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Comparative Analysis of Various Water Quality Monitoring Techniques

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Abstract— **Water is central to the wellbeing of people. Water quality can be identified by its chemical, physical, biological and radiological characteristics of water. It is a measure of the condition of water relative to the needs of one or more biotic varieties and/or to any human requirement or use. 70% of the earth is covered with water but out of it only 1/3rd of water is consumable. Growing population and industrialization increase the rate of polluting water by many actions like addition of chemicals and toxins through the factory outlet, agricultural run-off etc.**

The WHO estimated that in India about 77 million people are suffering due to not having safe water. It also estimated that 22 % of diseases are related to un- safe water in India. Also, more than 1600 deaths alone cause due to diarrhoea in India daily. Therefore, continuous water quality monitoring is very important for the healthy and hygienic living.

***Index Terms*— Water, Water quality, monitoring, pollution, IoT**

I. INTRODUCTION

Drinking water is precious and valuable for all the human beings. Water pollution is one of the main problems in today's world, which is nothing but the impurity of water bodies. So human well-being is affected by impure water.

So it needs constant assessment and revision of water resource. It has been surveyed that water pollution is the primary cause of deaths and diseases globally. As per the data that has been collected, more than 14,000 people die daily worldwide. In India on an average, 580 people die everyday because of drinking unhygienic water. In many evolving countries, unclean or polluted water is being used for drinking without being treated earlier. One of the causes for this is the obliviousness of public and organizations and the lack of water quality monitoring system which creates severe health issues [7] So Water management is a key issue affecting 21st century globally. Due to worldwide development and rapid mechanisation drinking water resources are becoming scarce. The responsibility of water management is upon everyone living in the society.[6] It is a challenge in the implementation side as it is difficult for the establishments to unceasingly monitor the location of water resources due to limitation especially in human resource, amenities and price of equipment. This often leads to a situation which cannot be handled easily.[4] For that, it is important to have a real time monitoring system that is of low cost, reliable and flexible.[5]

II. RELATED WORK

The conventional method of collecting samples and sending it to laboratories for testing the water quality is prevailing in several parts of the country.[8]

Currently, there are primarily four methods for monitoring water bodies, each of which has its pros and cons:

1) Artificial sampling with portable water quality checking devices and following laboratory testing. This method is applicable only to samples on cross-sections of river and lakes with a sampling frequency ranging from several times a day to many times a month.

2) Live monitoring of water quality parameters by an automated system which consists of monitors, control centers and sub-stations. Data can be remotely and automatically transferred. Each of which provides real-time water parameters. These systems can be costly and have a major impact on the surrounding ecological environment.

3) Water environment monitoring with remote sensing technology, namely sensing the spectrum data of an electromagnetic wave in a non-contacting method with respect to the water body. After the processing of the data from the collection of illustrative spectra, its physical and chemical properties are to be known. However this method can only provide a low precision, and it is also difficult to perform real-time monitoring.

4) Water quality monitoring technology realized using some sensitivity of aquatic organisms to the presence of poisonous substances in water bodies by measuring or analyzing the change of activities of different organisms in different water environments, then coming to a qualitative evaluation report of the water quality. Basic measuring methods of this type

being practiced include Fish Measuring and Beach Louse Measuring. Still, these methods can by no means be expected to reach high accuracy for water environment monitoring.[1]

III. LITERATURE SURVEY

Submerged WSN is the basic way to monitor the quality of water using WSN technology driven by solar pane. To monitor the quality of water over different sites as a real-time

application, a base station and distributed sensor nodes are recommended. A WSN technology like zig bee is used to link the nodes and base station. To design and implement this model driven by solar cell and WSN technology is a challenging work. Through WSN several data collected by numerous sensors at the node side such as pH, turbidity and oxygen level are sent to base station. At the base station collected data is displayed and is analyzed using different simulation tools. The benefits of this system are low power consumption, no carbon release, more flexible to install at the remote site and so on [9]

Good water quality is vital for the health of marine ecosystems. Constant water quality monitoring is an important tool for catchment management establishments, providing real-time data for environmental protection and tracing pollution sources; however, nonstop water quality monitoring at high temporal and spatial resolution remains exorbitantly costly. An inexpensive wireless marine monitoring system will allow cost-effective water quality data collection, assisting catchment managers to keep up the health of aquatic ecosystems. The results indicate that with suitable calibration, a reliable monitoring system can be built. This will allow catchment managers to uninterruptedly monitor the quality of the water at higher spatial resolution than has formerly been feasible, and to maintain this surveillance over an extended period of time. In addition, it helps to understand the behavior of aquatic animals relative to water pollution using data analysis. [10]

Water is a vital natural resource in our life. Quality of water needs to be monitored in real-time in order to guarantee non-toxic and fresh supply of drinking water. For that purpose IoT (Internet of Things) based water monitoring systems such as tank water level sensing monitoring and water pollution checking has been proposed, notifying the user of the real-time water quality parameters. The system measures physical and chemical factors of water quality such as pH, level, turbidity, temperature and humidity. This parameter detects water pollutants. The measured values from the sensors are processed by Wi-Fi module and these processed values are transmitted remotely to the raspberry pi via Wi-Fi and make the raspberry Pi display the data on a simple graphical interface over different time periods. [5]

IV. COMPARATIVE ANALYSIS

There are different instruments like pH meter-to measure pH, Conductivity meter-to measure conductivity, Nephelometer-to measure turbidity and many such instruments in the laboratory to measure the other parameters of water.

The pH meter has to be calibrated and the buffer solutions of 4.01 pH and 9.14 pH should be prepared. Rest of the apparatus are made ready according to the operating procedure. The pH switch has to be pushed out to the pH position and STBY/READ switch to the READ position. We need to wait for some time to obtain the results.

The Conductivity meter has to be calibrated and the standard solution has to be prepared. Rest of the apparatus are made ready according to the operating procedure. Then, the conductivity cell has to be connected to the CELL terminals of the instrument. We only have to select appropriate conductance range and cell constant. The MEAS/CAL switch is pushed out to the CAL position and the readings are displayed after some time.

The Nephelometer has to be calibrated. Next, the standard solution and reagents are prepared. A sample solution is compared against the standard solution and the values are determined.

NAME	INDICATION	FAULT
pH meter	Display doesn't glow	Mains failure
		Fuse blew off
	Standardization not possible/ readings are erroneous	Contaminated buffers
		Defective electrode
Conductivity meter	READOUT is not changing with variation of CALIBRATION control in CAL position of CAL/MEAS switch	Calibration potentiometer is open
	READOUT indicates OVER RANGE during conductivity measurement	Improper range selection
	Conductivity value of the standard solution is not getting set on READOUT	Defective cell
		Selection of wrong cell constant
Nephelometer	When the instrument is switched ON, nothing is displayed on the READOUT	The switch on the power outlet is in OFF position
		Fuse blew off
	0 is not settable with set 0 push button switch	Test tube is defective with scratches, etching and finger prints and/or dirty
		Distilled water used is not turbidity free

V. CONCLUSION

Currently, low-resolution water quality monitoring is conducted, and water samples are collected only a few times for chemical analysis in the laboratory. This means that it is not done frequently on a real time basis and also not in every remote location. It is also laborious and costly for staffs to collect water samples, go back to the laboratory to test and repeat the same procedure for different water resources. Laboratory testing has a much slower turnaround time compared with on-site monitoring.

Therefore, there is a serious need for real-time, on-site, water quality monitoring systems which can provide continuous data of high quality at an acceptable cost with high amount of precision.

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