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Water Quality Monitoring using IoT and Machine Learning

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Abstract: Water Quality Monitoring is the method for the wireless sensor data monitoring by using the smart sensor network and monitoring the system data and to send the alert notification. We have a bunch of sensors like pH, salt sensor, conductivity sensor, LDR, GSM module. By using the values provided by the sensors, we can easily compute by taking the data provided and analyzing the data which will give the quality of the water and its purity. We have the ph sensor and also purity sensor, by using this we get the sensor values and also we get the alert message. After collecting all sensor values, we are converting the data's to CSV file Format. Then we are predicting the result based on the purity. Then we are giving result as a daily or weekly or monthly level purity analysis and usage of the water using machine learning algorithm.

Keywords: Machine learning, internet of things, ph sensor, solenoidal valve, ultrasonic sensor, node MCU, turbidity.

I.   INTRODUCTION

As the world is transforming further into the "Computerized Age," we're seeing a hazardous development in terms of water quality over the Internet. Clean and pure drinking water is the most valuable resource for humans. Any imbalance in the water quality would seriously make an impact in the health condition of the humans. Now a day's drinking water utilities are facing various challenges in real time due to limited water resources, global warming, growing population and pollution. Hence there is need of better methodologies for real time water quality monitoring. As the recent survey of WHO estimated that in India 77 million people face problems due to unsafe drinking water and 21% of the diseases are related to impure water. WHO also estimated that 1600 people die every day in India due to diarrhea. Conventional method of water quality involves the manual collection of the water at different areas and this water is tested in laboratory. Internet of Things (IoT) and technology like Remote Sensing (RS) is used in different area of research for collecting,monitoring and analysis data from remote locations. Due to the vast increase in global industrial output, rural also the urban drift and the overutilization of land and sea resources, the water quality available to people has deteriorated increased significantly. The high usage of artificial fertilizers in farms and also other chemicals in sectors such as construction and mining have contributed immensely to the overall decrease of water quality globally. Water is an important need for human survival and therefore there must be some special mechanisms put in place to vigorously for testing the quality of water that made available for drinking in towns and cities articulated supplies and as well as the creeks, rivers and shoreline that surround the nearest towns and cities. The availability of good quality and pure water is paramount in preventing outbreaks of water-borne diseases as well as improving the quality of life. Fiji Islands are located in the vast Pacific Ocean which needs a regular data collecting network for monitoring the water quality and RS and Internet of Things can improve vastly the existing measurement. This paper presents a smart water quality monitoring system for Fiji, using remote sensing and Iot technology. Water quality monitoring in real time faces several challenges because of global warming makes water resources limited, increase in the population, etc. Hence there is significant need to developing some better methodologies to monitor the water quality parameters in real time application areas. The water quality parameters includes sensors like pH which measures the concentration hydrogen ions. It shows the water is acidic or base in nature. Pure water has pH value of 7, less than 7pH is acidic, more than 7pH is base or alkaline. The range of pH is 0-14 pH in value. For drinking purpose it should be around 6.5-8.5pH. Turbidity is used to measure the large number of suspended particles which are present in water that is invisible to naked eyes. Higher the turbidity value will increases the risk of diseases. Lower the turbidity will show that the water is clean. Temperature sensor is used to measure how the water is, whether it is hot or cold. Flow sensor is used to measure the water flow through sensor. The traditional methods of water quality monitoring includes the manual collection of sample of water from different locations across the area. The whole design of this system is based mainly on IOT which is newly introduced concept in the world of development. There is basically two parts included, the first one is hardware & second one is software. The hardware part includes sensors which help to measure the real time values, another one is Arduino uno which converts the analog values to digital one, & LCD shows the displays output from

sensors, Wi-Fi module gives the connection between hardware and software. In software we developed a program based on embedded c language. The PCB is design at first level of construction and component and sensors mounted on it. An app is installed in the android version to see the output. When the system get started dc current given to the kit and node mcu and WIFI gets on. The parameters of water is tested one but one and their result is given to the LCD display. The app went provided with hotspot gives the exact value as on LCD display shows on kit. Thus like this when the kit is located on any specific water body and WIFI is provided we can observe its real time value on our android phone anywhere at any time. After sensing the data from different sensor devices, which are placed in particular area of interest. The sensed data will be automatically sent to web server, when a connection is established with server device. Internet of Things can be describe as the network of electronics devices communicating among them by the help of a controller. The IoT acts as a collection of devices that work together in order to serve human tasks in a efficient manner. It combines computational power to send data about the environments. These devices can be in form of appliances, sensors, embedded systems, and microchips for data analysing. This paper present a low cost water monitoring system, which is a solution for the water wastage and water quality. Microcontrollers and sensors are used for that system. Ultrasonic Sensor is used to measuring water level. The other parameters like TDS and pH, the turbidity of the water can be calculated using different corresponding sensors. This system use the flow sensor which can measure the water flow and if the necessary quantity of water flow through the pipe then water flow can be stopped automatically. The calculated values from the sensors can be computed by the Microcontrollers and uploaded to the internet by the Wi-Fi module.

II. RELATED WORKS

Overview National Water Quality Assessment Program has finished various water-quality expectation models for nitrogen and phosphorus for the coextensive United States just as for territorial zones of the country. Notwithstanding evaluating water-quality conditions at unmonitored streams, the adjusted SPAtially Referenced Regressions On Watershed traits (SPARROW) models can be utilized to deliver appraisals of yield, stream weighted focus, or heap of constituents in water under different land-use condition, change, or asset the board situations. An online choice help foundation has been created to give access to SPARROW reproduction results on stream water-quality conditions and to offer refined situation testing capacities for research and water-quality arranging through a graphical UI with natural controls. The SPARROW choice emotionally supportive network (DSS) is conveyed through an internet browser over an Internet association, making it generally available to people in general in a configuration that enables clients to effectively show water-quality conditions and to portray, test, and offer displayed situations of future conditions. SPARROW models as of now bolstered by the DSS depend on the changed advanced adaptations of the 1:500,000-scale River Reach File (RF1) and 1:100,000scale National Hydrography Dataset (medium-goals, NHDPlus) stream systems.

Oluwaseye Samson Adedoja , Yskandar Hamam , Baset Khalaf and Rotimi Sadiku in 2018. Assurance of the water framework is vital because of the negative results of polluted water on the general wellbeing. Water assets are one of the basic frameworks that must be safeguarded from purposeful and inadvertent assaults. Water characteristics are inspected at the treatment plant. Be that as it may, its quality can considerably be tainted amid transportation from the plant to the shoppers' taps. Pollution in water appropriation systems (WDNs) is a risk that can have extreme outcomes on general wellbeing just as a financial and social insecurity. Water conveyance systems are gigantically powerless to consider or coincidental assaults because of the unpredictable idea of the framework. Consequently, sullying source recognizable proof (CSI) is a topical issue in water circulation frameworks that require prompt consideration of scientists so as to shield humanity from the unfriendly impact of devouring sullied water. More often than not, a contaminant occasion can be distinguished by utilizing the water quality observing sensors or the contaminant cautioning framework (CWS) introduced on the system. In any case, how to infer the wellspring of the defilement from the gathered data is a troublesome assignment that must be handled so as to assess the spread of the pollution and for quick therapeutic procedures. In the previous two decades, significant endeavors and headway have been made by scientists applying different systems so as to find the wellspring of the pollution in WDNs.Every one of the procedures has certain constraints and materialness as detailed in the writing. This paper introduces a far reaching audit of the current strategies with accentuation on their significance and specialized difficulties. Regardless of a progression of examinations in this area, the field is yet to be bound together. Consequently, open research regions are as yet accessible to investigate. Thus, enhancement for the current methods is important and therefore proposed. All the more significantly, down to earth utilization of these procedures offer a noteworthy research hole that must be tended to. Kulwinder Singh Parmar ,Rashmi Bhardwaj in 2014.This paper manages water quality administration utilizing measurable investigation and time-arrangement expectation show. The month to month variety of water quality guidelines has been utilized to look at measurable mean, middle, mode, standard deviation, kurtosis, skewness, coefficient of variety at Yamuna River. Display approved utilizing R-squared, root mean square mistake, mean supreme rate blunder, most

extreme total rate blunder, mean total mistake, greatest total mistake, standardized Bayesian data rule, Ljung– Box investigation, anticipated esteem and certainty limits. Utilizing auto backward coordinated moving normal model, future water quality parameters esteems have been assessed. It is seen that prescient model is helpful at 95 % certainty cutoff points and bend is platykurtic for capability of hydrogen (pH), free smelling salts, complete Kjeldahl nitrogen, broke up oxygen, water temperature (WT); leptokurtic for synthetic oxygen request, biochemical oxygen request. Likewise, it is seen that anticipated arrangement is near the first arrangement which gives an ideal fit. All parameters aside from pH and WT cross the recommended furthest reaches of the World Health Organization/United States Environmental Protection Agency, and in this way water isn't fit for drinking, agribusiness and modern use.

III. PROBLEM STATEMENT

Problem Definition is probably one of the most complex and heavily neglected stages in the big data analytics pipeline. It is essential to handle and manage historical data sets of the parameters measured. Considering the large amount of data available and to distinguish the pattern and extent of relationships for useful and efficient extraction of knowledge, there is a need for using various techniques which is used to find the quality of water and also monitoring frequently.

The proposed model of this project includes
1) Admin
2) Web Server
3) Technologies
4) Sensors
5) Arduino
6) Cloud

A. System Architecture

Block Diagram:
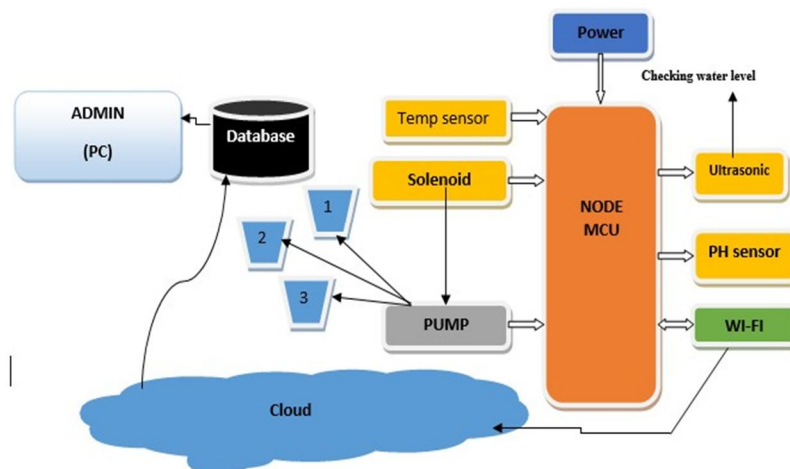
B. Admin

Admin has to create the profile in cloud. Admin will monitor the sensor data which we are getting from micro controller. If the sensor value flow is high, admin will take necessary action in cloud. We are using MySQL database for storing the sensor value. From there, admin will get all the data. User has to create one profile in cloud. User they can keep the data's securely. After login, user also can see the data from database which we are getting from micro controller.

C. Web Server

A Web server is a programming that uses Hypertext Transfer Protocol (Http) to serve the files available that form Web pages to users, also in response to their requests, which is being forwarded by their computers' HTTP clients. Dedicated computer systems and appliances can be referred as Web servers as well.

D. Technologies

1) *HTML:* HTML is a markup language which is used for presenting and structuring content on the World Wide Web (WWW). HTML-5 is the latest and most enhanced version of HTML.

2) *CSS:* Cascading Style Sheets (CSS) is a style sheet language which is used for describing the look and formatting, designing and alignment of a document written in a markup language.CSS3 is a latest standard of CSS.

3) *JavaScript:* JavaScript is a full-fledged dynamic server based programming language that, which is applied to an HTML document and provide dynamic interactivity on websites.

E. Sensors

1) *pH sensor:* The two electrodes submerge in the solution, the reference electrode potential will remain constant with the changing of hydrogen ion concentration. The pH is used to find the water quality in the tank. This is automatically observed for the good water resource to produce to the consumers by day-to-day life. The pH sensor is used to check the pH range of the water to be. The pH range varies from 0 to 14. The value range from 0 to 6 is acidity, the value range from 7 and 8 is the pure water and the value range from 9 to 14 is the alkalinity.

Fig-1: pH sensor

2) *Temperature Sensor:* LM35 is a analog linear temperature sensor. Its output is proportional to the temperature .The operating temperature ranges between -55°C to 150°C. The output voltage varies from 10mV in response to every o degree C increase or decreases in temperature. It can be operated from a 5V also 3.3 V supply and the stand by current must be less than 60uA.

Fig-2: Turbidity sensor

3) *Flow Sensor:* The flow sensor is used, when the valve is turned ON and the water flows from the tank to the consumer through the pipe. The flow sensor is used to find the water flow rate and the leakage detection of the pipe. The water flow rate is identified with the water flow sensor. The leakage detection is found in the pipe, through the two difference of the water flow sensor placed in the pipe at a longer distance, such that the flow rate senses the flow of water through the pipe. The difference of the water flow rate1 and the water flow rate 2 is the leakage detection of the same pipe at longer distance. The difference of the two water flow rate must be zero, such that there is no water leakage in the pipe.

Fig-3:Flow sensor

F. Arduino

Arduino is an open source IoT platform. It consists of firmware which runs on the hardware based on the ESP-12 module. Arduino acts a connector between the sensors and the system. It can be connected using the USB or an external Wifi. It requires a power supply of 3-5 V. It consists of both a material coded instruction circuit board (referred to as a microcontroller) and also a piece of software, or IDE that runs on your machine, used to write and upload machine code to the solid material board. The USB is used to connect the machine and the Arduino microcontroller using the USB interface. The analog pins are used for sensing the flow rate in this project and the digital pins are used to control the valve of the pipe by turning ON and OFF.

G. Cloud

 Cloud Computing is a technology for remote location that have incorporating Internet of Things. Cloud technology is used here for storing the data provided by the sensors and Arduino remotely which can be used anywhere and at any time with authentication and more secured manner. There are many free cloud service providers are available in the market so that there is no cost involved in storing by using this technology.

Ph Analysis
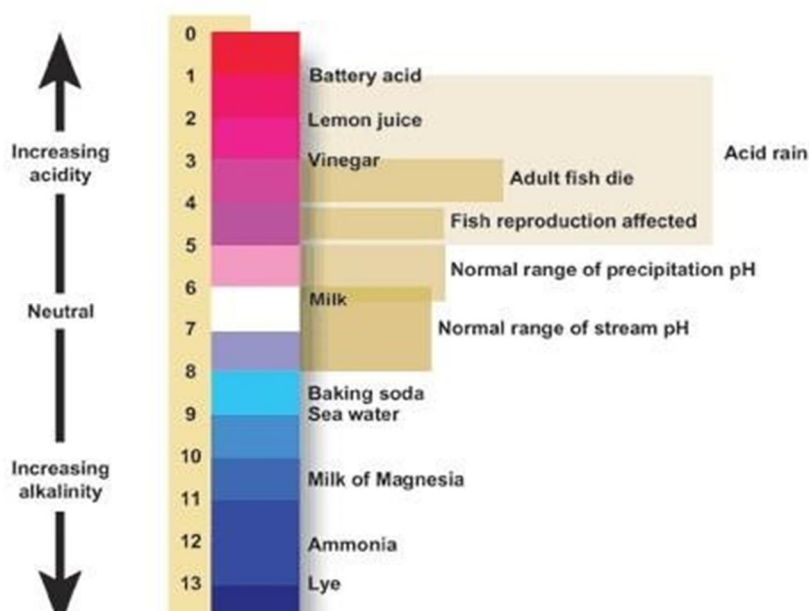
IV. CONCLUSION

In this technology, the design and development of low-cost system for real time monitoring of water quality and controlling the flow of water by using IoT is presented. The proposed system consists of sensors for water quality monitoring and solenoid valve for controlling the water flow in the pipeline. These devices are low in cost, highly efficient and flexible. These are connected to Arduino core controller and IoT module. Finally, sensed values is viewed and controlling is performed by internet and also through Wi-Fi to system. There are lots of techniques available to do the same. All these techniques are expensive and difficult in terms of collecting and analysing the data.

V. FUTURE ENHANCEMENTS

The drinking water emergency in Asia is achieving disturbing extents. It may very before long accomplish the idea of worldwide emergency. Subsequently, it is of most extreme significance to protect water for people. In numerous houses there is superfluous wastage of water because of flood in overhead tanks. Programmed Water Level Indicator and Controller can give an answer for this issue. The activity of water level controller works upon the way that water conducts power because of the nearness of minerals inside it. So water can be utilized to open or close a circuit. As the water level ascents or falls, distinctive circuits in the controller send diverse signs. These signs are utilized to turn ON or turn OFF the engine siphon according to our prerequisites. The aggregate sum of water accessible on Earth has been assessed at 1.4 billion cubic kilometers, enough to cover the planet with a layer of around 3 km. About 95% of the Earth's water is in the seas, which is unfit for human utilization. About 4% is secured in the polar ice tops, and the rest 1% establishes all new water found in waterways, streams and lakes which is appropriate for our utilization.

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