Monitoring Water-Level in Overhead Tanks

Team-17
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Framework of the Project

Relevance of the problem

Our project will help resolve the problem of wastage of water and electricity.

We will get to know the level of water in the tank, and can hence automate the turning ON and OFF of the switch which controls water filling in the tank.

This will prevent overflow of water and unnecessary wastage of electricity. It would also relieve the human of checking the tank level to turn the switch ON and OFF.

Three teams have suspended their sensors at different heights (ours being at 50% of the height of the tank). We can use the three values to determine the level of water, and whether to turn the switch ON or OFF.

About the sensor

This is a photoelectric liquid level sensor that operates using optical principles. The advantages of this are:

- High sensitivity.
- No need for mechanical parts - meaning less calibration.
- It can handle high temperatures and high pressures.

The operating voltage of the sensor is 5 volts. It works in the temperature range of -25 to 105 ℃. It is accurate up to 0.5 mm. Its life expectancy is about 50,000 hours. The length of the wire is about 45 cm and it weighs 26g.

Expected Result

The sensor used in the tanks is a photoelectric water level sensor. When liquid comes into contact with the sensor probe, the microcontroller will output HIGH logic. When the liquid is not in contact with the probe the microcontroller will output LOW logic.

Caution:

Avoid placing the sensor near bright lights or in direct sunlight as these can cause interference.

Working of the sensor

The sensor works of the optical principle of refraction.

Firstly, light is released by an emitter inside the glass material. It hits the corresponding wall, at a different angle (because the walls are not parallel). Hence, on hitting the wall, there is a possibility of refraction, or total internal reflection (TIR).

If the opposing medium is air, then it TIR occurs. If the opposing medium is water, then refraction occurs. Hence, if the opposing medium is air, light returns towards the centre, whereas if the opposing medium is water, it doesn’t.

There is a light sensor inside which will get light only if the opposing medium isn’t water. Hence, the sensor will determine if it is in contact with water or not.

ESP32

Image of ESP32

The ESP32 Arduino Kit is used for communication between the sensor and the cloud.

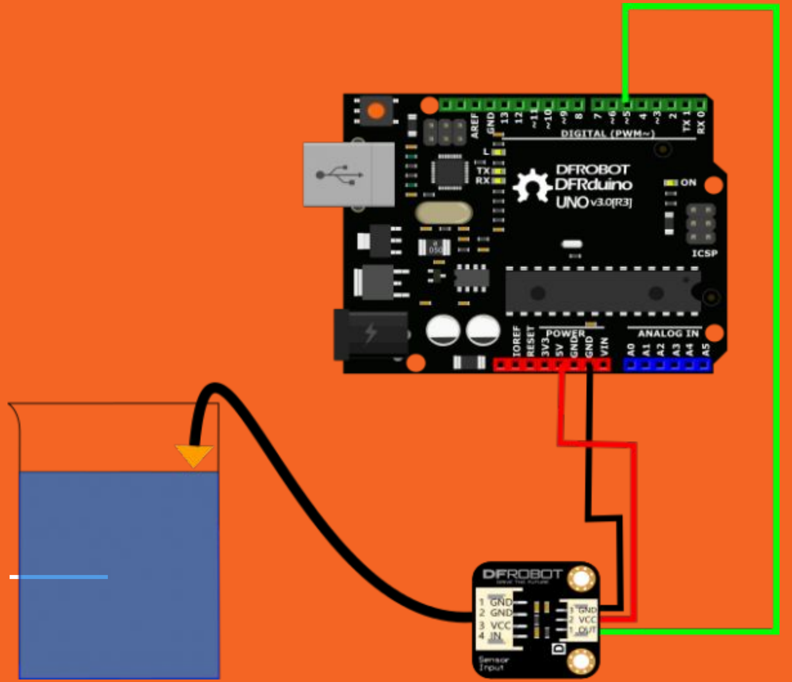
The sensor communicates with the ESP32 board via GPIO pins to receive the bit indicating the presence of water.

The ESP32 board will communicate via WiFi and will send the modified (meaningful) data to the cloud.

Model

Suspend the sensor at an appropriate height in the overhead tank to detect the presence of water.
Connect it to the ESP32 Arduino Kit present outside the tank via physical wires.
ESP32 is connected to AC Mains of the building via physical wires for power.
Code running in ESP32 shall wait for sensor data at regular intervals of time, and shall send this data over WiFi to the oneM2M server.

ESP32 connection to the sensor



Deployment

Phase I: Testing the Sensor

Testing of the sensor began with dumping of the preliminary code on the ESP32 and dipping the sensor in a water-filled container. It gave LOW output normally and HIGH output in contact with water.

Phase II: Increasing the Sensor Length

The selected tank of Bakul Nivas is around 8 metres in depth, but our sensor, a mere 45 centimeters. Hence, to dip it to 50% depth, we would need to increase its length.

Hence, we cut the sensor wire, took a long wire, and soldered it to the ends of the two parts of the sensor wire. To keep it functional and water proofed, we glue gunned the soldered intersection.

After soldering and water proofing the extended wires, we had tested the sensor working by keeping it in a bucket of water for a couple of hours, resulting in success.

Phase III: WiFi Testing

To send the data over WiFi, we need to connect our ESP32 board to WiFi. There are three SSIDs set (our WiFi hotspots) and it will try to find whichever of these is available. JioFi is set up as there is no reliable internet connection on Bakul Nivas terrace.

For testing, we provided the IP address of the test server and created a local oneM2M server, which collected data at regular intervals of 10 minutes each.

In case of Power Outage or WiFi Disconnection, the ESP32 is restarted. This makes sure that data is sent to server whenever possible.

Phase IV: Deployment Day

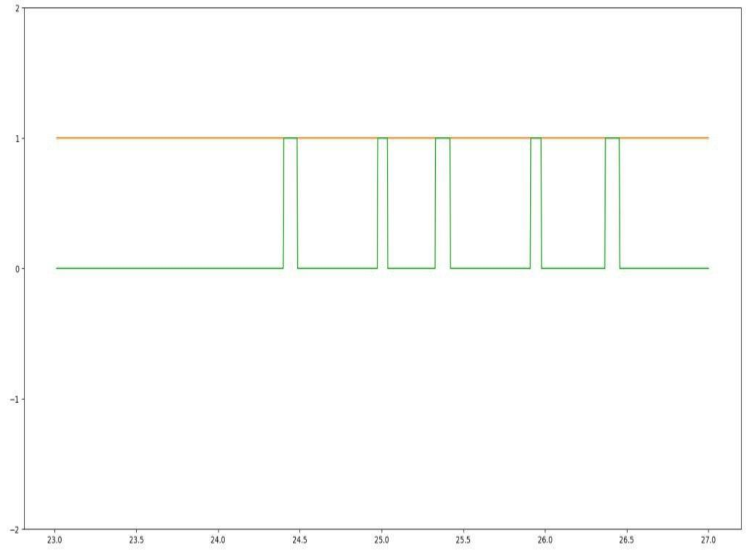
For the deployment of the project, we used a container to keep and protect the circuit from the external factors (rain etc.). The container contains the node MCU connected to an adapter for power consumption received from a nearby socket which allows all the containers to be put in series.

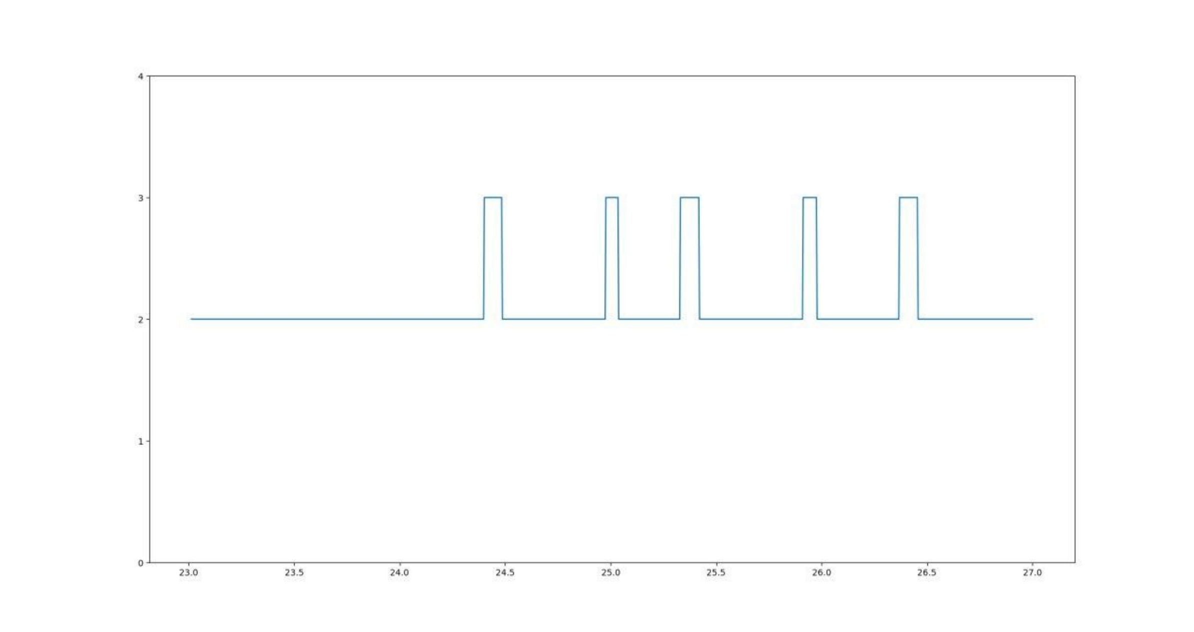
For suspending the sensor vertically, we tied a stone at the tip of the sensor to maintain its height. Otherwise the sensor would have been floating loosely.

We used the silicon gun to coat the outlet of the container to keep it isolated from the environmental factors like wind, rain, dust etc.

Data Analysis via Graph

- X coordinate has been normalized with frequency of data instances per day.
- Adjacent graph shows sensor values for all 3 teams.
- Green is for team 22(only one which shows 0).
- Blue and red are teams 4 and 17.
- Following graph shows water level during the entire duration of testing.





All the data along with time stamps is available in file format and has been cross verified with the plots.