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TRADITIONAL QUALITY MONITORING TECHNIQUES AND IMPORTANCE OF INTERNET OF THINGS (IoT)

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Abstract
An extremely growth in an industrial and infrastructural frameworks creating environmental affairs like atmospheric changes, malfunctioning and pollution. Pollution is becoming serious issue so there is need to build such a flourishing system which overcomes the problems and monitor the parameters that affecting the environmental pollution. The solution includes the technology Internet of Things (IOT) which is a hook up of computer science and electronics. It can provide means to monitor the quality of environmental parameters like Air, Noise, Temperature, Humidity and light. To monitor pollution levels in industrial environment or particular area of interest, wireless embedded computing system is proposed. The system is using a prototype implementation consists of sensing devices, Arduino uno board, ESP8266 as wi-fi module. These sensing devices are interfacing with wireless embedded computing system to monitor the fluctuations of parameters levels from their normal levels. The aim is to build powerful system to monitor environmental parameters.

Key words : Internet of Things (IOT), wi-fi module

Introduction

According to the US Geological Survey (USGS), water covers a staggering 71% of the earth's surface. This implies that the health of people and the environment are significantly impacted by the general quality of the water in the planet. The phrase "water quality" is used to characterise a water resource's state or environmental health. Based on certain physical, chemical, thermal, and biological parameters, water quality is a measurement of the acceptability of water for a given usage. Thermodynamic characteristics of water quality include turbidity and temperature. Chemical properties include elements like pH and dissolved oxygen. Monitoring of water quality is crucial for environmental monitoring. The water has several applications such as enjoyment, drinking, fishery, agriculture and industry. It is necessary to measure, monitor, and analyse certain water body parameters in order to determine the quality of the water. Poor water quality has an impact on the ecosystem all around it in addition to the aquatic life. A water body's quality, whether it be surface water or ground water, can be evaluated to determine whether it is fit for human consumption.

The World Health Organization (WHO) reported that 2.1 billion people do not have access to clean drinking water at home on July 12, 2017. In other impoverished nations, where contaminated water is utilised for drinking without being properly treated, the situation is even worse. The absence of public understanding of water quality monitoring systems is a major contributing factor to this scenario. This study described the design and implementation of a low-cost IoT system for real-time monitoring of water excellence.

Importance of Water Quality Monitoring and Control

Monitoring water quality is essential because, according to the World Water Assessment Programme (WWAP), two million tonnes of human waste are dumped into waterways every day. Pollution management is crucial for maintaining water quality because 70% of industrial waste is deposited directly into water systems. The following are reasons why maintaining control over water quality is crucial:

- Regularly checking the quality of the water is essential for spotting any concerns that are currently occurring or might do so in the future.
- Access to clean, dependable water is essential for human health and survival.
- With the use of water quality monitoring and control, individuals can better understand the nature and degree of water quality impairments and contribute to the establishment of realistic improvement goals.
- It also identifies long-term trends and approaching critical thresholds, such as rising phosphorus levels that, if left unchecked, might cause recurrent algae blooms.
- Used to inform local populations of the issues affecting their waterways.
- Used to raise the standard of the water.
- Create and develop pollution control and prevention plans. It is quite helpful to have data from water quality monitoring.
- React to aquatic emergencies including oil spills and severe erosive conditions.
- The detection of water pollution and the release of harmful chemicals and contamination.
- Monitoring of water quality offers the unbiased data needed to make wise management decisions for controlling water quality now and in the future.
- Monitoring water quality is used to notify us of new, continuing, and urgent issues.
- Used to preserve other beneficial uses of water as well as to assess whether drinking water regulations are being met.
- Useful for measuring the success of water policies, determining if water quality is improving or declining, and developing new policies to better safeguard public health and the environment.

Lake water is the primary source of domestic water for the majority of Indian cities. Unfortunately, a number of contamination sources are causing the lake's water quality to worsen. The urgency of the hour is to protect our water supplies from pollution. The lack of water available for different uses is another issue, thus new sources of water must be found or recovered. In light of this, it is crucial to monitor the lake system's water quality as a first step towards its rehabilitation. Monitoring water quality aids in determining the causes of pollution, locating polluted stretches of water, and assessing the spatial and temporal variance of various water bodies. The entrepreneurs' ability to develop and properly implement practical solutions for the restoration and protection of our water bodies is aided by the baseline data on water quality. The selection of parameters for water quality assessment depends on the receiving water, the nature of discharges into the receiving water, water use, and any legislative designation relating to the system.

Monitoring the quality of the sediment in addition to the water is crucial. This is due to the fact that sediment quality is a key factor in establishing a lake system's trophic status. Silt, clay, and other soil particles that collect at the bottom of bodies of water are examples of sediment. The examination of residues is a valuable tool in determining the level of environmental contamination since they are indications of the quality of the water beneath them. In the aquatic system, it serves as the primary sink for impurities. The geology of the hinterland, the features of land use, the quality of the water column, the pore water, and the physicochemical processes taking place at the sediment-water interface are all related to the properties of lake bottom sediment. The biogeochemical cycle and the distribution of chemical components in the environment are significantly impacted by human activity. The increased sedimentation is what causes lakes to be swallowed. Generally speaking, aquatic sediments are heterogeneous, dynamic, multi-component chemical systems where there is constant elemental cycling and exchange between the sediment, water, biota, and atmosphere.

Traditional Water Quality Analysis

In essence, water sampling and analysis determined the quality of the water. Guidelines for drinking water quality were provided by the WHO. According to the WHO's guidelines, water samples were collected at designated water source, treatment plant, storage, and distribution sites as well as places where water was distributed to consumers. Sample collection and evaluation times should not be longer than 6 hours, with 24 hours being the absolute maximum.

To ensure quick cooling, these water samples were immediately placed in a light-proof, insulated box with melting ice or ice packs filled with water. If ice wasn't available, the travel time could not go over two hours. It was crucial that samples be stored in the dark and be quickly cooled. The samples should be rejected if these conditions weren't met. To ascertain the water quality, bacteriological and physicochemical tests were performed on this sample of water.

Sampling of Water

According to Lizotte et al. (2015), water sampling changed from 1854 to 1998. Weekly, daily, and hourly water samples were taken in that instance. Hippocratic sleeves were employed to filter the water down to the teeming droplet stage, and a microscope was used to assess the cleanliness of the water. Hippocrates' Sleeve served as an early form of water filtration. This traditional technique involved pouring water into a piece of fabric that had been folded at the corners, usually after it had been boiled, and letting it pass through to promote cleanliness for use in medical operations and treatments.

Figure 1.1 Collection of water sample from river

According to David et al. (2012), water samples were conveniently collected in the field in a sterile bottle and briefly kept in a cooler or refrigerator before being tested in the lab.

Figure 1.1 depicts the acquisition of a water sample from a river using a sterile bottle. The following four field sampling techniques were created: The first approach involves collecting 15 mL of water, preserving it with ethanol and sodium acetate, and freezing it right away. The second method involves filtering the water using cellulose nitrate, the third method uses glass fibre, and the fourth method uses a carbonate filter. The final three techniques demand the measurement of filtered water and pumps. Moreover, filter procedures needed the filter paper to be either frozen or dehydrated in vials of molecular-grade ethanol. Despite the success of all of these techniques, applications for inventory and monitoring programmes will continue to advance thanks to continued testing, standardisation, and improvement of field and laboratory protocols.

Manpower was used to complete the entire process of water sampling and analysis. Testing the water sample in the lab took extra time. To test the water sample, expensive filters and a microscope were also needed. It was impossible to monitor the water quality continuously and in real time. Monitoring every water resource region in the world was quite challenging.

Remo Tesensing

Using remote sensing techniques to assess water quality was explained by Jerry et al. in 2001. Monitoring water quality metrics like turbidity, chlorophyll, and temperature was made possible through the use of remote sensing technology. To detect changes in the water quality parameter, optical and thermal sensors were placed on the ship, the plane, and the satellite. It delivered the time and spatial data required to track changes in water quality. The Global Positioning System (GPS) and the Geospatial Information System (GIS) were used as study tools. A geographic information system, or GIS, is a tool for gathering, manipulating, managing, and displaying geographical or geographic data. Users of GPS, a radio navigation system, may pinpoint their precise location on land, at sea, or in the air.

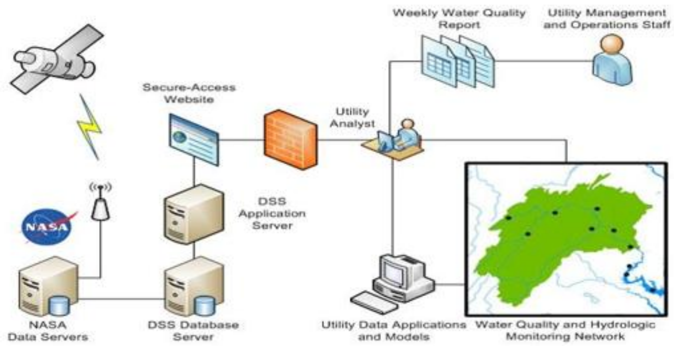

Figure1.2 Structure of Water Quality Monitoring By Remo Tesensing

Figure 1.2 depicts the structure of remote sensing water quality monitoring. The term "remote sensing" refers to the process of gathering data from distant platforms, such as satellites, aircraft, or ground-based booms, regarding objects (such as soil, water, or crop surfaces). The optical sensors on the satellite transmitted the light waves to the earth's surface. The satellite received a reflection and used this information to record various graphical images.

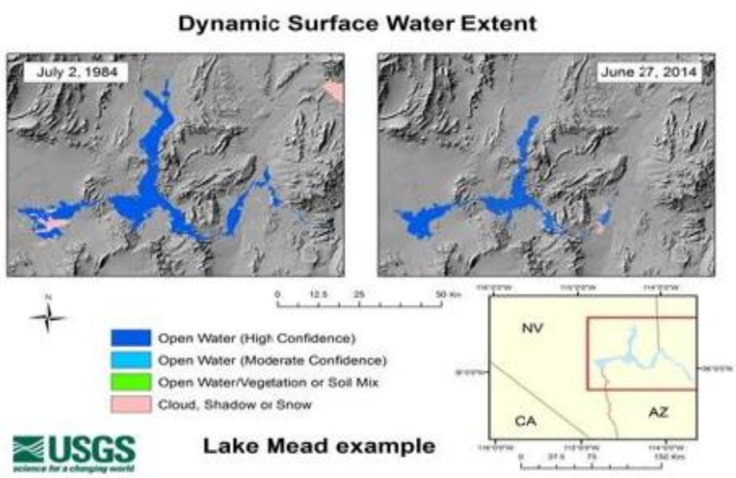

Figure 1.3 : Example Output For Remote Sensing Based Water Quality monitoring

Using GPS, the gathered data was transmitted to the surface of the earth and then to the data server. Utility operations and management workers as well as utility analysts gathered these stored data.

The example graphical result for surface water quality monitoring using remote sensing technique was gathered from the US Geological Survey. As seen in Figure 1.3, this. More open water is likely when the colour is royal blue. Pink indicates the reflection of clouds in the atmosphere. Sky blue colour indicates a slight chance of open water. The colour green signifies a mixture of open water, earth, and vegetation.

The researcher was unable to clearly monitor all water quality measures by using remote sensing technology. Because the sensors and cameras were integrated into the satellite or aeroplane system, the installation costs were also very high. It was incredibly challenging to maintain every component. Only those with a technical background can comprehend the outcomes of a remote sensing approach. Thus, physical sensors are required to monitor the parameters of water quality.

Temperature Sensors

Figure 1.4 Thermistor S520272 Model

The thermistors 520272 models used to measure water temperature are shown in Figure 1.4. The sensor could easily be submerged in water because to the 20' cord length. The primary thermistor parameter is resistance. The resistance of the thermistor changed as the temperature of the water did. The resistance varied between a few ohms and many kilo-ohms. Thermistor is a solid state temperature detecting device. Up to 200 degrees Celsius, it can work. Thermistor has a negative temperature coefficient, which means that when the water temperature rises, it drops or decreases the resistance value.

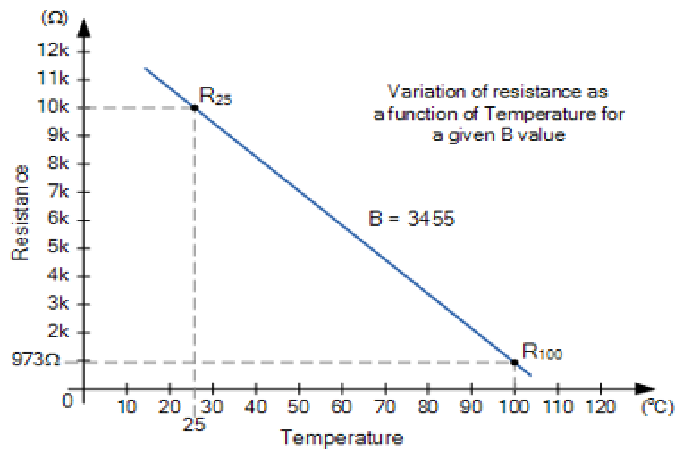

Figure 1.5 Temperatures Versus Resistances

Figure 1.5 plots different water temperatures against thermistor resistances. It only reveals two points, however thermistors typically experience an exponential change in resistance as a function of temperature, leading to a nonlinear characteristic curve.

Figure 1.6 : Hand Held Thermostats to Measure Water Temperature

The conventional method of monitoring water temperature with thermistors is shown in Figure 1.6. The pH sensor, turbidity sensor, and conductivity sensor were described by Che et al. (2015). We shall talk about the specifics of sensors in the section that follows.

PH Sensors

The concentration of hydrogen ions in the water was determined using the pH sensors. Water's pH level is measured with a pH sensor called the DPD1R1-WDMP.

Figure 1.7 : DPD1R1-WDMPPH Sensor

The pH is a crucial sign of a chemically changing body of water. The DPD1R1-WDMP pH sensor is depicted in Figure 1.7. Its pH testing range is between -2.00 and 14.00. The measuring interval is 1 minutes, and the sensitivity is + or - 0.01. It costs approximately $1 021. Pure water has a pH of 7. Water is typically categorised as acidic or basic depending on its pH value, which ranges from 7 to 14. Groundwater systems typically have a pH range of 6.0 to 8.5, while surface water systems typically have a pH range of 6.5 to 8.5.

Turbidity Sensors

A turbidity sensor, such as the LXV421.99.10100, is used to gauge how much water transparency is being lost as a result of suspended particles. The water seems murkier and has higher turbidity when there are more total suspended solids present. Turbidity will result from the suspended aquatic debris, such as clay silt and algae, which lessen the water's clarity. Water clarity is described by turbidity, which is regarded as a good indicator of water quality.

Figure1.8 : LXV424.99.10100 Turbidity Sensor

The LXV424.99.10100 turbidity sensor is depicted in Figure 1.8. It was employed to gauge the water's turbidity. The turbidity measurement unit is the NTU (Nephelometric Turbidity Unit). This sensor had a measurement range of 0.001 to 4,000NTU. The measuring interval was 1 minute, and the sensitivity was + or - 0.001NTU. The temperature range for operation was 0 to 40 degrees Celsius. The cable was 10 metres long. Weight-wise, PVC (Polyvinyl Chloride) weighed 0.52 kg, immersion stainless steel weighed 1.38 kg, and insertion stainless steel weighed 2.4 kg.

Conductivity Sensors

It is a conductivity sensor, the D3725E2T-WDMP. A measure of water's electrical conductivity is called conductivity. The amount of ions present in the water has a direct impact on this ability. These conductive ions are produced by inorganic substances such alkalis, chlorides, sulphides, and carbonate compounds and dissolved salts. Water conductivity is measured with a conductivity sensor.

Figure 1.9 : D3725E2T-WDMP Conductivity Sensor

The Figure 1.9 depicts the D3725E2T-WDMP conductivity sensor. This sensor had a measurement range of 0 to 2,000,000 s/cm. The measuring interval was 1 minute, and the sensitivity ranged from + to - 1 s/cm. It had a 20-foot analogue wire that could be used to submerge sensors.

Compared to sample methods, these sensors have improved the efficiency and timeliness of assessing water quality. But, these handheld sensors were so large and heavy that they needed at least two hands to grasp them. Moreover, these water quality monitoring sensors were more expensive. The use of these sensors prevented continuous and real-time monitoring of water quality indicators. The criteria of the water quality test took extra time.

Internet of Things

Due to its increased use in the ubiquity of smart mobile devices like smart phones, tablets, notebooks, Personal Digital Assistants (PDA), etc., the Internet of Things is a rapidly expanding technology that is pervasive in day-to-day life. In modern digital age, these devices are a part of everyone's life and are used in a variety of settings, as stated in. To build a smart environment, it is necessary to concentrate deeply on the vast array of challenges that are currently available. a beautiful setting for smart organisation is created when a physical environment and a digital and virtual network set come together. The primary goal of IoT-enabled objects is to be "linked anywhere at all time," as shown in Figure 1.10, which explains the connections between IoT-enabled objects.

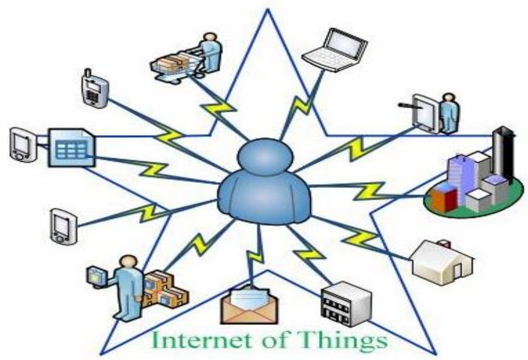

Figure 1.10 Internets of Things

In order to detect and transmit data among things, between things, between humans, between humans and things, and between humans and things, there is a network of physical devices and objects that are embedded with electronics, software, and sensors and then connected using various technologies. Figure 1.11 shows how many smart phone devices will be linked to the internet between 2010 and 2017, growing from 76 billion to 317.1 billion devices via wired or wireless broadband connections. These interconnected gadgets are employed in a variety of industries, including the smart health care industry, intelligent buildings, smart cities, cars, and portable devices.

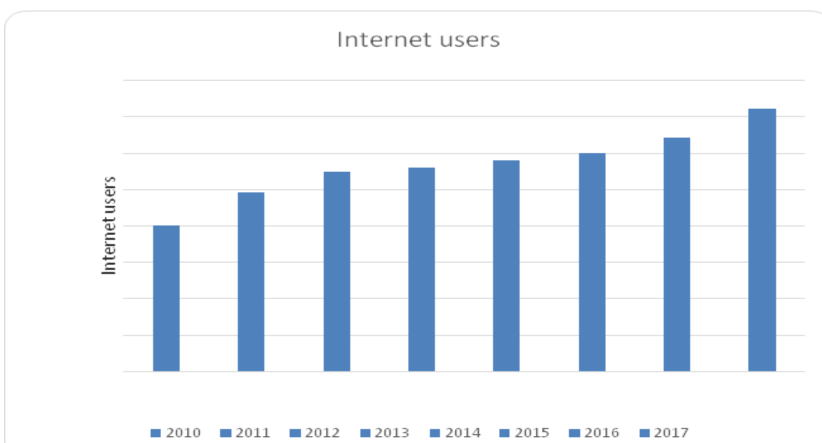

Figure 1.11 Internet Users Ratio

Since a few years ago, research groups have been drawn to smart phones because of their sensing, processing, and communication features. These features include the ability to track user activity signals and positions in various contexts via the phone, transmit real-time trip information to passengers with expected fare and trip duration, and automatically tag digital images on various sets of surfaces.

In IoT applications, it has been stated that globally interconnected technologies including Ethernet, Bluetooth, Bluetooth Low Energy (BLE), Wi-Fi, Zigbee, Z-waves, etc., play a crucial role. BLE is the technology that allows for the permanent connection of power-sensitive devices to the internet. When the effective battery has been used, the BLE sensors will continue to work for many years. Wi-Fi is a practical wireless technology that can lower power or energy consumption and be prepared for massive data transfer using high-speed throughput.

Local Area Networks (LANs) and Metropolitan Area Networks both frequently use the computer networking technology known as Ethernet (MAN). It was commercially released in 1980, and in order to handle larger bit rates and longer link distances, it was standardised as IEEE802.3 in 1981. Zigbee is an IEEE-802.15.4 compliant low power wireless technology that is mostly used for mesh networking and Internet of Things (IoT) applications like smart home automation and remote control units, respectively.

The technology used to connect with numerous devices, including home automation, is called Z-waves. Smart phones now come with more modern features thanks to the Internet of Things, including potent central processing units, large memory slots, built-in sensors (accelerometer, gyroscope, orientation, proximity, global positioning system, etc.), and sophisticated communication technologies. IoT enables devices to have user-friendly features including processing contextual information, processing relevant information, and having increased security and privacy. The availability of so many cutting-edge features and services on smartphones has led to their incorporation into daily life.

Architecture of Iot

After static online pages and social networking-based web, the Internet of Things (IoT) is seen as the third wave of the World Wide Web (WWW). The Internet of Things (IoT) is a global network that connects many types of items at any time and anywhere using the Internet Protocol (IP). The majority of researchers believe that the traditional IoT architecture consists of three layers:

Application Layer, Network Layer, and Perception Layer

In addition, several researchers looked at a support layer, which sits between the application layer and the network layer and is also a part of the most recent IoT architecture. Fog computing and cloud computing make up the support layer. The cloud is currently the most popular research topic.

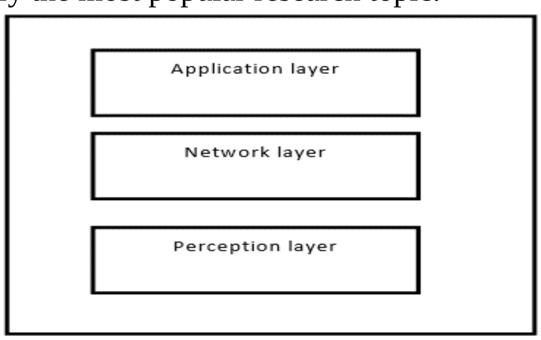

Figure 1.12 Architecture of Iot

The IoT's basic architecture is shown in Figure 1.12. Yet, other experts believe that the Internet of Things is made up of four layers. The fourth layer, which sits between the perception and network layers of the traditional IoT architecture, is regarded as a support layer. Technology employed in this new layer include cloud computing, intelligent computing, fog computing, etc. The recognition layer is another name for the perception layer. The lowest layer in the conventional IoT topology is the perception layer. The main duty of this layer is to gather relevant data from items or the environment (such WSN, heterogeneous devices, sensors of real-world objects, humidity, and temperature, etc.) and translate it into a digital arrangement.

Unique address recognition and communication amongst short-range technologies like RFID, Bluetooth, Near-Field Communication (NFC), and 6LoWPAN are the main functions of items (Low Power Personal Area Network). The typical IoT architecture's brain is located at this layer. The main duty of this layer in an IoT architecture is to facilitate and secure data transmission between the application and perception layers. This layer primarily gathers data and transmits it to the perception layer for delivery to various servers and apps. The internet and communication-based networks have converged at this layer. Researchers recently concluded that the network layer of traditional IoT architecture is the most advanced layer after studying different communication-based technologies. The IoT's fundamental layer (network layer) is able to forward the information needed for pertinent procedures. IoT administration was handled by tasks pertinent to data processing.

Conclusion

Always essential to daily existence is water. Water management and conservation are essential for human survival due to the current state of the environment worldwide. Particularly susceptible to pollution is water. More substances can be dissolved by water than by any other liquid on earth, earning it the moniker "universal solvent". It's also the reason water is so easily contaminated. It is easily dissolved and mixed with toxic compounds from companies, municipalities, and farms, which results in water pollution. Humanitarian projects based on consumer demand have recently been in great demand and may be built quickly using IoT technology. The relevance of water quality monitoring using the architecture model of IoT technologies was explored in this paper, along with numerous traditional water quality analyses from the last 50 years and their shortcomings.

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