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Iot Based Smart Water Quality Monitoring System for Smart City

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ABSTRACT:
His paper represents an IoT(Internet of things) based smart water quality monitoring (SWQM) system that aids in continuous measurement of water condition based on four physical parameters i.e., temperature, pH, electric conductivity and turbidity properties. Four sensors are connected with arduino-uno in discrete way to detect the water parameters. Extracted data from the sensors are transmitted to a desktop application developed in NET platform and compared with the WHO (World Health Organization) standard values. Based on the measured result, the proposed SWQM system can successfully analyze the water parameters using fast forest binary classifier to classify whether the test water sample is drinkable or not.

Keyword-Water quality, water supply, water pollution.

I. INTRODUCTION

Water is a vital resource for human health. Although around 71% of the world is covered with water, only 2.5% corresponds to fresh water. In developing countries, 80% of the population has no access to fresh water [1]. Water is widely used for industry, for domestic uses and agricultural activities, etc. Furthermore, water requires a fulfillment of a variety of characteristics that include the water quality standard. To ensure that the water quality complies with the required characteristics it is necessary to have systems that monitor the corresponding parameters and validate that they are within the acceptable ranges.

Methodology:

The major components used in the proposed have been discussed briefly: 5.1Raspberry Pi3 Model B The Raspberry Pi3 Model B is a wonderful platform that can be used to build automation systems. Clearly, the Raspberry Pi3 model
B board is perfect when being used as a “hub” for automation systems, connecting to other open-source hardware parts like does Like spread sheets, word processing, Internet, Programming, Games etc.

Water Quality Management

The current procedure for WQM can be summarized in three phases:
1. Taking the samples
2. Laboratory analysis
3. Investigation (in case of analyses reveal a non-compliance with the quality- required parameters).

Problem statement:

The world’s water resources are under increasing threat from the impacts of climate change, population growth, and pollution. As the global population grows, a persistent challenge is how to access enough water to meet humanity’s needs while also preserving the integrity of aquatic ecosystems. The Pacific Institute works on water resource issues around the globe, collaborating with stakeholders to ensure communities and nature have the water they need to thrive now and in the future.

Internationally, the Institute promotes source water protection and “green infrastructure” solutions in order to increase the climate resiliency of water systems and improve ecosystem function. The Institute collects, catalogues, and shares good practice examples of nature-based solutions; catalyzes investment in green infrastructure projects; and connects stakeholders with a common interest in advancing nature-based solutions. In California, the Institute has played an active role at the Salton Sea for more than two decades, emphasizing the importance of the sea and the

negative consequences of failing to act on its behalf. The Sensor-Based Water Quality Monitoring System proposed in this research which is s used to measure physical and chemical properties of water so that the harms to human life can be resists.

Wireless Sensor Network

This chapter gives the theoretical background for the performed work. It starts by exploring IoT communication protocols narrowing the study to three key protocols and stating their advantages and drawbacks over each other.

A background on water quality monitoring as well as machine learning are also part of this chapter,
which finishes with related works in IoT, machine learning and water quality monitoring.

Fiona Regan, Antoine and Audrey [19] designed smart water quality monitoring system. In that system they made water quality smart sensors so the sensors send data wirelessly to the device which collects data from all the nodes. This data is given to the remote server through GPRS network and user can see data remotely. This system is highly scalable, faster and user friendly, but it is costly because of smart sensors. Furthermore, the size of sensors is not reliable for water tap.

Zulhani Resin and Mohr Rizal Abdullah [20] developed a water quality monitoring system using Zigbee based wireless sensor network. In proposing system the sensors are connected to a single circuit which is connected to the Zigbee ZMN2405HP module. The receiver side Zigbee is connected to the PC that shows the GUI of the network circuit. In this system the high power Zigbee is used and it can be applied to small area network, also the base station is necessary for data storage.

A Ning.

Designed monitoring system for water quality. In this system the water quality sensors collect data, from industrial water and municipal water storage, are gathered at the sub-station at which the data are processed. This processed data are sent to the main station through Ethernet networks running on TCP/IP and from the main station that data is again differentiated and given to the environment department and public department using the internet. This system has increased data accuracy, reliability and efficiency, also it gives effective data management and fully integrated information systems. But the drawback is that it cannot provide real time monitoring of water parameters.

Qiao Tie-Zhu, Song Le [23] designed Online Monitoring System of Water Quality Based on GPRS. The system is used to process the sample and send the relevant data to the monitoring center via the GPRS data transmission. The aim of developing this system is the remote monitoring of water quality parameter and makes it real time and faster than previous system used for water quality monitoring, also to control water quality.

Components

Temperature, pH, conductivity and salinity, turbidity, and dissolved oxygen are the frequently applied parameters to obtain water quality. Nevertheless, measuring algae, ISEs (ammonia, nitrate, chloride), and laboratory variables can also be considered as a water monitoring guideline. It is essential to monitor the water quality on open systems if the water is being used for humans or industrial purposes. [10.] Moreover, the description of a few parameters can be found below:

Temperature

The measurement of the average kinetic energy of water molecules on a scale of Fahrenheit or Celsius degrees is referred to as a temperature. It also determines the internal heat or the intensity of heat inside the objects . The change in the temperature varies with the layers of the water and the duration of the time, i.e., colder at night and warmer at broad daylight. As a result, the temperature is considered an important criterion for water quality. [11.]

PH

The measurement of hydrogen-ion (H+) or negative logarithm of the hydrogen ion concentration is pH scale. Its value determines the acidity and base of the water where acidic water holds an extra amount of hydrogen ions and base water with extra hydroxyl ions (OH-). It is important to have a pH measurement to determine the state of water, and it is favorable for plants, aquatic animals, or even for drinking purposes.

Dissolved Oxygen

Dissolved oxygen is a basic test of water pollution and one of the important parameters. The water with a higher concentration of oxygen is evaluated as pure water. Although the dissolved oxygen might not have severe consequences on human health,it can bring changes in the taste of water. Atmospheric pressure, temperature, pollution level, the concentration of salt are the

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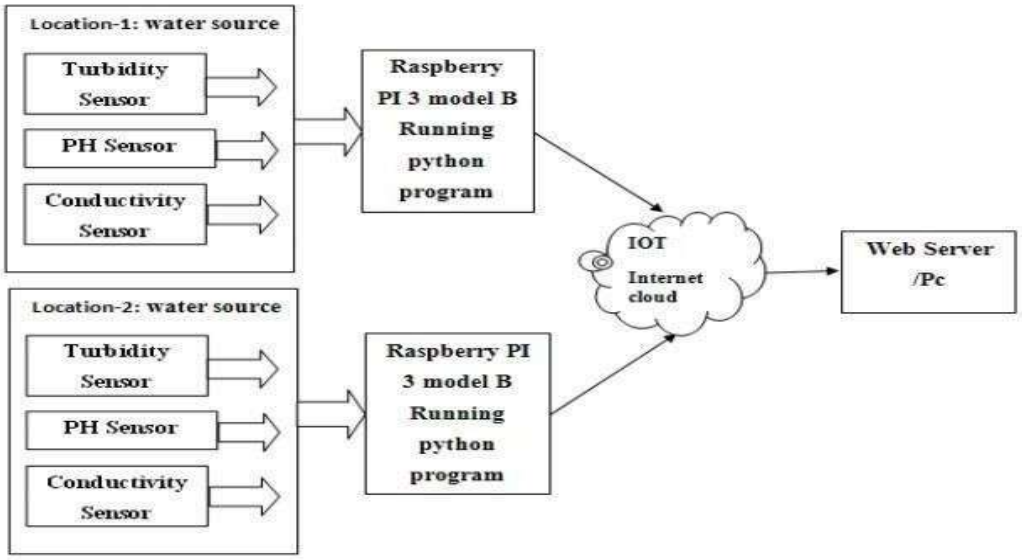
several aspects that differentiate the dissolved oxygen (DO) concentration.

Proposed Block Diagram of IoT based smart Water Quality Monitoring System Using Raspberry Pi



Raspberry Pi3ModelB Built on the latest Broadcom 2837 ARMv8 64bit processor, thenew generation Raspberry Pi3 Model B is faster and more powerful than its predecessors. With built-in wireless and Bluetooth connectivity, it becomes the ideal IoT ready solution. It consists of 1.2GHz QUAD Core Broadcom BCM2837 64bit ARMv8 processor,BCM43438 Wi-Fi on board, Bluetooth Low Energy (BLE) on board,1GB RAM,4x USB 2 ports,40pin extended GPIO,HDMI and RCA video output. The Raspberry Pi3B model is shown in Fig-2. Raspberry Pi3Model B runs on Linux kernel based operating systems. It boots and runs from the SD card. It does not have any internal memory other than the ROM. It has an SD card slot which is capable of reading up to 32 GB. The GPIO pins of the raspberry Pi3 Model B are programmed using Python programming language. The I/O devices like sensors are given to GPIO pins whenever needed.

ESP 8266

The ESP8266 Wi-Fi module that allows microcontrollers access to a Wi-Fi network.
This module is a self-contained SOC (System On a Chip) that doesn't necessarily need a microcontroller to manipulate inputs and outputs as you would normally do with an ESP-01 is a Adriano, for example, because the ESP-01 acts as a small computer.
Depending on the version of the ESP8266, it is possible to have up to 9 GPIOs (General
Purpose Input Output). Thus, we can give a microcontroller internet access like the WiFi shield

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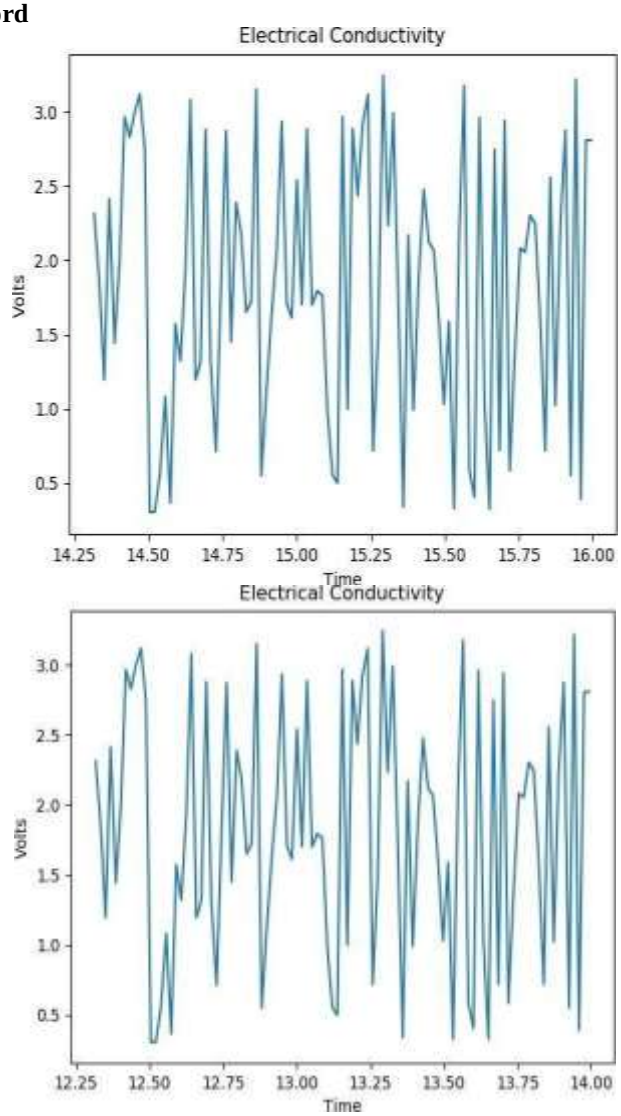
does to the Adriano, or we can simply program the ESP8266 to not only have access to a Wi-Fi network, but to act as a microcontroller as well.
The ESP8266 ESP-01 module has three operation modes: Accession
Station (STA) Both
In AP the Wi-Fi module acts as a Wi-Fi network, or access point (hence the name), allowing other devices to connect to it. This does not mean that you will be able to check your Facebook from your device while the ESP-01 module is operating in the AP mode. It simply establishes a two way communication between the ESP8266 and the device that is connected to it via Wi-Fi.
In STA mode, the ESP-01 can connect to an AP such as the Wi-Fi
network from your house. This allows any device connected to that network to communicate with the module.
The third mode of operation permits the module to act as both an AP and ST

Thing Speak Server Record



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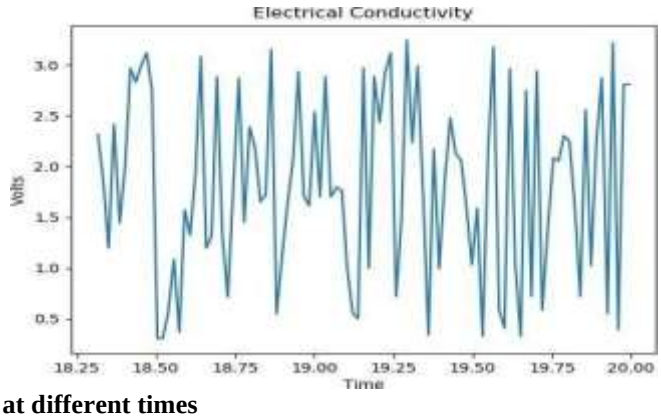
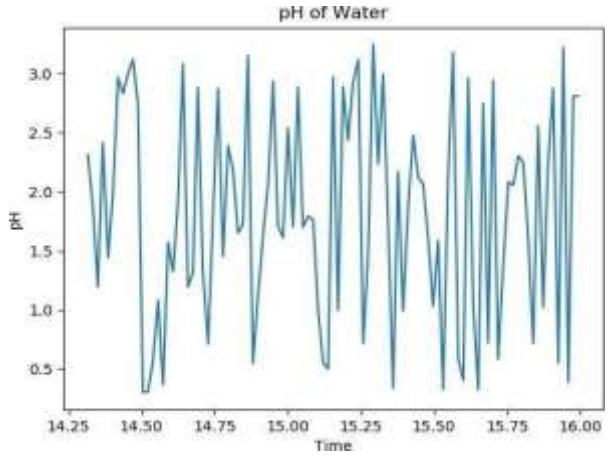
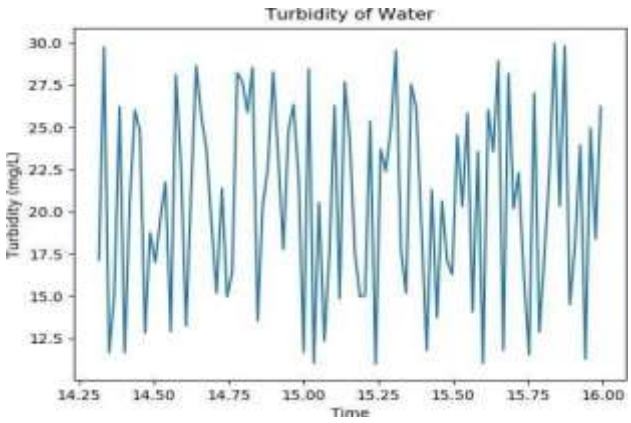


Electrical Conductivity at different times





Graphs measurements

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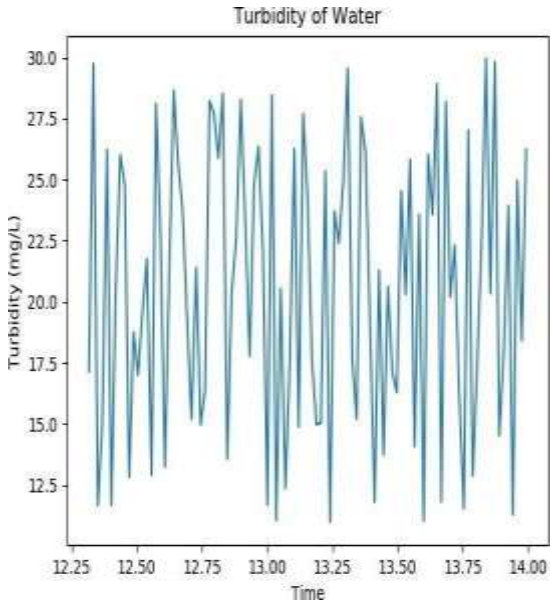

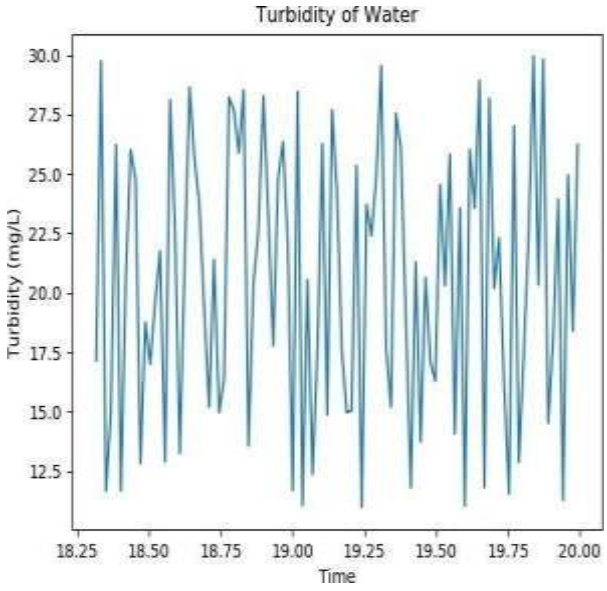

II. CONCLUSION AND FUTURE SCOPE

The system designed in this work show implementation of multi sensor monitoring IoTsystem. The water quality analysis data is uploaded to the server periodically to monitor the water quality. The electrical conductivity, pH level and turbidity level is measured and uploaded periodically to Thing Speak server using raspberry pi based system.

The system performs well in continuous manner. Two hours records can be observed through the recorded data which provides sufficient information for water quality monitoring system.

Future Scope

The existing system can be extended with the use of MySQL server space and multi sensor network can be configured which can locate multi sensor modules at different locations to record zone wise data.