low level, medium level and high level) in a tank, an automatic control system was introduced. We gained a better understanding of the problems people confront while trying to stop a water pump after working on this project. The motor controller was needed to stop the pump because pump was powered through a digital pin, not by a power pin. When the water level rises above the set maximum, the digital output turns off the water pump. The system's performance results shows that it is a highly efficient sense that fully removes human interaction while also improving the pumping machine's workable lifespan. When the tank is full, the Automated Water Pump Controller sensor detect water level and it will stop pumping water by stoping the pump. Therefore, the Automated Water Pump Controller will be an excellent gadget to every household and industries.

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Appendix

```
/* Change these values based on your calibration values */
int lowerThreshold = 420;
int upperThreshold = 520;

// Sensor pins
#define sensorPower 7
#define sensorPin A0

// Value for storing water level6
int val = 0;

// Declare pins to which LEDs are connected
int redLED = 2;
int yellowLED = 3;
int greenLED = 4;
int pump = 5;

//motor A
int enA=9;
int in1=10;
int in2=11;

void setup() {
  Serial.begin(9600);
  pinMode(sensorPower, OUTPUT);
  digitalWrite(sensorPower, LOW);

  // Set LED pins as an OUTPUT
  pinMode(redLED, OUTPUT);
  pinMode(yellowLED, OUTPUT);
  pinMode(greenLED, OUTPUT);
  pinMode(pump, OUTPUT);

  // Set motor pins as an OUTPUT
  pinMode(enA, OUTPUT);
  pinMode(in1, OUTPUT);
  pinMode(in2, OUTPUT);


  // Initially turn off all LEDs
  digitalWrite(redLED, LOW);
  digitalWrite(yellowLED, LOW);
  digitalWrite(greenLED, LOW);
  digitalWrite(pump, LOW);
  analogWrite(enA,250);
}
void loop() {
  int level = readSensor();

  if (level == 0) {
    Serial.println("Water Level: Empty    Pump : ON");
    digitalWrite(redLED, LOW);
    digitalWrite(yellowLED, LOW);
    digitalWrite(greenLED, LOW);
    digitalWrite(pump, HIGH);

    //motor A forward

    //analogWrite(enA,0);
    digitalWrite(in1,HIGH);
    digitalWrite(in2,LOW);
    analogWrite(enA,250);
    delay (200);
  }
  else if (level > 0 && level <= lowerThreshold) {
    Serial.println("Water Level: Low    Pump : ON");
    digitalWrite(redLED, HIGH);
    digitalWrite(yellowLED, LOW);
    digitalWrite(greenLED, LOW);
    digitalWrite(pump, HIGH);

    //motor A forward

    //analogWrite(enA,0);
    digitalWrite(in1,HIGH);
    digitalWrite(in2,LOW);
    analogWrite(enA,250);
    delay (200);
  }
  else if (level > lowerThreshold && level <= upperThreshold)
{
    Serial.println("Water Level: Medium    Pump : ON");
    digitalWrite(redLED, LOW);
    digitalWrite(yellowLED, HIGH);
    digitalWrite(greenLED, LOW);
    digitalWrite(pump, HIGH);

    //motor A forward

    //analogWrite(enA,0);
    digitalWrite(in1,HIGH);
    digitalWrite(in2,LOW);
    analogWrite(enA,250);
    delay (200);
  }
  else if (level > upperThreshold) {
    Serial.println("Water Level: High    Pump : OFF");
    digitalWrite(redLED, LOW);
    digitalWrite(yellowLED, LOW);
    digitalWrite(greenLED, HIGH);
    digitalWrite(pump, LOW);

    //motor A stop

    analogWrite(enA,0);
    digitalWrite(in1,HIGH);
    digitalWrite(in2,LOW);
    analogWrite(enA,0);
    delay (200);
  }
  delay(1000);
}

//This is a function used to get the reading
int readSensor() {
  digitalWrite(sensorPower, HIGH);
  delay(10);
  val = analogRead(sensorPin);
  digitalWrite(sensorPower, LOW);
  return val;
}
```