A Real Time Water Quality Monitoring Using Machine Learning Algorithm

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Abstract—
Water quality parameter is of much importance in our day to day lives. Prediction of water quality will help to reduce water pollution and guard our human health. An intelligent process of monitoring the quality of water automatically detects the condition of water through IoT by processing sensors data and instantly provides notification to water analyst, when the quality of water is abnormal. With the initiation of Machine to Machine Communication analyzing and communicating the data becomes simple and efficient. This work has advanced an "Intelligent IoT based water quality monitoring system" pertaining to lakes is being used in rural areas. The structure uses pH, Turbidity and Conductivity sensors for determining the water quality parameters about hydrogen ion and total dissolved solvents in the water. Likewise, K Means calculation has been utilized for anticipating the nature of water, with the assistance of prepared informational collection from various water tests. Swotting and comparing the water quality parameters with time-stamped prediction results in the cloud server has been communicated to the water analyst through the personal computers for better knowledge and understanding of water quality. This proposed model safeguards standard quality water to the rural people using low prices embedded devices like Arduino Uno and Raspberry Pi.

IndexTerms —Machine to Machine, IoT, Support Vector Machine, Fuzzy, Raspberry Pi4

I. INTRODUCTION

Water is one of the greatest natural resource that has been gifted to human beings. But due to the rapid growth of the industrial companies and abundant human happenings raced up the contamination the water resources. To rectify the overhead issues water quality monitoring is essential to identify any fluctuations in water quality parameters forreal time to assure that it is safe for drinking purpose**.**

The Main Objective of water quality monitoring using Internet of things are:

1. The system effectuallyassist to screen the water quality parameter and analyse the quality of water at long distance without loss of data to avoid its life-threatening effects on Human beings, and on Animals
2. With the help of IoT, we can have a continuous water quality monitoring system on various water parameters.
3. All the IoT data are stored and analysed in the cloud. Therefore, the proposed solution is very affordable (less cost).

II. LITERATURE SURVEY

A. Internet of things

The term Internet of Things (IoT) has been around for quite few years. In this scenario, it is gaining with the evolution of advanced wireless technology. It is a network of devices connected to a sensor, Node microcontroller and a network which makes the communication possible among the devices. Through IoT devices we are capable of capturing real time information autonomously. The main building blocks of IoT are sensors, sensor gateway, processor and an application system. The cloud service providers collect the data from sensors, store and analyse the data collected by the sensors and takes decision accordingly. In recent years Wireless Sensor Network(WSN) and Internet of Things(IoT)are the vital technologies in the field of environmental monitoring.

Cloud offers easy access to the store data with the help of sensed data. The data now can be processed, analysed, pictured. With the help of the above it is able to predict thequality of water. The predicted result can be visualized in the form of plots, charts, and graphs using online analytical tools.

B. Machine learning

Machine learning, a prediction based on experience system which is a subcategory of artificial intelligence (AI) that offersstatistical tools to explore, understand and analyse the data. Foremost, it enables the machine to think without human interpretation. With the help of past data, called as the training data, it can expose to take decisions for the future.

Machine learning in Water Quality monitoring where the water quality parameters are analysed and predicted based on the K Means algorithm. K means is unsupervised learning model which analyses the data with the help of training data sets which produces an output of hyperplane which separates the new inputs. Various sorts of water are taken as preparing sets which incorporate Mud water, Lemon water, Saltwater, Tap water, and Drinking water are taken. The new data sets that is to be predicted, that have similar Ph, conductivity and Turbidity value fall on to the same category of cluster. All the water quality values that are trained during the training period are clustered ina way that each cluster in the network represents a detailed kind of water like mud water, lemon water, salt water, tap water and drinking water. When a new input of data set is tested using the K Means algorithm, the machinewilldecide the number of clusters that is need to be made and will provide centroid for all clustersand will classify in which cluster the new dataset needs to be filled in and results in the closest cluster name. Hence the prediction of water quality parameter is done using K Means algorithm in the field of machine learning.

C. Big data analytics in water quality management:

Mohammad Salah Uddin Chowdurya, Talha Bin Emranb†, Subhasish Ghosha, Abhijit Pathaka, Mohd. Manjur Alama, Nurul Absara, Karl Anderssonc, Mohammad Shahadat Hossaind (2019),IoT gadgets utilize different kinds of sensors to gather information about turbidity, ORP, temperature, pH, conductivity, and so forth of stream water consistently. In like manner, IoT devices have the ability to stream the assortment of accumulated data remotely to the remote Data Aggregator Server in the cloud. In addition, the volume of semi-organized information increments with time in such a speed, that solitary the Big Data Analytics applications can proficiently store and dissect the information continually. Thus, the data official's layer will be sent and operational on the Apache Hadoop bundle. Hadoop helps dispersed taking care of and getting ready for colossal data over a gathering of PCs. Hadoop is deficient tolerant as employmen*ts are diverted naturally to the running hubs when hubs are fizzled. IoT applications need fast of perusing/compose of information and exceptionally accessible information in the database. Right now, the system will use Apache HBase NoSQL database to store huge data as HBase which is realized on Hadoop. Hence, the data is circled over the Hadoop scattered record system (HDFS). Additionally, HBase is prepared for executing consistent inquiries similarly as bunch taking care of. High-availability of data is given by the HBase as it is taken care of in HDFS. Hadoop bunches are spreading over numerous servers which are overseen by Apache Zookeeper. The IoT application will assist the clients with visualizing the water quality investigation results created by the information the board layer over various time arrangement ceaselessly. The information representation application runs on customer gadgets, for example, Smartphones, PCs, and work areas. The root clients will have the option to produce day by day/month to month/yearly water quality report from the information the board layer and picture in the customer gadgets [3].

III. SENSORS

Sensors collect data from the environment and is capable of detecting the changes in the environment. Sensors measure physical spectacle such as temperature, pressure, moisture and so on.Sensors are used in medical system, biometric system, water monitoring system etc.,

A. pH Sensor

Acidity or the alkalinity of the water is measured using Ph. Translation of hydrogen ion concentration is considered as pH.The logarithmic pH scale is measured from 0 to 14. Whereas the pH level less than 7 ae considered as acidic and the pH level greater than 7 are considered as basic. The pH range of 6.5 to 8 is considered as pure water and values less than 6.5 and values above 8 is considered as impure water. For time there is a increase in number of pH, the hydrogen ion concentration reduces to ten times and water becomes less acidic in nature. A pH sensor is capable of measuring the electrode and the reference electrode. The pH sensors battery's certain terminal is associated with the estimating cathode and negative terminal is associated with the reference anode.when the pH sensor immersed into the water the reference electrode gives us the static potential.The fluctuation in the hydrogen ion concentration does not affect the reference electrode.

B. Electric Conductivity

Conductivity sensor is capable of measuring the absorption of dissolved solids in water quality. The conductivity unitin measuring water quality is Siemen per centimetre (micro-Siemens per centimetre or µS/cm).The conductivity scope of ocean water is 5 S/m, drinking water is in the scope of 5-50 mS/m, while profoundly sanitized water is in the scope of 5.5 µS/m. Electric conductivity of a water is measured using a probe and a meter. The probe of a electrical conductivity sensor consists of double metal electrodes set apart 1 cm away from each other. A continuous voltage supply is applied across the electrodes. The electrical conductivity of water is estimated with the momentum which courses through the water which is straightforwardly relative to the retention of broke down particles in water.

C. Turbidity Sensor

Turbidity is the quantifiablenumber of deferred particles in water. It may be the soil particles or dirt in water ,and as same as the chocolate flakes in our chocolate drink . The acceptable limit of turbidity should be 1NTU.Package drinking water has the limit of about 2NTU. The turbidity range of drinking water should never be greater than 5NTU and never lesser than 1 NTU.

IV. MAJOR WATER CONTAMINANTS

A. Nitrate, Phosphate, and Ammonium

kunyi zhang1, ziqian dong (2019),Nitrogen and phosphorus are essential requirements for plants and individuals to endure. The presence of nitrogen in water is as NO3 which is nitrate.Large amount of nitrate increases the algae growth. Increase in Algae content can steal the waters dissolved oxygen and can cause the death of many fishes and can also affect many aquatic life. Nitrate content are present in human as well as animal wastes, industrial chemical outlets and excess from severe fertilized croplands. In the same way, high levels of nitrates in drinking water can be poisonous to human being which can also bring serious sickness and also even death. The standard limit of nitrate in waste water and in industrial waste is found out to be 30 mg/L[2].

B. Heavy metals

kunyi zhang1, ziqian dong (2019), The components which has high metallic synthetic substances and that has moderately high thickness and which is venomous at low fixations in water is called overwhelming metals. A few instances of overwhelming metals incorporate mercury (Hg), cadmium (Cd), arsenic (As), chromium (Cr), thallium (Tl), and lead (Pb).Release from some of the steel containers and mills and corrosionof natural deposits causes contamination in drinking water which are the main sources of chromium. Long-term exposure to such contamination may cause vulnerable allergic dermatitis. Common standard levels for chromium in squander water and drinking water are 1 µg/L and 100 µg/L [2].

C. Dissolved Oxygen

kunyi zhang1, ziqian dong (2019),Normally, maintain a healthy ecosystem asignificant amount of DO in shallow water is necessary. Levels below 5 mg/L may affect on aquatic life, and levels below 2 mg/L will make the fishes fall to death. In the case of rivers and of lakes, DO levels must not be under the rate of 6 mg/L. In the water of egg and sperm discharge by amphibian creatures, the DO must not be under 7 mg/L. The earth's surface water will not be under 3 mg/L. Estimating ongoing DO in water bodies will give basic information to general wellbeing impacts [2].

S.NO	PROJECT	TECHNIQUES	RESULT	ISSUES
1	A Biological Sensor System Using Computer Vision for Water Quality Monitoring	The classificationmodel based on neural network model is used to categorize the parameters of different water quality environments	Provided more accurate results in in the case of multi-level classification in compared to shallow neural network.	Explanation to the progress of applicability, accuracy and reliability of the systems approach is not given.
2	Microwave Sensing of Water Quality	Microwave sensor array, standard printed circuit board (PCB) technology	With the usage of array, it helps us to collect more information in comparison with the single sensor system.With the utilization of Microwave dielectric spectroscopy, the framework can create an outcome in an ease incorporated framework for the utilization of a lab on-a-board application System.	Post-processing tools such as machine learning algorithm and pattern recognition method can be used toproduce more accurate results in the detection and in the evaluation of water quality.

3	IoT Based Realtime River Water Quality Monitoring System	IoT, Machine Learning and Cloud Computing technique are used .	The system is fully automated which uses Node MCU, which is lighter in weightand also less in cost. Email alerts system and access to data picturization tothe authorized water analyst users is also included for its enhancement.	Additional quality sensors such as temperature sensor, TDS sensor can detect the chemical and physical parameters which canhelp in improvement ofthe results and thus will make the system more effective.
4	Water Quality Monitoring System using IoT and Machine Learning	Wireless sensor technology	The type of sensors and number of sensornodes provide high scalability ,low cost and low power consumption.	Time-consuming as multiple sensor nodes is employed.
5	Energy Efficient Solutions in Wireless Sensor Systems for Water Quality Monitoring: A Review	Microcontroller for processing the system .Belief Rule Based (BRB) system and wireless sensor network .	. In the event that the gained esteem is over the limit esteem remarks will be shown as 'Awful'. On the off chance that the obtained esteem is lower than the edge esteem remarks will be shown as 'Acceptable'.	Sensors, for example, absolute broke up solids, synthetic oxygen request and disintegrated oxygen can likewise be evaluated to additionally improve the proficiency in water the board.

6	Enabling Communication Networks for Water Quality Monitoring Applications: A Survey	K-Means clustering algorithm is used.	Devices communicate among themselves to result in a real time automated water quality monitoring system using the IoT devicesin predicting the Quality of water for suburban area.	Other water quality parametersother than just PH and TDS values can be computed to extend the same work to con-trol the flowing water based on water quality.

7	Intelligent IoT Based Water Quality Monitoring System	Machine to Machine communication(M2M) approach	K-Means Clustering a Machine learning algorithm is been employed for prediction based on the Ph, turbidity, conductivity values.	Security in data and data integrity is needed to be ensured while transmitting the data for prediction and stimulating the valve tank and in water storage area too.
8	Amulti-class classification system for continuous water quality monitoring	artificial Uses Neural Network , Radial Basis function ,Deep Belief Network, Decision Tree , Improved Decision Tree , Support Vector Machine , Improved Support Vector Machine	support vector machine and improved support vector machine produced more accuracy and efficiency than other techniques	Big data demonstratesthe issuesin lively water quality monitoring. Data quality and validation is also a issue here.
9	Predicting and Analyzing Water Quality using Machine Learning: A Comprehensive Model	Artificial Neural Network	Using Back Propagation (BP), a neural network approach and with the help of Radial Basis Function (RBF) it is easier to predict the total phosphorous in determining the river water quality.	In anticipating the water quality parameters more precision is should have been a more client driven towards undertaking the water quality issues.

CONCLUSION AND FUTURE WORK

Water Quality monitoring system is essential needas it is consumed by all the human beings and plants.The Olden water Quality monitoring system and some of the new technology-based Water Quality monitoring has got lot of challenges and issues in it. The existing water Quality Monitoring and prediction system does not provide any intelligence. Devices communicate among themselves with the help of Machine to Machine communication which can be organized in a large environmental area compared to small area. Along these lines, the proposed framework has settled to an Intelligent constant IoT based Water Quality Monitoring framework which depends on Machine to Machine correspondence through AI. Turbidity and the conductivity sensors are connected. The conductivity acts as a sensor gateway. The sensor input are sent to the pi4, a edge level processor(personal computer) where in the K Means, a machine learning algorithm is used for predicting the quality of water.The predicted water quality data are stored in Cloud server for future access. The predicted data is sent to the water controller unit for further action.This has brought about complete computerized Water Quality Monitoring framework utilizing IoT and AI Technologies by which the gadgets impart among themselves in anticipating the Water Quality for private country region. Subsequently, the water quality can be watched consequently with no human interference. The proposed system can be extended further by water retreatment mechanism

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