Smart Water Control with IOT And Cloud Computing

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Abstract--- In this paper, we bring about the idea of water level monitoring and controlling with *IOT* and *Mobile applications*. The vast amount of water wasted in the current scenario, mostly due to overflowing tanks is not acceptable. Existing water tanks control systems can monitor and control the *water level* in tank, which leads to reduction in amount of wastage of ample water but the type of sensors which are used in such a system does not specify exact changes in water level leading to unstable control parameters. Other technologies had some drawbacks based on speed of detection and approximation of sensor data. The need of improvement of these short-comings and providing an accurate and ethinic solution has been the main aim of this project. The project has been further improvised by using electronic water level sensors which uses potentiometric techniques to measure water level in water tanks, along with ultrasonic sensors for better metrics and control. Further up, this project can be implemented on large scale to control and detect rising water levels in dams and reservoirs to avoid flash floods and excess pressure in dams. The proposed system will help to identify the smallest changes in water level in case of rainfall measurement as well.

Keywords--- Cloud Computing, Internet of Things (IOT), Water control, Potentiometric Sensors, Arduino, Flood control, Android Application, ZigBee network.

I. INTRODUCTION

To say that water is an important resource would be an understatement. It is the elixir that grants us life itself. Despite most of the planet being covered in water, only a small percentage is fit for our consumption and use. As such it is of paramount importance to manage this resource and use it judiciously. With the help of IoT and cloud, we can create a smart water level control system. Utilizing both electronic potentiometric sensors and ultrasonic sensors, we can measure even the smallest changes in water level. As such, this system can be implemented at various places tailoring to different needs. With the help of cloud technology, we can provide users with immediate alerts.

Mobile application for domestic use can provide users with immediate alerts, as well as provide accurate readings regarding change in water level. Such systems can be utilized in a variety of fields. Such systems can be used in industries, for domestic application, to measure rainfall or even in dams and water reservoirs. All parameters are hence tailor made as per the consumers' requirements.

II. RELATED WORKS

- In the paper presented by Amogh Jayaraj Rau et. Al [5] introduces an innovative approach towards water control systems, but lacks accuracy due to less efficient ultrasonic sensors which usually give random readings.
- In the second paper by M Suresh et. Al [6] we saw an innovative approach towards controlling public water distribution, which can also be used in our project as an addition.
- The paper presented by Elias Farah and team [IEEE 2] explains the detection of water leaking using electrical contacts which is the main derivative as potentiometric prongs in our project.
- The concept explained by Teddy Mantoro et. Al [IEEE 2] has covered the concepts for a closed surface area like a bathtub but does not give any provocative solution for large scale operations.
- Purification of waste water is also a good concept in addition to controlling water resources, hence the paper by Md Nasir Sulaiman and team [3] gives us a way not only to control but improve water resources drastically.
- All Papers explain concepts but have a certain drawback, the sensors that they use are all outdated and slow, but our systems use fast potentiometric sensors which respond to even the smallest stimuli.

III. TECHNIQUES AND CODING

Water control has been previously discussed and implemented a plethora of times before, but every time a new technology is established, the system is improvised in some or the other way. In this paper we have implemented the existing sensing system with an improvised sensor combination, consisting of potentiometric water sensor and ultrasonic sensor which improvises the data collection and comparison.

As we can see from the graph [Fig.1], data generated by the ultrasonic sensor is not consistent and can lead to faulty control. This occurs due to various reasons like:

- Environmental causes
- Sensor Fault
- Interference in LOS (Line of Sight)
- Insufficient power supply

But on the other hand, the data set obtained from the water sensor based on potentiometer generates much more stable and accurate measurements which helps take better decisions in case of control.

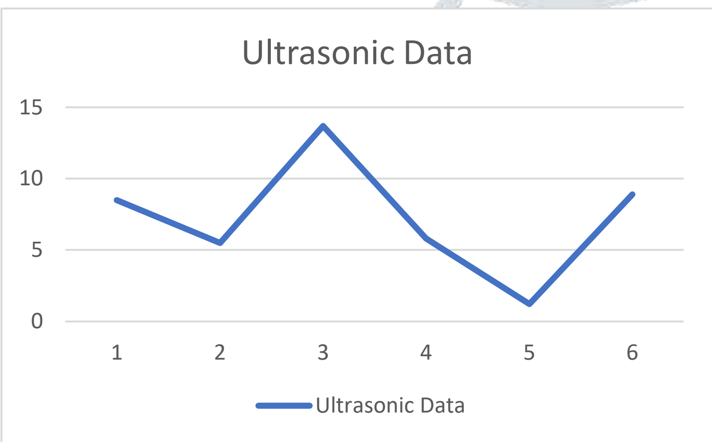

Fig.1 Ultrasonic Data Set

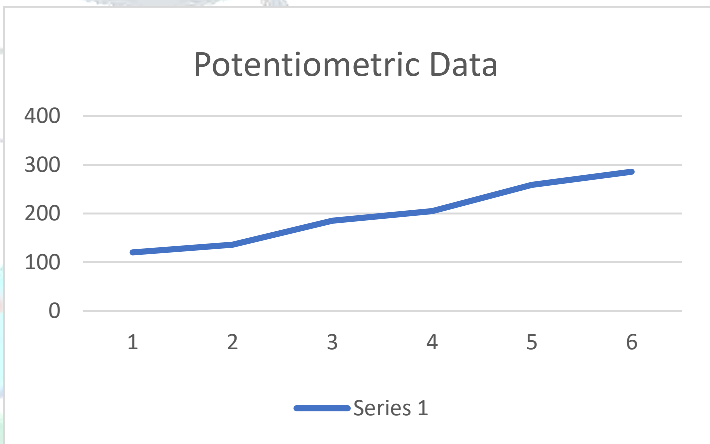

Fig.2 Potentiometric Data Set

A. Water Control Algorithm: (Proposed)

Step 1: Read the data set from the microcontroller and assign to respective variables.

Step 2: If the input value is greater than the threshold value, sends stop signal and updates flag variable.

Step 3: If the input value is lower than the threshold, then continually updates the sensor value as percentage to the cloud server.

Step 5: If the input is less than the lower threshold, updates empty flag and sends start signal to the pump controller.

Step 6: If sensor data set is null, report error and exit the program flow.

Step 7: If no error then send data to cloud and exit the flow.

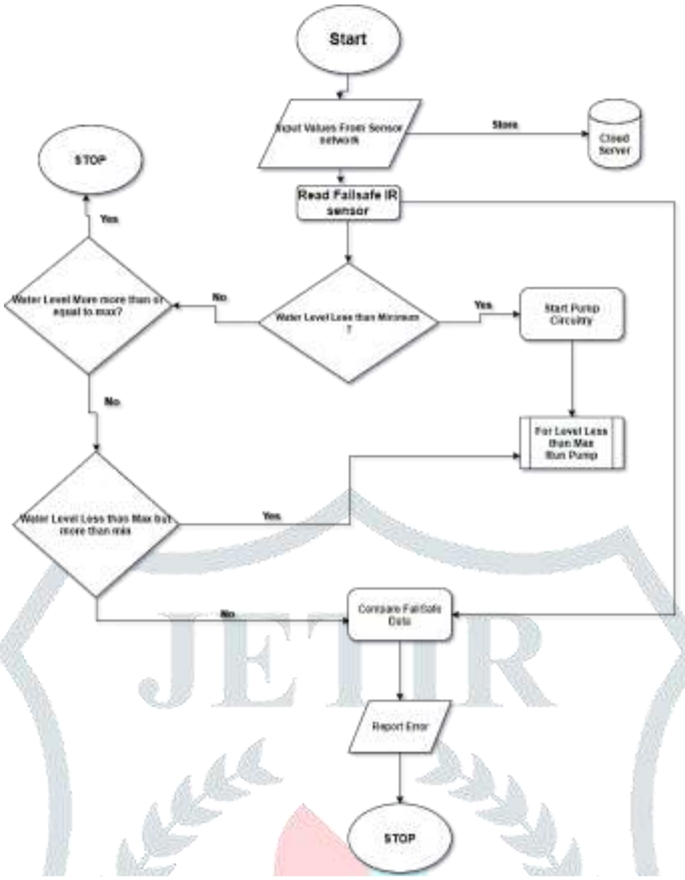

Fig. 3 Proposed Algorithm Logic

A. Arduino Code: (Proposed C++ based)

```
#define led1 9
#define led2 2
#define echo 10
#define trig 11
#define vol 0.06
#define maxheight 8
#define lbound 1
#define irout 6
#define alert 7

void setup()
{
  Serial.begin (115200);
  pinMode(trig, OUTPUT);
  pinMode(echo, INPUT);
  pinMode(led1, OUTPUT);
  pinMode(led2, OUTPUT);
  pinMode(irout,INPUT);
  pinMode(alert,OUTPUT);
  pinMode(LED_BUILTIN, OUTPUT);
}

void loop()
{   long duration;
```

```
  long distance=0.00;
  int obs = HIGH;
  float perc;
  int waterSensor = analogRead(A0);
 digitalWrite(trig, LOW);  // ultra-ON
 delayMicroseconds(2); // delay
 digitalWrite(trig, HIGH);//ultra-OFF
 delayMicroseconds(15); // delay
 digitalWrite(trig, LOW);
 duration = pulseIn(echo, HIGH); //echo - read pin
 distance = (duration/2) / 29.1; //calculation
 obs=digitalRead(irout);
 Serial.println(distance);
 Serial.println(waterSensor);
 if ((distance < lbound)||(waterSensor>=281)) {
   // This is where the LED On/Off happens
   digitalWrite(led2,LOW);//green led OFF
   digitalWrite(led1,HIGH); // When the Red condition is met, the Green LED should turn off
 Serial.println ("Water Level Extremely High!! Water Stopped!");
}
 Elseif ((distance<=maxheight)&&(distance>=lbound)||((waterSensor>18)&&(waterSensor<280)))
{
   digitalWrite(led1,LOW);
   digitalWrite(led2,HIGH);
   tone(alert,1000);
   delay(50);
   Serial.println("Water is filling UP!!    ");
   perc = (waterSensor/320)*100;
   Serial.print(perc);
   Serial.println("%");
  }
 else if ((distance > maxheight)||(waterSensor<18))
  {
   digitalWrite(led1,LOW);
   digitalWrite(led2,HIGH);
   Serial.println("Water Level Extremely Low!!");
  }
 else if((distance=0.00)&&(waterSensor==16))
  {
   Serial.print("Sensor Error");//comment for sensor error
   digitalWrite(led1,HIGH);
   delayMicroseconds(15);
   digitalWrite(led1,LOW);//both leds blink when error is caught
  }
 delay(1500);
}
```

The percentage calculation is done by a simple formula by analysing the upper bound of the water sensor and dividing the current sensor value by it.

$$\frac{Sensor_{value}}{Upper_{bound}} * 100 \quad (1)$$

When plotted in line plot, percentage can be plotted [using (**1**)] in a straight line. This shows the percentage varies linearly with value [Fig.4].

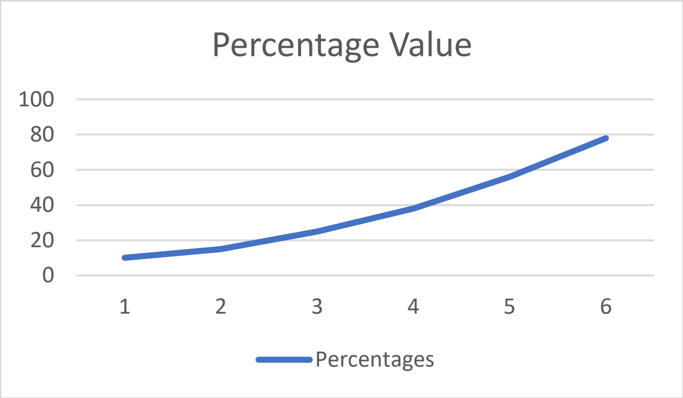

Fig.4 Percentage Plot

IV. SMART WATER ARCHITECTURE

The system consists of 4 major parts:

1. User
2. Smart water hardware
3. Cloud Services
4. Water Control Algorithm

User contacts the cloud service using mobile application. The water control parameters are recorded using ultrasonic and potentiometric sensors which is read by the Arduino. Based on the prespecified constraints, the values are compared and further action is decided. Also, the data is transferred to cloud like *ThingSpeak* or *FireBase* using *Node MCU ESP 8266*.

ESP 8266 uses push-pull model to upload data to cloud. The ESP 8266 is connected to the Arduino Uno by using 3.3V connection. TX, RX pins are connected to the Pins 0 and 1. The ESP 8266 is connected to all the sensors through the Arduino. All decisions are taken by the Arduino and the updated variables are transferred to the cloud by using the Wi-Fi module [Fig. 5].

In this project Arduino D1 R2 has been used for easier interfacing and communication with the ESP module. Using the built-in commands and AT commands, the system directly responds to requests generated by the subsystem.

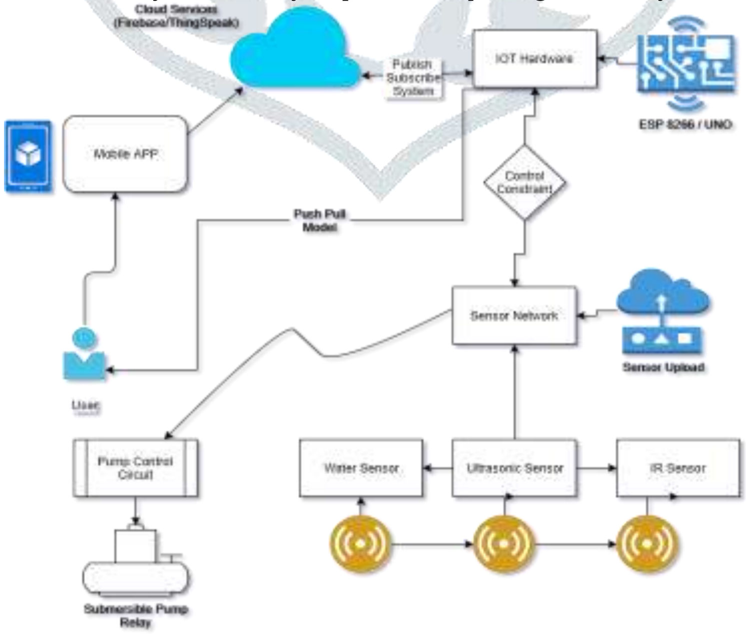

Fig.5 Smart Water System Schema

V. SYSTEM IMPLEMENTATION

The system when implemented successfully consists of four hardware and three software components:

Hardware:

- **Arduino:**
  Microcontroller based logic board with low power consumption.

- **Node MCU ESP 826x:**
  Controls the data upload to the cloud servers and accepts AT commands.

- **Ultrasonic Sensor:**
  Calculates water level using sonar properties in air-water interface.

- **Water Sensor:**
  Uses the conductivity of water to detect the level of water by means of potentiometric measurement.

Software:

- **Cloud Services:**
  Cloud Services like Thing Speak or FireBase are used to store the data collected by the sensors to maintain a link with the mobile application.

- **Water Control Algorithm:**
  Controls and coordinates the complete function of the system

- **Mobile Application:**
  Made for all round control of the system and user convenience, smart and clean app for Android, developed using Android Studio and Kotlan.

There are three activities of the app, the Main Activity, the control page and the news and alerts page. The main activity consists of the selection page between the news and the controller. Also, the main activity is overlaid by a login/signup page. [Fig.7] The controller page consists a numeric analog meter which depicts the percentage filled and time remaining. The final activity is the news activity and it consists the latest news about meteorological department and other important announcements from the developers.

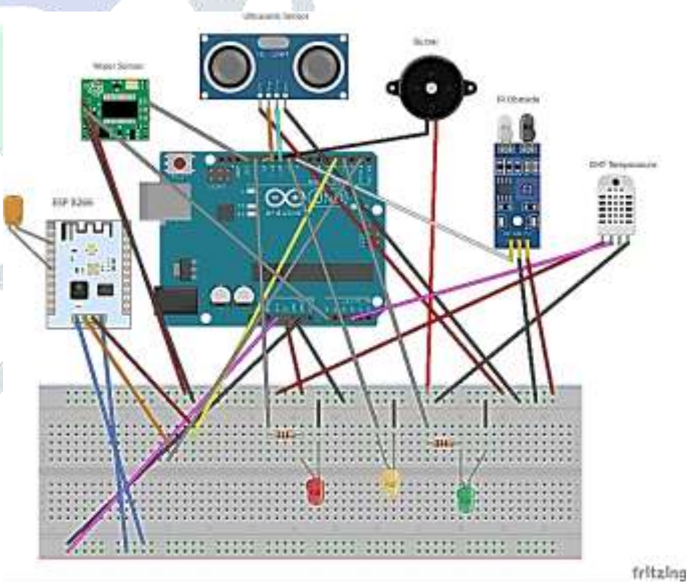

Fig. 6 PCB Design

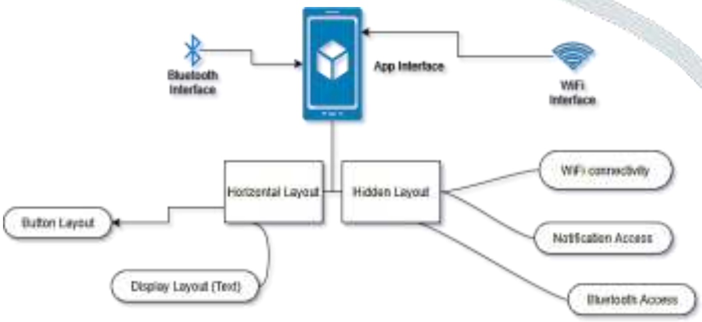

Fig. 7 App Layout

The App also involves hidden layouts and access permissions like Bluetooth access, Wi-Fi access, mobile data access and continuous active status control. The Login Page [Fig.8] has been given here as a screenshot as well the controller page [Fig.9] has been presented as a screenshot in the next section. The final system accesses the system variables from the cloud using the API read key and uses Write Key to reply to the microcontroller.

Fig. 8 Login Page

Fig. 9 Control Page

VI. CONCLUSION & FUTURE WORK

Hence, we conclude that the existing systems for water control and flow detection have successfully been implemented and the results and proposed design has been mentioned in the paper. Also, by adding better sensors this project can be further improved and the sensing times can be reduced. Using advanced mapping sensors like *LIDAR* which are powered by laser light can scan a subject in a jiffy and control the system with more efficiency and accuracy.

VII. REFERENTIAL ACKNOWLEDGEMENT

The team of authors would like to wholeheartedly thank **Ms. A. Shiny** and **Dept. of Computer Science** for guiding and supporting us throughout the project and making it a successful one. With due respect we would also acknowledge any further work that they contribute towards this project.

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