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Smart Water Flow Monitoring

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Abstract

Water is one of the most essential resources on our lovely planet. Without water we are like a cactus in a desert. In today's world the availability of water is less yet the wastage of water is more. Several automations arose to save water as smart as possible. In this project, we have included water level monitor in the tank and also focusing on the flow of water through the pipes. For example, if a boy forgot to close the tap after using the water will be wasted continuously, this may lead to lot of water usage and today's scenario the ground water level is being depleted drastically than the normal. Thus, the wastage of water through human errors gains the importance of water conserving. We have developed a model to analyse and alarm the user that the water is wasted and thus the user can monitor and save the water flow. It will be efficient in preserving the water that is being wasted and also makes us explore other possibilities of saving the water and conserving them.

Keywords: Water, Waste, Consumption, Saving

1. Introduction

High-cost to low-cost conversion is an essential feature in today's world. Many homes are and offices are demanding for a water conservation yet the tech is high cost for the people to buy and every human being knows that wasting money on some tech that are too cost to buy is unnecessary, thus the tech is not successful in many markets[1-5]. In the home, water is being wasted due to lack of attentiveness so that the people always wake up in the middle of the sleep to check whether the water is prevented from being wasted and also while in jobs they may get the thinking of whether we closed the tap or not and thus not doing the job. Thus, we need the computerization to save the water leakages by b by managing the leakage water. Thus, water is saved a lot before and thus users can do their work happily. IoT which is abbreviated as Internet of Things, which deal with real-time data and internet technology which manages the water wasting in the real-life areas such as home and office. Real-Time otherwise called present data is an intelligent idea[21-23] in water monitoring system because the water demands to monitor continuously thus making sure that the flow of the water is not wasted and leakage of water in unwanted areas and finding the outliers of the usage of water[6-8]. The existing system the water is monitored and says the water is leaked here. The machine learning model used is of R-Clustering model and Ada boost technique to find the Accuracy of water leakage in the model. However, in this project, we have used Anomaly detection to detect only the outliers of the normal data [9-11]. It also says with the help of transmitter and helps with the exact location of the leakage and deals with it [12-18].

Here we proposed a simple solution, regardless of detecting the leakage we are trying to stop the water flow and helps the user to know that there is a leakage and the water is stopped. We are developing an android app

for the user to interact with the model and so that it will be user friendly to know whether the leakage found or not. It is efficient as the previous model says the location alone whereas in this project, we are trying to make the project to act on its own when the water is used in unaccounted time.

Our system includes Hardware components like (Arduino UNO, NanoESP 8266) microcontroller boards and ultrasonic sensor and flow meter to measure the water leakage and electric solenoid valve for controlling the water flow.

3. System Design:

The design to perform all decided the tasks divided into binomial parts, component system and computer system. The component system includes modules such as water flow sensor, microcontroller, Ultrasonic sensor, wifi-modulor) and Android Smartphone. The computer system consists of Arduino IDE for embedded system into microcontroller and android application for displaying the level of the water in the tank and also to control the water flow by the buttons and also giving a user-friendly chart for the user to get clear view of the data and when it is being wated the most time.

4.Component Design:

This design uses a water flow sensor type HZ21WA which works on Hall-effect method for detecting the flow rate. The Hall-Effect is generally described as a potential difference across an electrical conductor when a magnetic field is applied in a direction perpendicular to that of the flow of current. Hz21WA was provided with a propeller to measure the rate of flow. The water flow rate will eventually alter the rotating speed of propeller. The rotation tells us when the water flows through the propellor it gives electrical pulses. This electrical signal acts as a frequency pulse which is directly-related to the rotation of propellor with the water flow. It works with high-speed operation over 100 kHz. Then, the water flow data is processed on microcontroller.

The WIFI-Module is serially connected with Arduino uno to transfer the data from Uno to NodeMcu and it acts like a WIFI module so the data is sent to the server and analysed and sent to the API for the user to interact.

Then the data is transferred to the Firebase Server. It offers real time database, different APIs, multiple authentication types and hosting platform and also has built in ML- Model. The data is then monitored and analysed with the built in ML model in Firebase Server to analyse the data and check if the flow of water and if there are any outliers it will inform the user through the application built in Android API.

5. Software Design:

The computer design is constructed by Arduino IDE which stands for Integrated Development Environment for linking the program with microcontroller and Android Studio. These computer software's are easy to alternate and coded as per the needs of the user. Arduino IDE is a free coded software for embedded system. It is very happy go-lucky to code and upload into microcontroller. Arduino IDE is compatible with all the Operating system and supports all the user developing hardware's.

Android Studio is a programming platform for evolving Android application. It is comfortable to code to build android application of the developer thoughts which will make lot of users to happily use and the coding in this platform supports computer languages such as JAVA and KOTLIN.

Table 1. Specifications of parameters employed in water flow monitor

Flow Meter	• Model: SEN-HZ21WA • Working range: 1-30L/min
Microcontroller	• Arduino UNO • Node MCU ESP8266
Ultrasonic Sensor	• Operating Voltage: 5V DC • Operating Current: 15mA • Measure Angle: 15° Ranging • Distance: 2cm - 4m
Electric Solenoid	• 12V DC operating voltage.

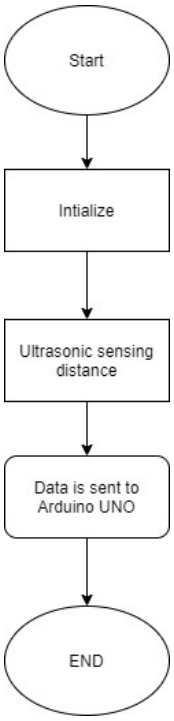

Figure 1.FlowChart for Implemenation of Ultrasonic sensor with Microcontroller.

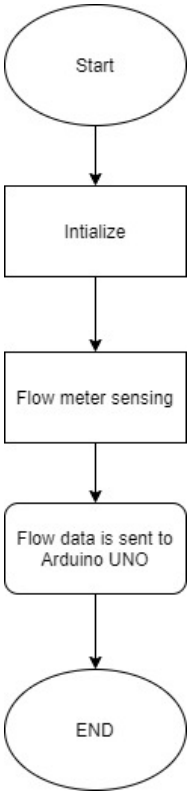

Figure 2. Flow chart Implementation of Arduino for Water Flow

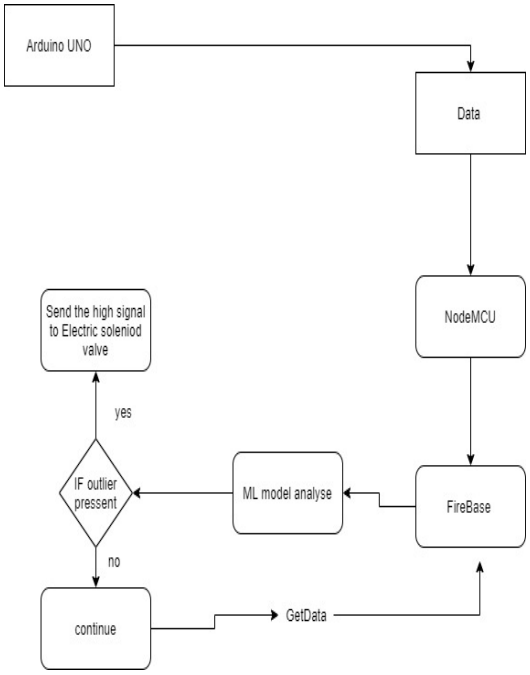

Figure 3 .Flow chart Implementation of Data Firebase

The first flowchart describes how the Sensor data is transferred to the Arduino. The second flowchart describes the way the flow meter readings that are transferred to the Microcontroller. The microcontroller is paired with WIFI-Module using Serial Monitor. The third diagram says how the data is transferred to the NodeMcu and to the Server (Firebase) and the ML model calculations are done.

6. Results and Clarifications

6.1. Experimental Set up

The first method of this project starts with attaching the home tank and giving the height of tank to the app developed to inform the developed model to work on the idea based on the height rather than setting to default height. Then the flow meter is connected to the water pipe flowing area to measure the water rate flow. When water flows, the propellor rotates whereas the velocity of water is equal with rotating speed of the rotor. Propellor gives an Electric Pulse which is measured using microcontroller's digital Pins. The pulse signal produced is directly proportional to the frequency with flow [1] which is calculated and converted to flow rate by the microcontroller using Arduino Ide platform. By adding to it, the water flow system is controlled on anomaly ml model which is deployed in the Firebase built in ML model. This Components with the computer system are developed by the modules water flow sensor, microcontroller, WIFI-module. Here Ultrasonic sensor is also used for the detection of water level in the home tank and calculated the distance by IDE.

The Controlling process plays a major role in this project to make accurate readings which are suitable for the real-world condition. The controlling process is used to scale the water flow measurement in this system by analysing it with manual measurement of water flow using manual water flow pipe. The conversion of flow data to flow rate uses a multiplication factor for precise readings. The following table depicts the scaling of data with multiplication factor. Based on scaled data from table, the product factor 3.4 is the best flow measurement using the HZ21WA as it is the closest to the real-world measurement.

The accepted value of multiplication factor for 1.5 litre/minute is 3.4.

The water flow sensor is 1.52 per litre/minutes.

Table 1 Actual with Sensor Data Comparison.

Multiplication Factor	Water flow Sensor (Litre/minute)	Actual Measurement (Litre/Minute)
3.0	1.23	1.5
3.2	1.345	1.5
3.2	1.432	1.5
3.3	1.67	1.5
3.4	1.52	1.5

Figure 4. Real time application deployed(1)

6.2 Android Studio

Android IDE is used data monitoring and this system was developed to get an accurate reading from the Arduino IDE platform and this IDE is simple, user friendly, real-time data Acquiring from the Server and connect with the internet. The smartphone which supports android whose requirements for run the system are Firebase and data communication because it designs for both communications.

The page starts from getting the input of how much the litre of tank capacity and the next page tells the user with two different options of Water flow monitor and Flow meter monitor. The water flow monitor page gives the user how much the water Is there in the tank and also has start and stop button for communicating with the motor relay.

The flow meter tells us the graph of the flow with the real time and also tells if the Solenoid valve is closed due to exceeds water flowing at that time.

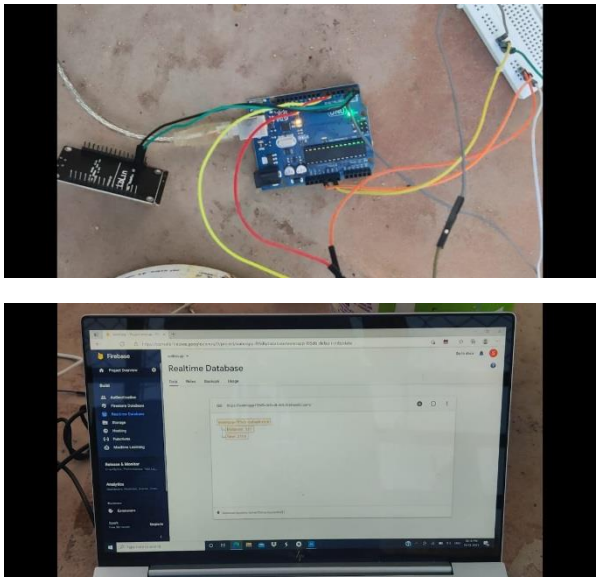

Figure 5. Real time application deployed 2

The code here is HZ21WA Water Flow Sensor. It is coded in the Arduino IDE and deployed with serial monitor of Nodemcu. Here attached codes for Serial Monitor.

6.3 Coding Of Arduino Ide of Micro-Controller

```
const int pingPin = 7; // Trigger Pin of Ultrasonic Sensor

const int echoPin = 6; // Echo Pin of Ultrasonic Sensor

unsigned long timeNow = 0;

unsigned long timeLast = 0;
```

```
int startingHour = 12;
int seconds = 0;
int minutes = 01;
int hours = startingHour;
int days = 0;
int flowPin = 2;
double flowRate;
volatile int count;
int dailyErrorFast = 0;
int dailyErrorBehind = 0;
int correctedToday = 1;.
void setup() {
pinMode(flowPin, INPUT);           //Sets the pin as an input
  attachInterrupt(0, Flow, RISING);
  Serial.begin(9600);  //Start Serial
}
void loop() {
  String s="";
  timeNow = millis()/1000;
seconds = timeNow - timeLast
if (seconds == 60) {
  timeLast = timeNow;
  minutes = minutes + 1;
}
```

CODING OF ARDUINO IDE OF WIFI-MODULE

```
  #include <ESP8266WiFi.h>
#include<SoftwareSerial.h>
#include <FirebaseArduino.h>
SoftwareSerial myserial (D1, D2);
#define WIFI_SSID "*****"
#define WIFI_PASSWORD "*****"

void setup() {
```

```
  Serial.begin(115200);
  myserial.begin(9600);
   // connect to wifi.
  WiFi.begin(WIFI_SSID, WIFI_PASSWORD);
  Serial.print("connecting");
  while (WiFi.status() != WL_CONNECTED) {
   Serial.print(".");
   delay(500);
  }
  Serial.println();
  Serial.print("connected: ");
  Serial.println(WiFi.localIP());
    Firebase.begin(FIREBASE_HOST, FIREBASE_AUTH);
}
void loop() {
String msg = myserial.readStringUntil('\r');
int delimiter, delimiter_1, delimiter_2;
delimiter =  msg.indexOf("%");
delimiter_1 = msg.indexOf("%", delimiter + 1);
delimiter_2 = msg.indexOf("%", delimiter_1 +1);
String first = msg.substring(delimiter + 1, delimiter_1);
String second = msg.substring(delimiter_1 + 1, delimiter_2);
int f = first.toInt();
int s = second.toInt();
}
```

6.4 Application Deployed Sample

The following pictures shows the user-friendly app developed for the users. Here the data's that are recorded are used for chart isolations.

The chart is deployed in the android studio by using MPchartAndroid.

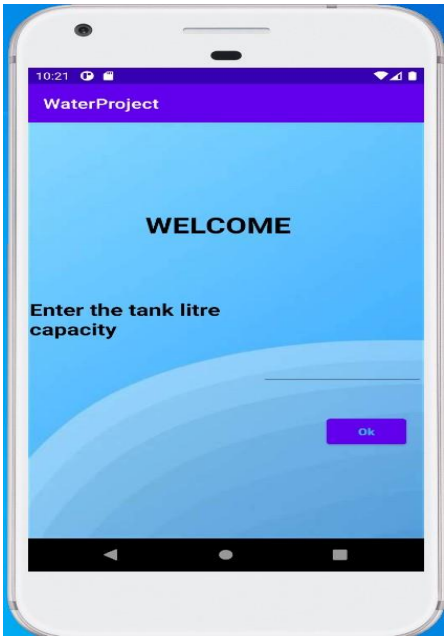

Figure 6.1

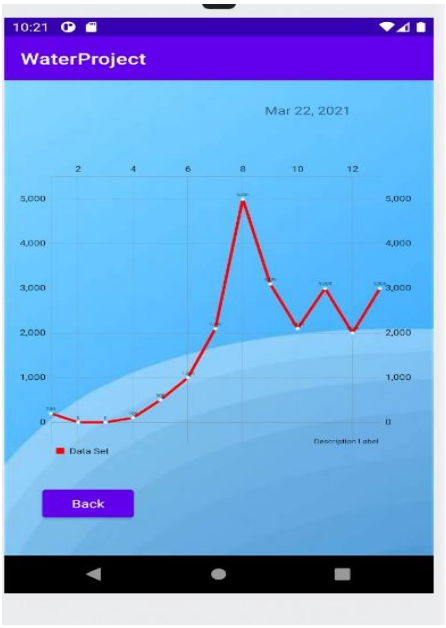

Figure 6.2

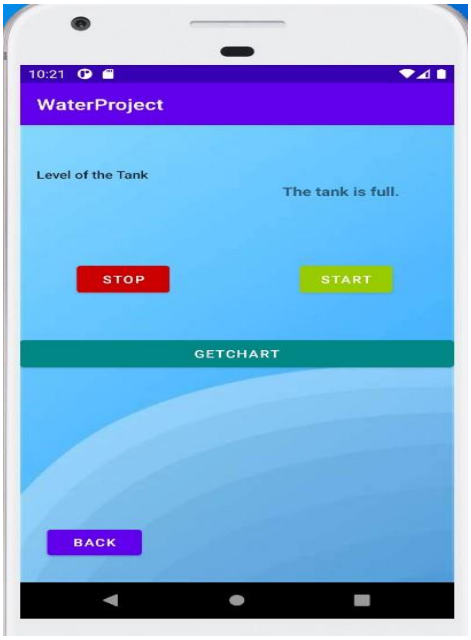

Figure 6.3

Figure 6. Real time applications 3

7. Conclusion

The wireless water flow monitoring system was successfully designed and developed on low cost for water flow monitoring using android smartphone application along with communication support of NodeMCU module. It is built with hardware system that contains Ultrasonic sensor, Node Mcu, Arduino uno and water flow sensor. Proposed system will provide real-time data and eliminates the manual mistakes caused by humans and gives extremely accurate automatic operation .It takes advantages because the system is easy and convenient for user, and provide real time measurement by online. Thus flow of water is monitored, forecasted and visualize from anywhere in the world using internet.

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