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Water Impurities Detection System using IoT

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Abstract

Water is one of the vital resources for life on the earth and the main concern is to find that whether the water is impure or not. As sources grow and urbanizes, its water bodies are getting lethal. According to forum, it is estimated that around 70% of surface water is not good for human consumption. Moreover, everyday waste water is been added to rivers and lakes with only tiny fraction adequately treated. To overcome these problem , this paper proposes a low cost system for detecting impurities in distilled water using the technologies like IoT, Machine Learning, Cloud Computing and Android Application. In this paper, the system is implemented by integrating sensors with Single Board Compute. The system is real time and work under IOT environment. The system is used to collect data which is used to generate the water quality report. This report can forward to the officials for resolving issues. This instantaneous reporting is used to resolve the issues in less time so that citizens will not face those issues for longer time. It considers the parameters of water like temperature, pH, Conductivity and Turbidity. It also helps to retrieve the lack of particular parameter in water. To advancement as the scope of system, more sensors can be integrated together considering extra parameters to get the accurate level of water quality.

Keywords: *Android App, Cloud Computing, Internet of Things (IoT), Machine Learning, Water parameters.*

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1. Introduction

Water is one of the most important assets for life on the earth and the major concern is to find whether the water is infected or not. All plants and animals need water to survive, and the human body is more than three-fourths water. According to forum, it is estimated that around 70% of surface water is not good for human consumption. The water is in the form of distilled water. This water is not useful for human body as it has evaporated its minerals and other nutrients. The distilled water indeed can be used for other purposes. By this approach, wastage of water can be reduced at a high scope.

The stored water can be monitored and used as well. But, the stored water can change its substances if kept for a longtime. Hence continuous readings of the water are must. This can be done by monitoring the data real time. This process says we require real time monitoring scheme which will observe water quality through sensors such as pH, turbidity and oxygen integrated using ZigBee[1]. Although, solar energy can be used to save the electricity supplied to the main power supply, but during the drizzly climate the sunlight is less and solar device is not in use. Hence, the real time data can be collected by monitoring the continuous flow of water. A low cost system is designed and developed using the water parameters like pH, temperature, turbidity and flow control. All associated sensors are integrated by Arduino and Wi-Fi Module [2].According to [3], the system can be developed in a way by considering water parameters with sensors respectively. These sensors are together integrated with Node MCU and values are updates at Azure Cloud Service. The proposed system is designed for monitoring the real time water related data. This can be helpful for the stored water as well as continuous flowing of water. The water parameters such as pH, conductivity, turbidity and temperature are considered as the primary factors affecting water quality. Single board computer is combination of sensors which is used for real time water quality monitoring in an IOT environment. These sensors are connected together with the Raspberry Pi. Finally, the values are updated at Firebase Cloud Service.

2. Literature Survey

R. Karthik Kumar et al. entitled “Solar based advanced water quality monitoring system using wireless sensor network”. This paper focuses to monitor the quality of water using water parameters with providing solar energy as a source of electricity [1].

Vaishnavi V. Daigavane and Dr. M.A Gaikwad proposed system named as Water Quality Monitoring System Based on IOT. This paper represents a expansion of a low cost system for monitor the water quality in IoT using sensors like pH, temperature, turbidity, flow control and Arduino[2].

Nikhil Kumar Koditala and Dr. Purnendu Shekar Pandey proposed Water Quality Monitoring System using IoT and Machine Learning. In this paper, authors discuss about a real time water monitoring system which checks water quality through sensors such as pH, temperature and turbidity using Node MCU, Azure Cloud service[3].

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Manish Kumar Jha, et al. proposed Smart Water Monitoring System for Real-time water quality and usage monitoring. This paper focus on solve two of the major problems connected to Water Quality Checking and Water Usage Monitoring [4].

Kamarul Hafiz Kamaludin and Widad Ismail entitled "Water Quality Monitoring with Internet of Things (IoT)". The paper recommends an Internet of Things (IoT) based system developed by embedding the RFID system; IP base communication into a single platform for water quality monitoring purpose and Wireless Sensor Network platform and [5].

Neha Garg and Ritu Garg entitled "Energy Harvesting in IoT Devices: A Survey". This paper focuses on providing the energy harvesting systems for IoT devices [6].

3. Proposed System

In this paper, Raspberry Pi will be used as a center controller. The temperature sensor, Ph sensor, turbidity and conductivity sensor can be read directly from the command line. However, this includes one to input a command every time they wish to know the sensors are reading. To access all the modules of the sensors, Python language is used, which will read the sensors value mechanically at some time intervals. The Raspberry Pi comes prepared with a range of drivers for interfacing with sensors and the cloud service.

Though, it's not suitable to load each driver when the system boots, as it will increase the boot time considerably and use a substantial amount of system resources for surplus processes. Then the monitor parameters of the water from the sensors are transmitted through IoT module to the gateway. The gateway is accountable for data analysis and ahead sensing data to the remote server.

The scheme consists of PH sensor, temperature sensor and conductivity sensor for water quality and testing, acquisition module single-chip microcontroller data, monitoring center and information transmission module and other accessories. For data collection Raspberry Pi have used. It is also used to analyze data controlling which help in storing data on a single chip.

TABLE 1.
Water Quality Physical Parameters Standard Value

Water Quality Parameter	Standard Value Range	(unit)
pH	6.5 - 8.	
Conductivity	0.00 - 0.05	(mS/m)
Temperature	20-30	(0C)
Turbidity	6.0 - 10.0	(NTU)

3.1 Development of System

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In the current era as there is easiness to access technology in a wide range with the plentiful availability of resources Internet of Things has become a main keynote in application of scientific industry. IoT is extended of internet connectivity more than personal computers and mobile devices. It can reach a wide range of non-internet distant devices. Once the devices are assembling with technology, they are bring to life and can communicate with each other through the internet.

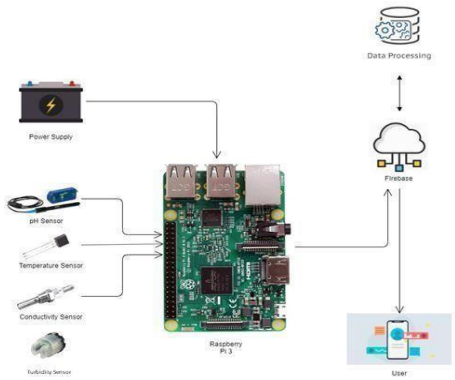

Figure 1. Architecture of System.

In this proposed system, we monitor the real time quality of water after a fix time interval. It includes IoT where hardware devices will be connected with the cloud services for exchange of data. The inclusive process of proposed system is elaborated when every minute module of process is elaborate in brief. The center controller is used as an intermediate to process and carry the collected data through the sensors, to cloud database for report generation. This generation has a gateway for intercommunication. The core controller provides inbuilt features which lessen the extra usage of modules. The communication takes place between cloud database and android application where the report will be examined.

Moreover, this mode of communication provides the feature of robustness for the system. Therefore, the proposed system can be installed and implemented in any place viz. continuous flow of water or collected water. This technique helps user to modify and examine data by analyzing the previous data. However, the system design is low cost maintenance; it can be used by indigent people as well.

3.2 IoT Architecture

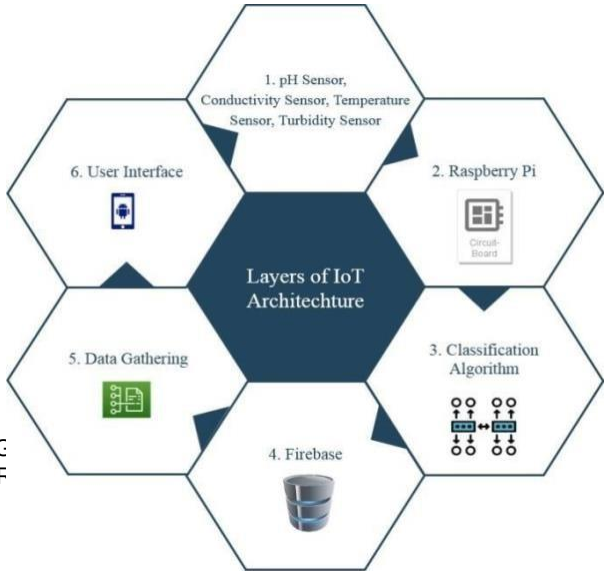

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Figure 2. Layers of System.

- Layer 1: The first layer consists of the hardware devices such as , conductivity sensor , pH sensor, turbidity sensor and temperature sensor. This layer will gather the real time data of water quality at a fixed time interval. The collected data will be retrieved by the further layer.

- Layer 2: The second layer is the core controller of the system. It consists of Raspberry Pi which has an inbuilt Wi-Fi module which helps in exchangeof data. IT integrates the sensors together and sends the data to cloud storage.

- Layer 3: The third layer is an important layer where the Classification algorithm takes place. The trained data is compared with the real time data for the finding the accuracy of water quality. The classifier used is Naïve Bayes Classifier which helps in collecting real time data appropriately.

- Layer 4: The fourth layer consists of firebase. Firebase is a cloud storage provided by Google where real time data can be stored and processed. It is a backend service. The data composed by the sensors is stored at the firebase station.

- Layer 5: The fifth layer consists of Report Generation. This layer forms the data to be shared with the user. Report Generation is a module where the predicted data is used for calculating the accuracy of water quality.

- Layer 6: The sixth layer is the last layer which provides the user interface through an android application. This application gives all the relevant data which describes the water quality. It shows the impurity level of water.

4. Experimental Components

4.1 Hardware Design

Hardware required for the proposed system is pH Sensor, Conductivity Sensor, Temperature Sensor and Raspberry Pi. The detailed description is as follows:

A. Raspberry Pi 3:
Raspberry Pi 3 model boots and runs from SD card. It provides inbuilt Wi-Fi module for data routing. SD card slot can read up to 32GB of data. The GPIO pins are programmed using Python programming language. The IO devices are connected to GPIO pins when needed.

B. pH Sensor:
- PH sensor is calibrated @24 degree centigrade room temperature.
- Calibrated Values are: PH4= 1.5V, PH7=1.2V, PH9=2.5V.

C. Temperature Sensor :
- Operate Voltage: DC 3~5.5V.
- Temperature Range: -40 ℃ ~ 80 ℃.
- Humidity Range: 0~100% RH.

D. Conductivity Sensor:
- Sensor type: 2 electrode sensor.
- Electrode material: Platinum.

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E. Turbidity Sensor:
- Rated Voltage: 5V DC.
- Operating Temperature Range: -10^0 C to 90^0 C.
- Insulation Resistance: 100MΩ by 500v DC.

4.2 Software Design

Software Designing will be used for the implementation of system is as follows:

A. Programming Language:
1. Python Programming:
   - IDE: PyCharm.
2. Java Programming:

B. Firebase:
Google firebase is used as the database for real time storing of data.

C. Android Application:
Android application is an interface between user and system. It uses Java language.

5. Conclusion

Water is essential require of all the living beings. If the water is infected it will cause damaging effect on human as well as other living beings. So, to get notify about the level of infectivity in water, this system is proposed. This system is monitor quality of water persistently. It reads values from sensors and check for threshold set for parameter. When sensor values strike the threshold value, the announcement of that event is fruitfully sent to establishment and populace. IoT based impurity Detection System is habitual system and has pointed human intervention.

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