A Review of IoT based Water Monitoring System

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Abstract- Natural resources like water are vital for maintaining life. Water scarcity is a problem in many parts of the world due to leaks and overuse of this precious resource. Technologies for remotely detecting leaks and water consumption, alerting consumers and permitting the disruption of the water supply may be important. Minimize costs contribution to achieving this goal. This study suggests creating, building and validating a clever system for remote water use monitoring, identifying water distribution leaks and disruptions. It has been shown to work for smart buildings and is simple to use in various surroundings that are connected. It was validated, demonstrated, evaluated and is ready for use.

Keywords-Intelligent Environments, Intelligent Communities, Water Consumption, Intelligent Consumption, Internet of Things (IoT).

I. INTRODUCTION

Up to 71% of the earth's surface, or about one-third of it, is believed to be covered with water. However, just 0.08% of that is available as fresh water pertaining to humans and other living things. The principal of fresh water origins suitable for human consumption and to the living things is the surface water accessible as a result of rainfall that also replenishes aquifers, lakes, and other water sources. The issue the country is facing a lack of water. The recent century has seen a rise in intensity. It is important to give the globally sustainable management of water substantial thought. There are many uses for water. Applications like aquaculture and irrigation. The monitoring system keeps track of the biological, physical, and properties of the water's chemistry. The specifics typically employed in applications for monitoring water quality Conductivity, pH, turbidity, and the amount of dissolved oxygen (DOC), nutrient-specific substances, such as sodium & potassium. All water monitoring systems will typically have three core architectural layers: layer for data collection, data processing as well as transmission. The layer of data acquisition is constructed by a vast number of wireless sensor networks connections. The strategies for data transmission include Ethernet, GSM, and ZigBee. The portion of processing will comprise the surveillance instruments, IoT systems like Ubidots for visualization. The sensor data for water monitoring includes pH, water depth, water temperature, DOC, and water level cloudiness, etc. The controller must combine all of the data then email it to the user. All of the data must be combined by the controller before being sent to the user. The controller must compile all the data before sending it to the user. It might be accomplished using GPRS, ZigBee, GSM, Ethernet, etc. Depending on the need for data and its importance, you have a choice of communication method. The goal of the monitoring the water's parameters is the application. By means of software will enable the user to keep track of water-related real-world scenarios' parameters.

Industries use the majority of the fresh water that is available for uses other than agriculture. More water is being used as a result of industrialization and urbanization, particularly in large companies and nuclear power plants for cooling. Minimizing delays and filling the gap is the top priority which shows that typically developed water is distributed for various purposes and water resources are apportioned and new management measures must be put into place. With this in mind, the initiative specifically focuses on tracking water use. Since monitoring will aid in further regulating and distributing water resources evenly in accordance with region and resource availability in each location. Since monitoring will aid in further regulating and distributing water resources evenly in accordance with region and resource availability in each location. For this project, it would be excellent to track water usage by specific housing complex and upload that information to the Off-base Data Center with the help of IOT technology and receiving updates on water usage via the cloud to the app on a mobile device. The updated mobile freeware aids in reducing water consumption because it informs users of their usage limits and the associated additional fees they will incur if they exceed them. People will start using water wisely and may not overuse it when water is charged based on usage and after a particular threshold is exceeded.

This article examines several IoT-based sensors, controllers, platforms, and approaches for managing water quality and controlling water management systems. There is no agreement on the metrics that should be applied to evaluate various aspects of water. The metrics are contrasted to show the benefits or drawbacks of each technique.

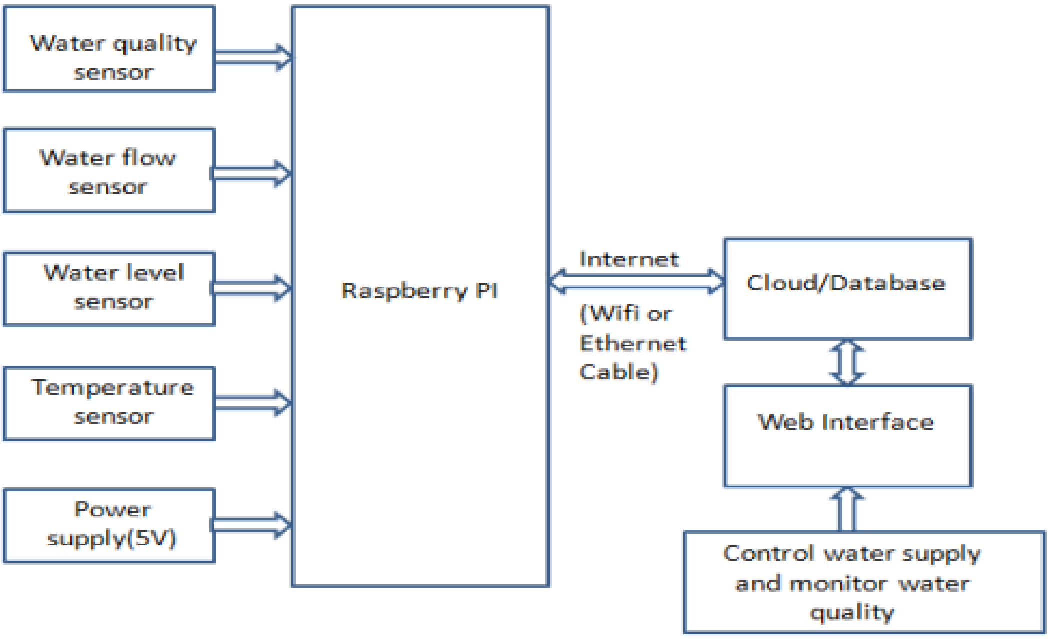

Fig 1. Block Diagram of The Proposed System.

The overall block diagram is show in **Fig 1** and consists of various sensors being connected with the core controller. The controller accesses the sensor values and processes the data and transfers it over the internet. The controller used here is chosen such that it can upload sensory values on the cloud over the internet.

II. EXISTING WORK REVIEW

A method for evaluating the water quality inside pipes that makes use of "Internet of Things" technology was proposed by S. Geetha et al. in 2016. The model is employed for both the evaluation of water samples and the analysis of online data. The method also addresses deviations from the predetermined parameters and enhances water accuracy. Additionally, a controller was utilized which had a built-in Wi-Fi module is used to manage parameter pH, turbidity, and conductivity using a less complex, less expensive water quality management system. The device also offers a warning function to notify the user of changes in water sub-standard. The experimental design computes conductivity, potential of hydrogen, turbidity, temperature, and water level, among other factors. The Ubidots network is connected to the installation. The estimated results are put into a connection with the WHO's guidelines for the quality of drinking water [1].

S. Hwang et al. proposed a real-moment input data system from Internet of Things modulars in 2017[2]. Using an Android phone, they remotely controlled and maintained the drip watering system for the smart farm. Zigbee transfers data between several nodal points. The programme delivers real-moment data grasping and display on a various nodal networking server using website-biased Java tool kits. Wireless management of outdoor plants and horticulture irrigation systems enables remote monitoring and control of an irrigation system. Thanks to the advancement of cloud computing, the enormous amount of data created by smart sensor networks can now be properly handled. Both an automatic and a manual model of the device exists. Real-time sensed data is processed for decision-making and behaviour monitoring on the cloud server. The Android app used by farmers to coordinate activities and irrigation can be observed and tracked by subscribers.

In 2018, B. Alomar et al. [3] put out a fuzzied logic-dependentwatering system based on the IoT that will increase agricultural yield rate while reducing irrigation frequency. The water pump's flow is controlled by a Mamdani fuzzy controller, which collects environmental data from sensors and utilizes fuzziedconditions to deliver water at the relatable and relevant time and intervals. This might be designed and produced using some freeware. In order to give an educated watering ideas some solution for water saving and improved wateringgovernance in areas of high water requirements, fuzzy logic and IoT design firmwares have been proposed. With the help of component functions based on Mamdani fortification, the produced fuzzy controllers successfully determines the length and duration of irrigation for a certain crop. Fumigation control is used to maintain soil moisture above a desired level with progressive changes that avoid device depletion from reoccurring and conserve water and energy.

A system that would permit access for specific people with the right to access mechanical controls and other members of the community to report problems with water pollution, leaks, and water status was presented by M. Bennet et al. in 2018 [4]. The development of the agreement can be closely monitored. This approach of water management has helped people who own mobile phones engage with their communities. The system is designed to leverage the IoT module, which is the primary source for system modules. In their suggested method, the authors used the pic 16f877a as a micro-controller. With the aid of this cloud and micro-controller, the highest and lowest peak speeds are possible. The controller board gathers these readings and the moment the high peak current value is reached.**Fig 2** shows the schematic diagram of a remote wireless sensor network for water quality management.

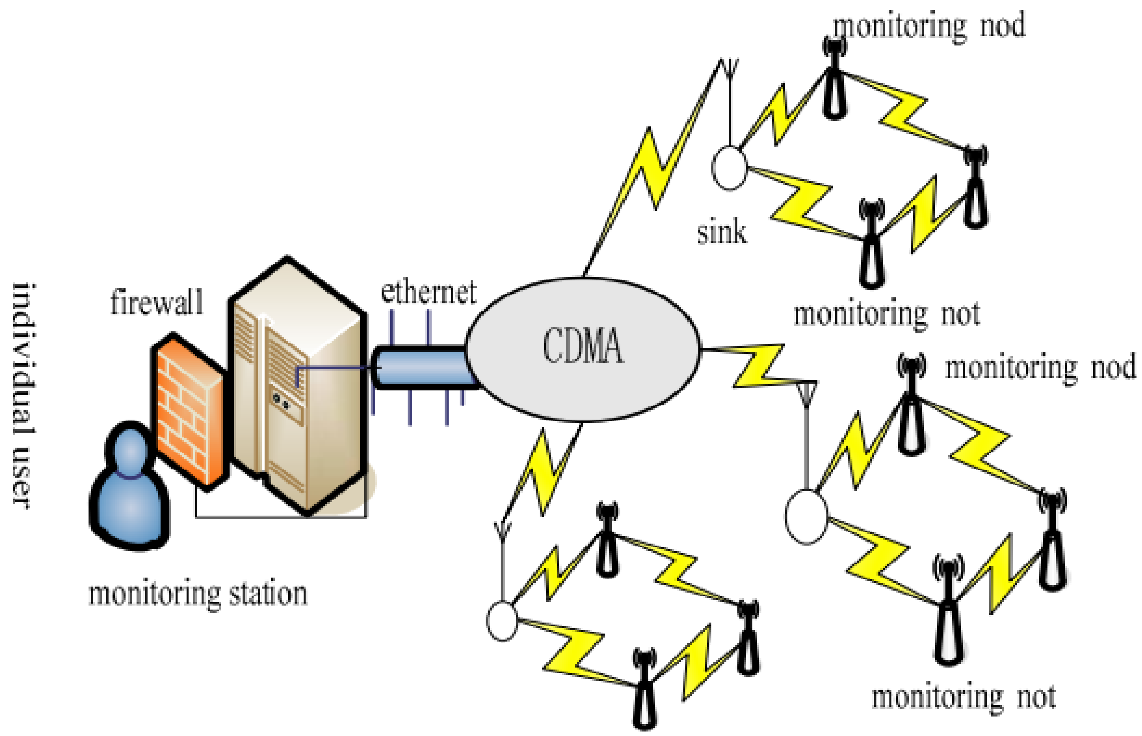

Fig2. Schematic Diagram of a Remote Wireless Sensor Network for Water Quality Management.

This typical wireless sensor network retains gateway nodes and several nodes which have been designated and set in the environment of interest. Each and every node is obliged to find and transmit information either directly or through a hopping method. In the hopping method, the implementation is handled in such a way that the software modules aid the hardware and a joint output is made available. [1]

A device that can be continually monitored by smart-phone apps from any location was proposed by K. Gupta et al. in 2018 [5]. It is feasible to automate everything intelligently, including the engine on its own. It is a little bunch ofcomponents that are strong and simple to arrange. Through the idea, locals can use their cellphones to remotely govern and manage the water management structure. In the event that the water amount drops below a predetermined level, the project will make it simpler for the business management to take the necessary actions. An ultrasonic water depth indicator and a turbidity sensor are the main tools used in the project. The sensing device will constantly check the available water present in the moment and send updates to the residents of the building via the offsite data system,. The secretary will be able to use this as the water level falls to call for a water tanker. Important features of water quality are measured by turbidity sensors, which is helpful when selecting water utilities because historical data was incorporated in a comparison bar of proportionality vs. quality.

In 2019, the need for creating a framework for remote managing of water utility system was needed so that it can identify corrections and issues was emphasized by H. D. Paula et al. in their study[6]. Nanotechnology can be used in a variety of real-world applications. The suggested remedy made use of an IoT strategy and is easily adjustable for this kind of system. It was verified, investigated, assessed, and proven. The suggested method can stop leaks by turning off the water supply. Users and other programmes can access the data that sensors have collected by using IoT middleware. IoT freeware employs both the Push/Pull architecture and the Message Queue Telemetry Transport (MQTT) protocol. The duties of the middleware include data storage, display, and transfer to other IoTrelated devices which can fastrack actions depending on sensor outputs and available data.

It was suggested to create a intelligent water management system that can foresee the user's water use over time by A. Hasibuan et al. in 2019[7]. This water management system uses the IoT. They have a water actiondetection sensor built into a Node MCU CPU. In the water outflow, they installed a microprocessor module with sensors. When collected, the information will be maintained in an off-site database system storage. With the aid of this specially created application, users will be able to have an idea of their water usage in actual time. On an online portal, one may see how the water is used. Any activity involving water is made into a vocabulary word off-site system storage. These then calculate the amount of information gathered for water management, and each user’s water consumption activity is classified as either using more or less water. The quantity of water consumed can also be used to predict behaviour.

2019 saw C. Patel et al. making a remote management and action overseeing system for Internet of Things-based monitoring and output managementof flow rate was installed at the end of the ultrasonic sensor device and water pump in order to regulate the water or liquid level in the primary sources. So, adding chlorine to water helps maintain its quality. You can assess the condition of the remote-control region using this web-based tool for smart phones. On Android smart phones, these recorded data are exhibited in real time. All consumers' essential problem of receiving an equal amount of high-quality water at a steady flow rate is solved by the proposal. A manual valve that alters the direction of flow in a valve with a step kind of engine rotation ensuring the same transfer rate. Customers' objections are reduced because they only pay for the water they actually use.[8]

N. Rapelli and co. [9] in 2019 payed attention to how much water is used in large residential complexes and ensure efficient water management. This article's main subjects include water supplying, management, and waste-water recycling. This model had guaranteed that the water marking is taken care of constantly. The solution has been put into effect using IoT connectivity and an embedded system. The central location's storage requirements and water usage are continuously updated by the system. The cloud will be used by IoT to update all data. A smartphone application will let users to communicate with the demand, tracking, and payment system.

R. Jisha et al.[10] provide utilities and solutions for domestic and agricultural water demands in 2019. According to LUCC, using smart IoT can considerably aid in the solution of a variety of issues. In addition to automatically utilizing the electricity from the wall socket, it also warns its users via their mobile phones of any water waste from household usage. The soil and the water marking in the water tank can be monitored from afar thanks to technology. The level of ultrasonic rays the ultrasound sensor releases that are reflected by striking the water surface is used to calculate how much of the water container/tank an ultrasound sensor is attached in. The amount of water in the water tank and the soil are both indicated in a moisture status notice that is sent to the user's phone.

Steven Sachio [11] provided a solution for water not to be wasted during filling or valve closing in domestic usage. The approach utilized a controller which was ESP 8266 which monitored the water levels. The controller was used to turn the valve or pump ON/OFF automatically to prevent the wastage of resources due to overflow and valve closing. The water was sensed using an ultrasonic sensor and blynk IOT service to provide water level monitoring as well as control was introduced with the help of PHP web programming. Fig 3 shows schematic diagram of a water monitoring system.

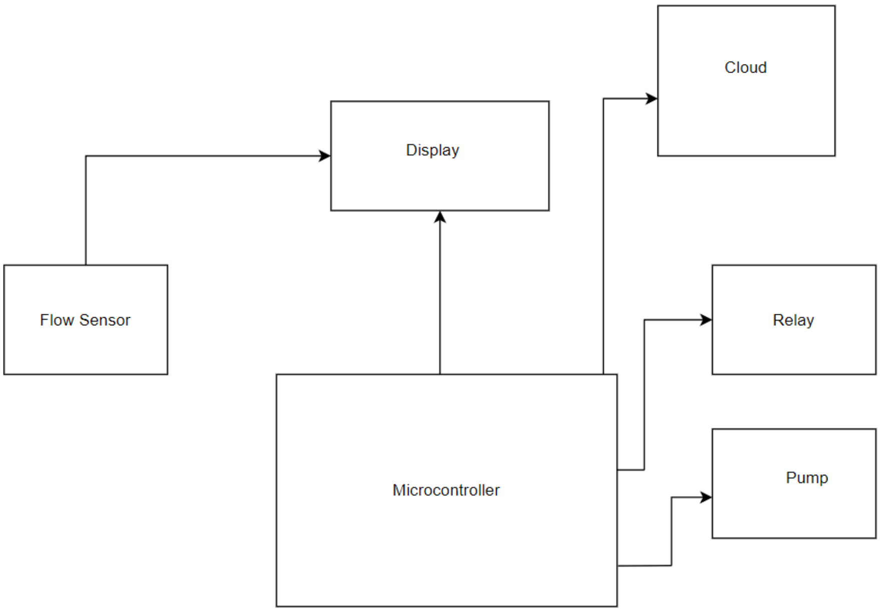

Fig 3. Schematic Diagram of a Water Monitoring System.

Geetha. S[12] had come up with a smart solution with advanced communication technologies for water management. The source presented a detailed view of all the recent works carried out in the field of Intelligent Water Quality Management. An economical method was provided to monitor the in-pipe water quality which was entirely based on IOT. The developed model was used to test water samples in various pipes in various areas of a town to monitor and upload the data using IoT. The system was also designed in such a way that, if there was any deviation, it could be intimated to a user by a comparison of pre-set data values.

Mithila Barabde [13] brought about a solution to prevent water pollution by monitoring the water parameters like pH, Nitrogen Levels, Oxygen Levels, etc., The authors compared the current process which is chemical tests conducted manually which was very time consuming and is also a very costly affair as it required software's, test kits, samples and what not. To speed up the process, they recommended that the testing module itself be placed in the river or at the place needed to be monitored. The data collected is sent over remotely and is thus a little time saving in nature. Each and every data collecting node is connected to the wireless communication hub and the data collected by the model can be viewed visually on a system.

R.M. Atta [15] believed that the management of water becomes a concern for both the governors and community as water use rises in desert nations like Saudi Arabia. The problem also includes providing consistent, high-quality water at a reasonable price. In this study, we provide a intelligent water management system that may be applied in buildings where there is no constant water flow and water is instead opted out to be stored in large tanks beneath the buildings. The suggested smart system uses LoRa communication technology to control the water flow between underground tanks and other tanks as well as govern the quality of stored water.

R.Saravana. K [16] trusted that Numerous diseases around the world have their roots in water contamination. For the purpose of preventing water pollution, sensors must be used to measure the parameters and quality of the water. The linked works continue to have issues with accuracy, communication and so on. In this research, we suggest a new SCADA system for actual time water quality management that combines with IoT technology. The Tirunelveli Corporation uses the technology to automatically collect sensor data. The SCADA system has been improved with more sensors and at a lowered cost. The outcomes demonstrate that the said system performs better than the ones in use and yields superior outcomes.

According to Brinda Das [14], the conventional method of assessing the water quality is manually collecting samples of the water and sending them to a facility for testing and analysis. This method is labor-intensive, time-consuming, and inefficient. As part of the water quality monitoring system we have set up, a different sensor measures the pH, conductivity, and temperature of the water in real time. The data collected by the sensors is wirelessly transmitted to the microcontroller through the system's ZigBee module.

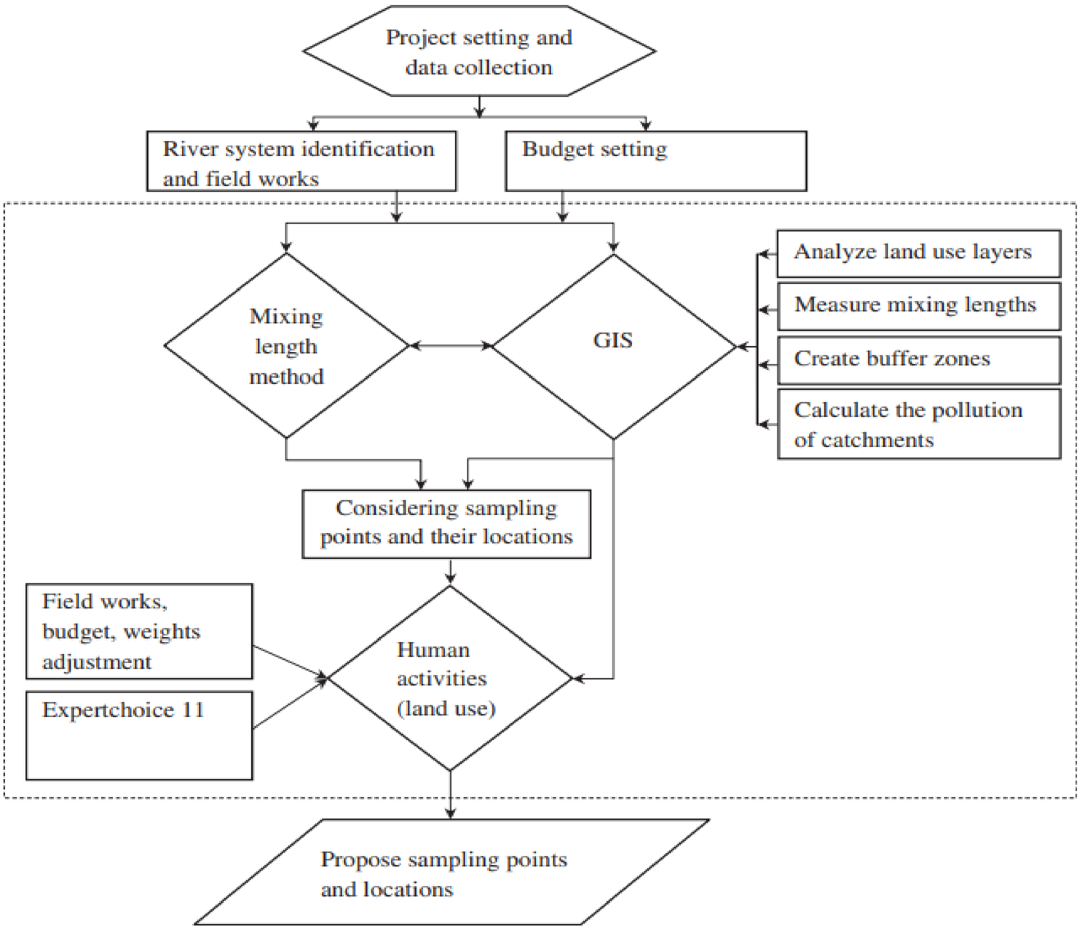

Fig 4. Outline of The Procedure to Monitor River Water Samples.

Manish Kumar Jha [17] believed that this study intends to develop a Smart Water Monitoring System (SWMS) for managing water usage and quality in actual time. The Intelligent Water Quantity Meter and the Intelligent Water Quality Meter are its two components. Utilizing a three-slab billing method, consumption bills are generated based on the amount consumed. By analyzing five qualitative aspects of water, the Intelligent Water Quality metre verifies the quality of movable water that the consumer receives. The technology makes sure to stop any potential threats or health risks brought on by unintentional sewage seepage or farm release into the transferable water.

KweeSiong Tew [18] came to an understanding that anthropogenic influences are degrading the coral reef ecosystemswhich has led to a decrease in coral cover. It is crucial to comprehend how changes in water maintainability impact these ecosystems on a precise period in order to stop the ongoing degradation of these coral reef settings. In order to do this, Nanwan Bay began using a real-time water quality monitoring system in 2010. We discovered that during 2010 and 2011, natural occurrences, such as cold-water incursion brought on by upwelling, tended to cause temporal alterations in coral spawning. Furthermore, in the summers of 2010 and 2011, DHW's, a commonly used predictor of coral bleaching.

Meghana. M [19] came to a conclusion that fresh water is incredibly important for human life, business, and agriculture. In many nations, this has developed into a significant problem. As a result, an effort is tailored to measure the crucial and critical factorsin water bodies and to ascertain the degree of water destruction. In this study, a system that was created to detect water's turbidity, dissolved solvents, pH, and temperature is described. The characteristics of the water have been taken into account for aquatic life, vegetation, and drinking. The system that was designed has the appropriate sensors to measure water parameters.

Michael V. Storey [20] arrived at a judgement that in the event of an unintentional contamination, technology for sourceof watersafety, treatment options, and delta distribution management have made significant strides and have struggled in recent years. The requirement to assess data in real time and put a management method into place in response further supports their viability. These findings are based on visits to top water utilities, research institutes, and technology companies in Europe, the US, and Singapore that are engaged in the creation and application of online monitoring technology for the identification of contaminants in water.

This approach overcomes the problems by taking into account the limitations of earlier water management models and employing the cloud to store sensor data. This will guarantee data security and stop data loss. The water level sensor in our model also provides actual time data on the water or liquid level in the water storage tank. Supply of safe water or liquids will be ensured via quality assurance. Data is shown on the website, therefore using the website as opposed to the application gives faster access to the data from any location.

The system for water environment monitoring is designed based on a WSN which has been iterated and shown in the **Fig 4** above and was divided into three parts namely: data monitoring, database transmission and remote monitoring from a data center. A number of nodes are to be detected and they directionally constitute the contents of a management network. [2]

The **Table1** shows the data collected by a river water quality management system with experimental data from 1991-2001.

Table 1. Data collected from 1991-2001

Data collected in the study	**Outcomes**
Used by few workers in GUMTOW	Identified species distributed data, generic data, etc., [4]
Patrick, Roberts	Number of Species present, pH levels, water quality, pollution level, etc., [5]
Patrick, Roberts	River water distribution, water flow levels, flora, fauna and so on [6]
Kolkwitz, Marsson	Basis for subsequent methods, single algae found in the river [7]
Descy, Douglas	Distinguishing of species of algae, particles, etc., [8]
Leclercq, Cambra	Acid levels, Fast flow of water, Effect of water flow on water quality, mineral levels, eutrophication, pollution increase in Europe [9]

III. FUTURE SCOPE

In this model, we are to implement a microcontroller which controls and manages the water which is being sent from the water tank to various houses in the villages in and around the area. A flow sensor is to be integrated to help control the flow of water and an app has been integrated with cloud to sync all the values and data from the module to the cloud with the help of an internet connection. The app notifies the user of the water flow levels in various areas as well.

IV. CONCLUSION

In the existing studies, the authors suggested a new SCADA system for actual time water factors management that interacts with IoT technological breakthroughs. The system now includes physical parameters like temperature, turbidity and colour. By utilizing the GSM module, this actual time programme produces, gathers, transmits and off-loads sensor data in the website/off-site database server. Instant reports were created after data processing and could be seen in a web browser at anytime and from any location. This system was created to streamline the distribution and monitoring of water while also lowering costs and increasing efficiency. Experiments confirm that the suggested system performs well and future plans include employing capable algorithms with an ON/OFF capability in water distribution stations for real-time data processing.

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