Real Time Water level Monitoring (Dam) using IoT

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Abstract: Water is the crucial part of everyday life. Therefore, the reason behind developing this project is to create the Realtime IoT based water level measurements. The main task of monitoring is done from place nearer to dam site. For communicating with device remotely, we are going to use internet.
The term Internet of Things means making devices work based on connected data through Internet. For above purpose we are using a powerful processor Raspberry Pi which is compatible with various Internet of Things (IoT) services like WebIOPi, Node-RED, ThinkSpeak, Thingsboard, Thingworx etc. Raspberry Pi runs on Raspbian OS which is based on Debian Linux developed by Jessie. Raspberry Pi can programme with Python, JAVA and HTM. This project is modular in which project content can easily replaceable in case of malfunctioning and for maintenance.
For Internet of Things we are using Node-RED an open source platform developed by IBM. User with sufficient knowledge of Javascript, HTML/CSS programming can develop application according to need. Node-RED platform provide a source to develop a Web User-Interface.

Keywords: IoT, PLC (Programmable Logic Control), Water Monitoring, Water level sensor, Raspberry pi, Ultrasonic sensor.

I. INTRODUCTION

In this project we are going to measure water level of Dam and Running status of Machines present in Dam site. We are going to store data taken by connected water level sensors and on rule basis like threshold value we will send notification by Mail. We created one User Interface dashboard on which respective user can see live status of water level and connected Machine running status. We have used Internet of Things technology to send data to cloud for backup and user can see live detailed Dashboard from anywhere in the world.

First for measurement of water level there are multiple types of sensors can be used. Some examples are as follows:

- Optical
- Vibrating or tuning fork
- Ultrasonic
- Float
- Capacitance
- Radar
- Conductivity or resistance

In our project we have used Ultrasonic sensor and also capacitive type of water level sensor. This sensors will give raw value to attached processors. We have used Raspberry pi and Arduino as processor. We used Node-red as a IoT platform where we are fetching data and do required processing on it.This processors will take raw data from sensors and calibrate it. This data is stored for future use. We have created one dashboard on which current water level of each reservoir shown also current running status of machines like generator is shown.

Objective of Work:

- To monitoring of water level of various Reservoir
- Monitor Running status of Machines at Dam site.
- Store Data to Cloud.
- Implementation of the system that will provide alert to the maintenance Engineer when the water level exceeded beyond the threshold limit or when the water level reaches below the reference limit.

II. BLOCK DIAGRAM

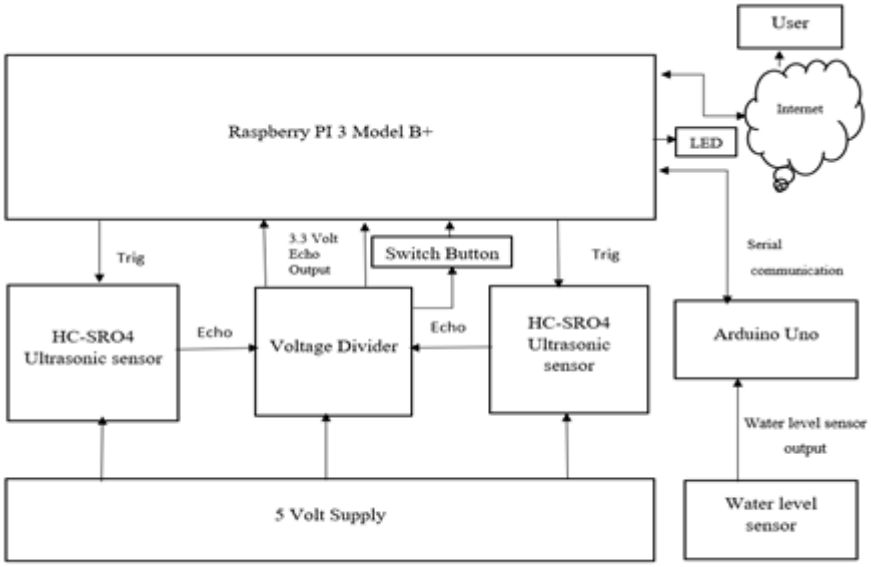


Fig 1. Block diagram

A. Description:

The Figure shows a schematic of the project. It shows wiring between various components of project content such as Raspberry Pi, HC-SRO4 sensor, PCB for voltage divider, LED, Power supply, Arduino UNO, Water level sensor, LED, Switch button.

There are lots of processors available like Intel Edison, Banana pi, Raspberry pi, Arduino which are compatible with Internet of things Development. Among these Raspberry Pi is having more Feature & cheapest of all of them. We can easily Program It with python. It is compatible with Web Development Languages such as JAVA, HTML/CSS. Raspberry pi has the integral WiFi. With the internet raspberry pi displays the data on the web page.

The raspberry pi will provide the Trigger signal to the TRIG pin ultrasonic sensor, which enables the module to create the 8-cycle ultrasonic(40kHz) bursts. The Echo pin has 5V output which is not compatible with the raspberry pi. Hence, we are using the voltage divider circuit to convert voltage 3.3V.

HC-SR04 is the ultrasonic sensor. we transmit short ultrasonic pulse and we measure travel time of that pulse from transceiver to liquid and back to transceiver. Ultrasonic pulse will bounce from liquid level since because change of density of ultrasonic pulse travel medium (ultrasonic pulse first travel through air and bounce of liquid with higher density than air).The LED will show the running status of the generator.

Raspberry Pi is capable of taking only digital signals, but in our project, we require input from analog sensor also like water level sensor. To make raspberry compactible with analog input we require to use external Analog to Digital convertors such as MCP3008, MCP3004, ADC2408 etc. which require complex wiring. Instead of this we can plug Arduino Board through USB port of Raspberry which has inbuilt 10bit analog to digital convertor.

B. Hardware Description:

1. Raspberry Pi 3 Model B+:

The Raspberry Pi is a low cost, credit-card sized computer that plugs into a computer monitor or TV, and uses a standard keyboard and mouse. It is a capable little device that enables people of all ages to explore computing and to learn how to program in languages like Scratch and Python. It is capable of doing everything you would expect a desktop computer to do, from browsing the internet and playing high-definition video, to making spreadsheets, word-processing, and playing games.

2. HC-SRO4:

Ultrasonic distance sensors (HC-SRO4) are designed to measure distance between the source and target using ultrasonic waves. We use ultrasonic waves because they are relatively accurate across short distances and don't cause disturbances as they are inaudible to human ear.

HCSR04 is a commonly used module for noncontact distance measurement for distances from 2cm to 400cm. It uses sonar (like bats and dolphins) to measure distance with high accuracy and stable readings. It consists of an ultrasonic transmitter, receiver and control circuit. The transmitter transmits short bursts which gets reflected by target and are picked up by the receiver. The time difference between transmission and reception of ultrasonic signals is calculated. Using the speed of sound and 'Speed = Distance/Time' equation, the distance between the source and target can be easily calculated.

3. Arduino UNO:

Arduino is an open-source platform used for building electronics projects. Arduino consists of both a physical programmable circuit board and a piece of software, or IDE (Integrated Development Environment) that runs on computer, used to write and upload computer code to the physical board.

The Arduino platform has become quite popular with people just starting out with electronics, and for good reason. Unlike most previous programmable circuit boards, the Arduino does not need a separate piece of hardware a simplified version of C++,

making it easier to learn to program. Finally, Arduino provides a standard form factor that breaks out the functions of the micro-controller into a more accessible package.

The Arduino hardware and software were designed for artists, designers, hobbyists, hackers, newbies, and anyone interested in creating interactive objects or environments. Arduino can interact with buttons, LEDs, motors, speakers, GPS units, cameras, the internet, and even smart-phone or TV. This flexibility combined with the fact that the Arduino software is free, the hardware boards are pretty cheap, and both the software and hardware are easy to learn has led to a large community of users who have contributed code and released instructions for a huge variety of Arduino-based projects.

Arduino makes several different boards, each with different capabilities. In addition, part of being open source hardware means that others can modify and produce derivatives of Arduino boards that provide even more form factors and functionality.

For our project we are using Arduino UNO R3 as shown in figure 2.3 which is relatively cheap and does sufficient functionality in our project. It has 14 digital input/output pins (of which 6 can be used as PWM outputs), 6 analog inputs, a USB connection, a power jack, a reset button and more. It contains everything needed to support the microcontroller; simply connect it to a computer with a USB cable or power it with AC-to-DC adapter or battery to get started.

4. Power (USB / Barrel Jack)

Every Arduino board needs a way to be connected to a power source. The Arduino UNO can be powered from a USB cable coming from your computer or a wall power supply that is terminated in a barrel jack. In the picture above the USB connection is labelled (1) and the barrel jack is labelled (2). The recommended voltage for most Arduino models is between 6 and 12 Volts.

5. Water Level Sensor:

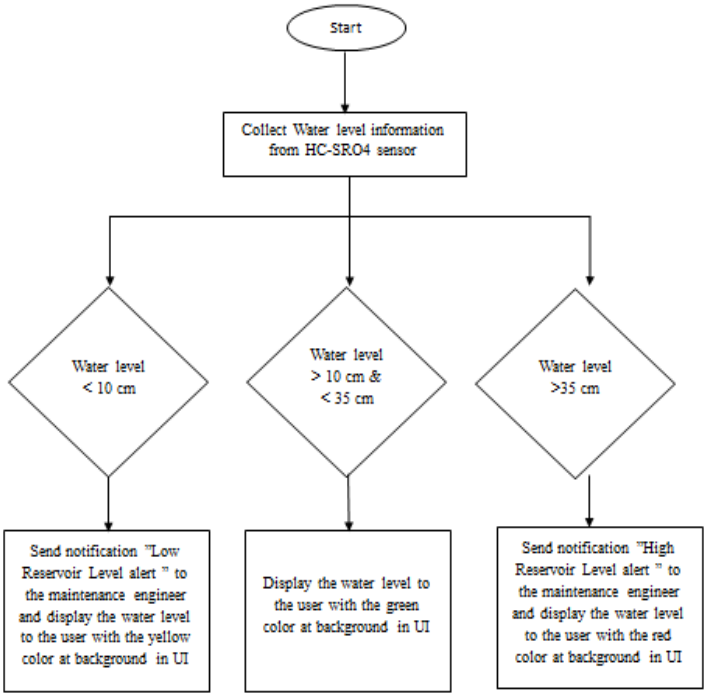
Water sensor brick is designed for water detection, which can be widely used in sensing the rainfall, water level, even the liquate leakage. The brick is mainly comprised of three parts: An Electronic brick connector, a 1 MΩ resistor, and several lines of bare conducting wires.

This sensor works by having a series of exposed traces connected to ground and interlaced between the grounded traces are the sense traces. The sensor traces have a weak pull-up resistor of 1 MΩ. The resistor will pull the sensor trace value high until a drop of water shorts the sensor trace to the grounded trace. Believe it or not, this circuit will work with the digital I/O pins of your Arduino or you can use it with the analog pins to detect the amount of water induced contact between the grounded and sensor traces.

6. Other Accessories:

The additional accessories used for our project are usual electronic component such as PCB (Printed Circuit Board), Power Supply (we have used the arduino uno for the 5V supply), Registers, LED, Jumper-Wires and Ribbon Cable, Buttons. Along with above accessories a casing box made by Hansel to incorporate Raspberry Pi and other electronic accessories and nut-bolt to support them in casing.

III. FLOW CHART



Flow chart for water level indication using HC-SR04 Sensor

IV. RESULT

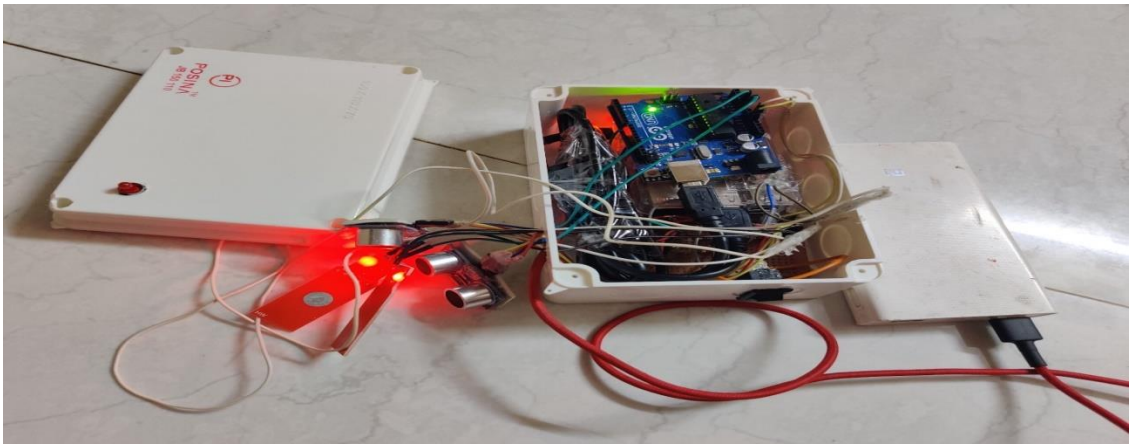


Figure 5.1 Inside view of project box

The box contains raspberry Pi, PCB(designed for the voltage divider circuit), replaceable & rechargeable power bank, power supply, Arduino Uno, Water level sensor, HC-SRO4 ultrasonic sensor. All the boards are fixed in the box with the help of nut and bolts. These nut supports Raspberry Pi which makes system rigid and shock proof. Arduino uno is connected with raspberry pi using adapter cable.

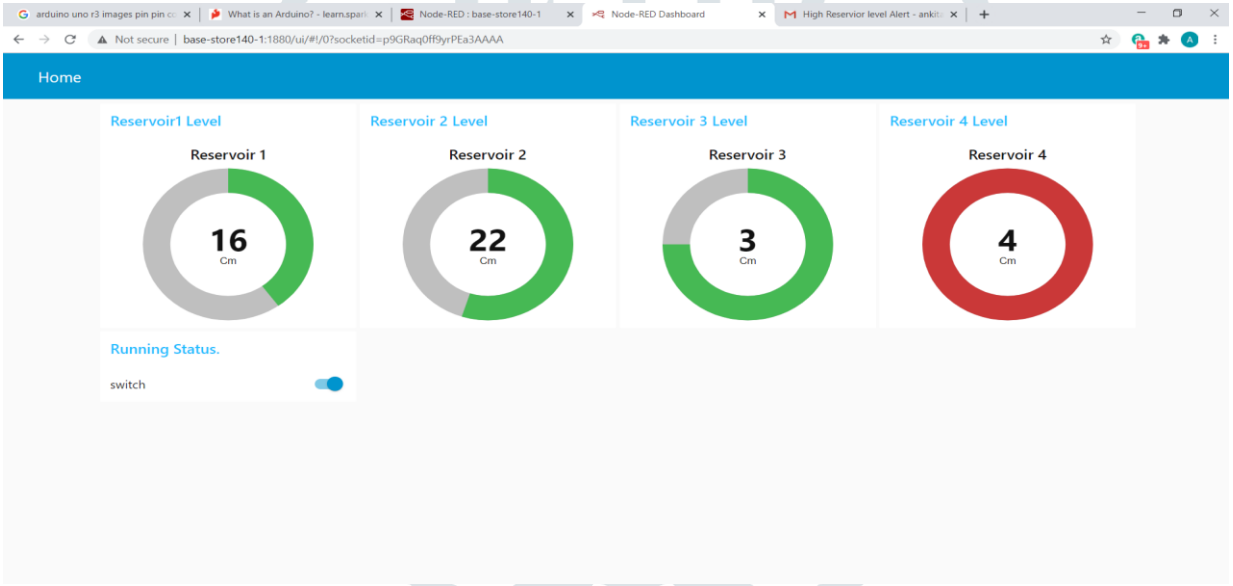


Figure 5.2 Generator status monitoring

Dashboard is showing water level in various Reservoir also running status of connected machine. Water level widget indicated in green, yellow and red color as per current water level. Yellow indicates low level, Green Indicates ok and Red indicates High reservoir level.

V. CONCLUSION

The concept of this project was set out to explore idea of Internet of Things in field of dam such as monitoring of water levels, status of running Machines. We achieved the task of low cost and reliable product for monitoring. we utilize a comparatively low cost and more powerful raspberry pi processor along with HC-SRO4 ultrasonic sensor and also the Arduino Uno along with the Capacitive water level sensor.

We utilize Node-RED application developed by IBM for Internet of Things platform. This thesis also guides us through Node-RED installation procedure on Raspberry Pi. Since Node-RED is an open source platform where user can utilize their ideas to build application based on JavaScript programming. As it's an open source platform one can add number of additional sensors such pressure, temperature, vibration to monitor which gives further development of project in future.

With this we can conclude that this project will monitor the objective data. It has also capability of storing these data over cloud. we can monitor data from anywhere in world provided internet data connectivity at project site.

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VII. REFERENCES

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