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Survey on Sarovarada Swatchthe

Vandana C P[1], Priya B Dutta[2], N C Nikhil Kumar[3], Rakshith P Bhat[4], Prajwal D[5]

[1]Senior Asst. Professor, Information Science, New Horizon College of Engineering, Bangalore, Karnataka, India
[2, 3, 4,5]Information Science, New Horizon College of Engineering, Bangalore, Karnataka, India

Abstract: Water is a fuel without which no lives can survive. This project is an IoT based impact analysis of detergents on Varthur Lake. The aim of the project is to develop a reliable, accurate IoT based solution for real time impact analysis of detergents used in apartments on Varthur Lake. IoT platform comprises monitoring system, a secure communication framework to collect and process the data using machine learning algorithms. This way the behavior of water can be monitored and predicted.
The data is first collected from the sensors with the help of Arduino Uno. The generated by the sensors are read and then uploaded to the cloud using third party server. The data is uploaded using esp8266 module. The collected data is processed to the required format and machine learning algorithm is applied on it to process and further predict the impact of it. Proposed IOT solution is the first water quality-sensing platform to feature a way to process real-time data. Machine learning algorithm would be used to predict the water quality and help monitoring the water conditions. It is suitable for portable water monitoring, cleaning agent level detection, sending user based alerts and initiating the automatic water treatment mechanism. This solution would provide accurate, reliable, autonomous, flexible efficient and low operational cost real time statistics to municipalities (BBMP) and other water quality detection and monitoring systems about the impact of cleaning agents used in apartments on Varthur Lake.
Keywords: IoT, Arduino Uno, esp8266, Machine Learning, Water Quality = [Temperature, PH, turbidity]

I. INTRODUCTION

Water is limited and essential resource for all creatures existing on earth .Any imbalance in water quality would severely affect the health of the humans, animals and also affect the ecological balance among species. Along with amazing technological advances that took place, the industrial revolution of the mid-19th century introduced new sources of air and water pollution. Water bodies in urban areas are highly polluted which is the result of both garbage dumped by individuals and dangerous chemicals legally or illegally being dumped by manufacturing industries, schools, market places, health centres etc. Due to water pollution organisms are being killed who depend on these water bodies. Dead fish, birds, crabs, sea gulls, dolphins, and many other animals often wind up on beaches, killed by pollutants in their habitat. Humans too face a lot of difficulty with the current water pollution as drinking water is scares. With the consumption of polluted many suffer with life threatening diseases like Guinea worm disease, Typhoid, Dysentery etc. Around 70 percent of industrial wastes are dumped untreated into the water bodies. On average, 22 million tons of fertilizers and chemicals are used each year in water bodies. Highly contaminating it , making it unfit for any use. Bangalore being "city of a thousand lakes", now 79% of it is lost. Bengaluru, lately, has been staring at doomsday with regard to its water sources depletion, frothing and burning. Varthur lake is one amongst highest polluted lakes in Bangalore. Mix of detergent, urine and faecal matter has led the lake to form harmful froth which caught fire. Experts claim huge amount of sewage flow from Bellandur lake to Varthur lake is the major reason for Varthur lake being highly polluted. Monitoring water quality is an important part of helping us determine whether or not we are making progress in cleaning up our waterways. It reveals the health and composition of streams, lakes, rivers at a snapshot in time, as well as over weeks, months and years. The importance of tracking the changes in water quality can't be overstated human health and livelihoods depend on clean, reliable water supplies. Monitoring drinking water is done on the rules set by US Safe Drinking Water Act, which sets federal requirement for contaminants, such as microorganisms and chemicals, to protect human health. The US Clean Water Act a landmark piece of environmental legislation that environmental legislation controls surface water pollution, which can come from numerous sources, including sewage treatment plants, factories, urban places and farms. Measuring the amount of in-stream phosphorus pollution tells not only what's going on at a single point in a stream, but also what is happening on the land upstream of that point. A number of land-use practices, ranging from poorly manages construction sites to farm erosion, can be the source of pollution also known as runoff. Monitoring is defined as collection of information at set locations and at regular intervals in order to provide data that can be used to define current conditions, establish trends etc. Water quality monitoring is very important in order to control the pollution. Water quality monitoring can be achieved through physiochemical measurements like temperature, turbidity, pH sensor etc. Studies conducted by United States Environmental

Protection Agency (USEPA) have shown that water parameters are affected by contaminants in specific ways and can be detected and monitored using appropriate sensors.

II. LITERATURE SURVEY

Studies involving the implementation of water quality monitoring systems using wireless sensor network (WSN) technology can be found in literature.

Firstly the quality parameters were monitored for drinking water, to accurately determine if the water quality was within specified regulations of the World Health Organization (WHO). Parameters such as pH, temperature, conductivity, flow, and ORP were measured. In [3] to monitor the data from all over the world IoT environment is provided using raspberry pi for creating gateway and also, cloud computing technology is used to monitor data on internet.
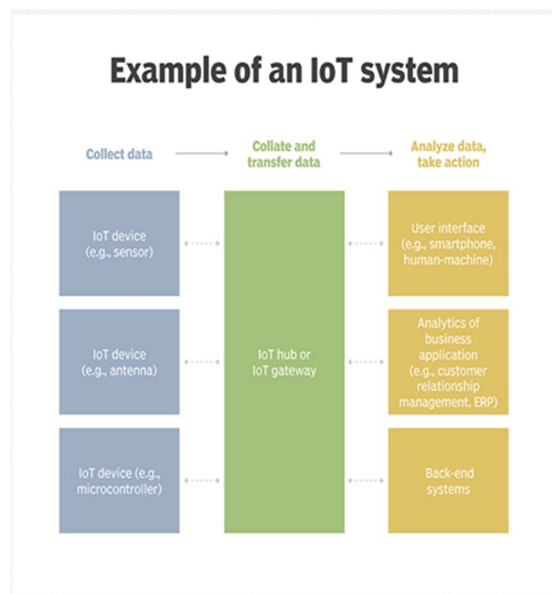
The pH of the water is one of the most important factor, as it measures how basic or acidic the water is. Water with a pH of 11 or higher can cause irritation to the eyes, skin and mucous membrane. Acidic water (pH 4 or below) can also cause irritation due to its corrosive effect. ORD is a measure of the tendency of the solution to either gain or lose electrons. A positive ORP reading show that water is an oxidizing agent, and a negative reading indicates water is a reducing agent (or antioxidant). Normal tap water has an ORP value between 200-400 mV. ORP is a non-standardized water quality indicator, WHO recommends that the ORP of drinking water should not exceed 60mV. Both the pH and ORP parameters are difficult to measure accurately as reference electrodes are required for the same. These reference electrodes typically hold a solution with a known pH or ORP value and require recalibration when used for a long period of time. In [2] they are using sensors like oxidation reduction potential, conductivity, pH, temperature. They test using four different water samples : seawater, surface water, tap water and polluted creek water to establish a reference.

The required and/or recommended ranges for human consumption of each water parameter determined by WHO guidelines and studies conducted are shown below in Table 1.

Sl.no	Parameter	Units	Quality Range
1	Turbidity	NTU	0-5
2	Dissolved Oxygen	mg/L	-
3	Nitrates	mg/L	<10
4	Free Residual Chlorine	mg/L	0.2-2
5	ORP	mV	650-800
6	Electrical Conductivity	S/m	500-1000
7	pH	pH	6.5-8.5
8	Temperature	Celsius	-

Table 1- List of parameters with standard units and quality range.

A. Internet of Things

Internet of Things (IoT) is determined as the network of environmental objects which includes devices, buildings, vehicles which are embedded with sensor, micro-controller, and network associativity. It helps integrate objects which can then exchange data. IoT is a system of interrelated computing devices, digital machines, objects, animals or people with unique identifiers and ability to transfer data over a network without any human-to-human or human-to-computer interaction. IoT consists of web-enabled smart devices that use sensors, embedded processor and hardware to retrieve, send and access data they collect by from their environments. IoT devices share the sensor data they collect by connecting to an IoT gateway to the device where data is either sent to the cloud to be analysed or analysed locally. The real-world applications of internet of things, ranges from consumer IoT and enterprise IoT to manufacturing and industrial IoT. IoT has evolved from the convergence of wireless technologies, microelectromechanical systems, microservices and the internet. IoT encourages companies to rethink the ways they approach their businesses, industries and markets and gives them tools to improve their business strategies. Because of IoT now more electronic devices are connected to internet and communicate to one another without any human interference. One of the earliest IoT enabled device was ATM (Automated Teller Machine). Wearable devices like fitness trackers, smartwatches are connecting more regular customers to the IoT. The era of Internet-connected clothing is coming. Smart homes are not a thing for future anymore. People have already started adopting smart home appliances and home automation devices.

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"Internet of Things" is far bigger than anyone realizes.

B. Sensors
Sensors are sophisticated devices that are used to detect and respond to electrical or optical signals. A sensor converts the physical parameter into a signal which can be measured electrically. The mercury glass thermometer expands and contracts when temperature is varied, this is on of the easiest way to check temperature changes.

C. Temperature Sensor
A temperature sensor is used to measure the temperature of water. There are various temperature sensor types: a thermocouple, thermistor, or a solid state temperature sensor. Basic two types are as follows:

Contact Sensors: This type of sensor requires direct physical contact with the object that has to sensed. They supervise the temperature of solids, liquids and gases.

Non Contact Sensors: This type of sensor does not require any physical contact with the object. They supervise non-reflective solids and liquids but are not useful for gases.

A thermistor temperature sensor was used in the paper referred as there is a better design control and designing such a sensor from first principles are easier.

Thermistors are generally used for application below 300 ^{o}C and would therefore be more sufficient for a system that operates at ambient temperatures.

A thermistor is essentially a resistor with a temperature dependent resistance. Due to its resistive nature, an excitation source is required to read the voltage across the terminals. The measured voltage is proportional to the temperature with either a negative temperature coefficient (NTC) or a positive temperature coefficient (PTC). This correlation is not linear, especially for large temperature regions, but can be compensated for with the Steinhart-Hart equation. Thermistors are inexpensive and widely used for many types of applications due to the small size and reasonable accuracy.

D. pH Sensor
The pH of water is an important parameter in order to monitor because high and low pH levels can have dangerous effect on health. The pH of a solution can range from 1 to 14. One method of measuring pH is through the use of conventional glass electrode with a reference electrode setup, the other is using an Ion-Selective-Field-Effect-Transistor (ISFET).

For this study the pH sensor will consist of the conventional glad electrode as these electrodes are more reliable and economical for long term monitoring. The glass membrane at the bottom, is doped to be ion-selective and is only sensitive to a specific ion (in most cases the hydrogen ion). The pH electrode acts like a single cell battery and there is direct correlation between the voltage output of the electrode and pH of the measured water. The change in the hydrogen ion concentration is related to the hydrogen ions which is sensitive to the measuring electrodes.

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E. Turbidity Sensor

Turbidity is the cloudiness or haziness of a fluid caused large numbers of individual particles that are generally invisible to naked eye, similar to smoke in air. The measurement of turbidity is a key test of water quality.

Turbidity sensors measure the amount of light that is scattered by the suspended solids (TSS) in water increases, the water's turbidity level (and cloudiness and haziness) increases. The particles suspended in water scatter light beam focussed on them. The scattered light is then measured at various angles from the incident light path.

Each sensor produces a signal that requires signal conditioning in order to interface with the microcontroller. The microcontroller is chosen so that multiple analogue signals can be read and processed. The signal is converted to fit within the allowable ADC (analog-to-digital converter) voltage range of 0 to 3.2V. In the case of the flow sensor a pulsed signal is conditioned to interface with the microcontroller's interrupt pin. Once the various signals have been read by the microcontroller the applicable equations can be used to process the raw data into usual measurements. The microcontroller then converts the measured values in float variables to char variables. The char values can then be transmitted across the wireless modules through serial communication. In [1] they use sensors like flow sensor, temperature sensor, conductivity senor, pH sensor alternatives, oxidation reduction potential.

In [4] the system makes use of four sensors (Turbidity, temperature, pH, conductivity) and the Arduino controller connected with Internet of Things. To send and receive data in Ethernet buffers, the Wi-Fi module uses the transceiver which is in serial format. The level of pollution in the water bodies are governed and the sudden warnings are send to the public through messages and alarm.
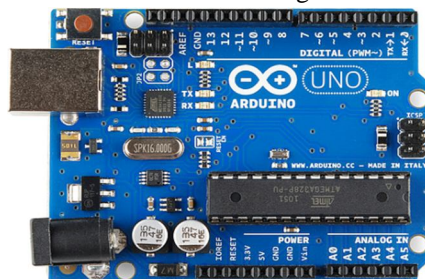

Figure : Arduino Uno board used to communicate the IoT devices.

Figure : Esp8266, Wi-Fi module.

F. Machine Learning

Machine learning is an application of artificial intelligence (AI) that provides systems the ability to automatically learn and improve from experience without being explicitly programmed. Machine learning focuses on the development of computer programs that can access data and us it for themselves.

In this project, we apply machine learning algorithm on our preferred data set which is obtained by the above mentioned sensors which mainly consist of values by pH Sensor, Turbidity Sensor and Temperature Sensor.

Random forest machine learning algorithm and clustering is used in order to classify the water quality as good or bad. The clusters are first formed using historical data set. As mentioned in [6] random forest improves prediction accuracy. Encourages diversity among the tree. In paper [5] Gerard with the mathematics and graphs explains the way in which random forest works. Clustering on the other hand helps divide the data into various set of category. Metrics used here is mahalanobis, method used is Linkage method. To find the maximum distance between cluster u and v we use :

$$d(u,v) = \max(dist(u[i], v[j]))$$

Suitable Machine learning algorithm will be used on out data sets in order to obtain a predictable water quality value which will then be displayed to the user.

III. PROPOSED SYSTEM

In this system we use three sensors (Turbidity, pH, Temperature) and Arduino controller with esp8266 module. The data is first collected from the sensors which are available in the form of bits with the help of Arduino Uno. Collected data is then sent to cloud "ThingsSpeak", a third party server where the data is analysed and graphs are produced using in-built functions with the help of Wi-Fi module esp8266. In previous papers [3], the data is collected and the authorities are alerted on sudden raise. In [1] and [2] the data is collected from various parts and analysed. But in this project the data is collected, processed and with the help of machine learning algorithm like clustering and rain forest to see which cluster does the obtained data belong to.

IV. CONCLUSION

This paper introduces a way to provide accurate, reliable, autonomous, flexible efficient and low operational cost real time statistics to municipalities (BBMP) and other water quality detection and monitoring systems about the impact of cleaning agents in water bodies. It helps provide predictions of the state of water, which can help monitor the water quality. Wireless communication is achieved which provides remote access to the data collected. The current design is able to display parameters in real-time and help perform machine learning algorithms on it and provide predictions.

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