

# IOT Integrated Water Quality Monitoring System

A. Annie Steffy Beula<sup>1</sup>, K. Ezhil Vignesh<sup>1</sup>, S. Epsibha<sup>1</sup>, M. Suvatha<sup>1</sup>, G. Saravanan<sup>1</sup>

**Abstract:** The system is designed to provide comprehensive monitoring of water quality parameters, including pH level, and turbidity, in real-time. Central to the system is the utilization of advanced sensors integrated into a Node MCU microcontroller, which serves as the main control unit. The pH sensor monitors the acidity or alkalinity of the water, which is crucial for determining its suitability for various applications. Additionally, the turbidity sensor measures the cloudiness or haziness of the water caused by suspended particles, offering valuable information about its clarity and overall quality. The collected data from these sensors is transmitted wirelessly to an Internet of Things (IoT) application, where it is visualized and analysed in real-time. This enables stakeholders, including water management authorities, environmental agencies, and end-users, to monitor the quality of water remotely and take timely action if any anomalies are detected. The IoT application provides user-friendly interfaces and dashboards, allowing for easy interpretation of the data and facilitating informed decision-making. This ensures efficient distribution of water while maintaining its quality throughout the delivery process. Additionally, a filtration mechanism is integrated into the system to further enhance water quality by removing impurities and contaminants. This multi-stage filtration process ensures that the water delivered to end-users meets stringent quality standards and is safe for consumption and various other applications. The data from this sensor is seamlessly integrated into the IoT application, providing a comprehensive overview of water quality across the entire system.

**Keywords:** Water Quality Monitoring, IoT Monitoring, Real Time Monitoring, pH and Turbidity Sensors, Filtration System.

## 1. Introduction

Access to clean and safe water is fundamental to human health, economic development, and environmental sustainability [1-2].

However, ensuring the quality of water resources has become increasingly challenging in the face of growing population, urbanization, industrialization, and environmental degradation. Contamination of water sources with pollutants, chemicals, and microbial pathogens poses significant risks to public health and ecosystems [3]. Therefore, there is a pressing need for innovative technologies and solutions to monitor, manage, and maintain water quality effectively [4].

In response to this challenge, this paper introduces an integrated IoT-based water quality monitoring and management system aimed at providing real-time insights into the quality of water resources. The system employs advanced sensors, wireless communication technologies, and IoT platforms to enable comprehensive monitoring, analysis, and control of water parameters [5-7].

### History

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A. Annie Steffy Beula

[anniesteffybeula@gmail.com](mailto:anniesteffybeula@gmail.com)

<sup>1</sup>Department of Electrical and Electronics Engineering, Stella Mary's College of Engineering, Kanyakumari – 629202, India

Central to the system is the utilization of state-of-the-art sensors, including pH, and turbidity sensors, integrated into a Node MCU microcontroller. These sensors are strategically deployed at key points in the water distribution network to continuously monitor the quality of input water. The pH sensor monitors the acidity or alkalinity of the water, while the turbidity sensor measures its clarity and presence of suspended particles [8].

The collected data from these sensors is transmitted wirelessly to an Internet of Things (IoT) application, where it is visualized, analysed, and stored in real-time. This enables stakeholders, including water management authorities, environmental agencies, and end-users, to monitor water quality remotely and take prompt action in response to any deviations from acceptable standards [9-11]. The IoT application offers intuitive interfaces and dashboards, enabling easy data interpretation and informed decision making [12].

Furthermore, the system incorporates smart and filtration mechanisms to ensure efficient distribution and enhancement of water quality. A multi-stage filtration process removes impurities and contaminants, ensuring that the water delivered to end users meets stringent quality standards and is safe for consumption and various other applications. This feedback mechanism enables continuous monitoring of water quality at different stages of the distribution network, ensuring the delivery of clean and safe water [13-15].

Moreover, the system leverages the BlynkIoT platform, enabling seamless integration with mobile devices and remote access to water quality data. Users can monitor water parameters, receive real-time alerts, and remotely control the system through the Blynk mobile application, enhancing transparency, accountability, and user engagement [16].

In summary, the integrated IoT-based water quality monitoring and management system presented in this paper offers a holistic approach to addressing the challenges associated with ensuring clean and safe water resources. By leveraging advanced technologies and innovative solutions, the system enables proactive monitoring, efficient distribution, and continuous improvement of water quality, thereby contributing to

the sustainable management of water resources and the well-being of communities.

The remaining paper is organized into following sections. Section 2, presents about the literature survey, Section 3, presents the existing system, Section 4, about the proposed system, the results are discussed in Section 5, and the conclusions are presented in Section 6.

## 2. Literature Survey

### 2.1 Case Study of Area of Agriculture, 'Agco's Fuse Technology's Connected Farm Services

Embedded with the Internet of Things, the Smart Agriculture vision is analysed in this case study. Smart Farming techniques offered by leading Agriculture Company AGCO's Fuse Technology's 'Connected Farm Services' are under study. The study presents a future projection of smart connected agriculture objects and processes and the scope of the internet-driven applications in the agricultural field. SWOT analysis has been used to analyse the issue under study. Case has been explained in majorly five portions, introduction, Smart farming operational Fundamentals, Smart Agriculture by AGCO, SWOT Analysis, Conclusion. a network of smart physical objects interconnected with the virtual objects to formulate a digital web of connected things through a combination of data capturing techniques along with sensor devices, forming a two-way communication network which can be remotely accessed, monitored or triggered. An extension of the internet and web services is used to establish a connection among things using a network cloud of sensors and computing devices [17-18]. The Internet of Things operation consists of a conjunction of real-time processing and ubiquitous computing; an expansion with brimming opportunities with the ability to provide smarter services to the environment or to the end user. The Internet of Things is a giant network connecting things, applications, people and data through the internet that enables digitally controlled, managed and interactively connected services. According to market prediction, Smart defines a state-of-the-art technology that performs the purpose appropriately with the use of the internet and can be used with the link of other things and technology. Smart things have the capabilities of state transitioning and intercommunication with a

higher level of compatibility with the surrounding objects as well as with the techniques both physical machines and with the virtual phenomenon. This case study features smart things which have changed the face of conventional agriculture. Study explains and analyses the use of Internet of Things in Smart Farming. The case under study is world's top agricultural Equipment Company, AGCO. Agriculture field is under study to analyse the scope of Internet of Things applicable to this field.

### ***2.2 Developing Smart Agriculture Applications: Experiences and Lessons Learnt***

Smart agriculture applications are promising to improve traditional agriculture in developing regions. Farmers use these applications to collect data on agricultural activities and monitor different conditions in modern farms. However, from a development point of view, these applications are often implemented using text-based programming languages that require experienced programmers. Visual languages can be an alternative to text-based languages that may allow non-expert programmers (e.g., farmers) to implement these applications and make adjustments to existing ones. This study considers two exemplars of concrete and deployable smart agriculture applications (WebLog and UtafitiLog) developed using two different technologies. The study defines a set of parameters to evaluate these exemplars from which lessons are drawn that can be generalised to other smart agriculture applications [19-20].

Smart agriculture aims to improve processes in modern farms to handle the increasing global demand for food. In developing regions, smart agriculture is partially realised by means of distributed mobile applications running on smartphones. Farmers in these regions have the applications installed and configured on their smartphones from where they can collect data and monitor environmental conditions on the farm. Farming activities in these regions happen in small-scale farms, typically located in remote areas that are faced with intermittent network connection issues. These intermittent network connection issues contribute towards lowering adoption rates for smart agriculture applications in developing regions. Also, the nature of modern farms requires distributed mobile applications that can be reconfigured to serve different crops and

farming seasons the data parameters to be collected vary for various crops and farming seasons. These applications require to be extended and reconfigured to meet the varying data parameters for various crops or farming seasons. Hence, developing mobile software applications is emerging as one of the vital sectors in smart agriculture to promote sustainable food security. However, programmers face several challenges while developing these applications, including changing application scenarios and, as a consequence, application requirements, limited development time, and intermittent network connection issues. During implementation, developers can use either text-based or visual languages to address the aforementioned concerns and the resulting challenges. This study considers exemplars of two concrete and deployable smart agriculture applications (WebLog and UtafitiLog) implemented using two different technologies. The study defines a set of parameters to evaluate these exemplars from which lessons are drawn that can be generalised to other smart agriculture applications [21].

### **3. Existing System**

The existing water management system is designed to automate the monitoring and control of water levels in a tank using an Arduino Uno microprocessor and integrated sensors. The system aims to address challenges related to manual monitoring and inefficiencies in traditional water management practices. It presents a summary of the system's functionality, components, and benefits. The core components of the system include an Arduino Uno microprocessor, a moisture sensor, and a flow meter. The moisture sensor is responsible for detecting the moisture level in the tank, while the flow meter measures the rate of water flow into the tank. These sensors provide real-time data to the Arduino Uno, enabling intelligent decision-making regarding the operation of the system.

The system operates in two primary modes: filling mode and overflow prevention mode as shown in Fig. 1. In the filling mode, the system activates and opens a valve to fill the tank when the moisture level falls below a predefined threshold. This ensures that the tank remains adequately filled to meet the desired requirements. Once the tank is filled, the system transitions to overflow prevention mode, where it

monitors the flow rate using the flow meter. If the flow rate exceeds a certain threshold, indicating a potential overflow situation, the system takes corrective action by closing the valve and stopping the flow to prevent wastage of water.

Additionally, the system is equipped with a GSM module for remote communication with the user. It sends SMS alerts to notify the user of any deviations from normal operating conditions, such as low moisture levels or potential overflow incidents, enabling timely intervention. Overall, the existing water management system offers a reliable and efficient solution for monitoring and controlling water levels in a tank. By leveraging the Arduino Uno microprocessor and integrated sensors, the system enhances water management practices, promotes resource conservation, and facilitates proactive management of water resources.

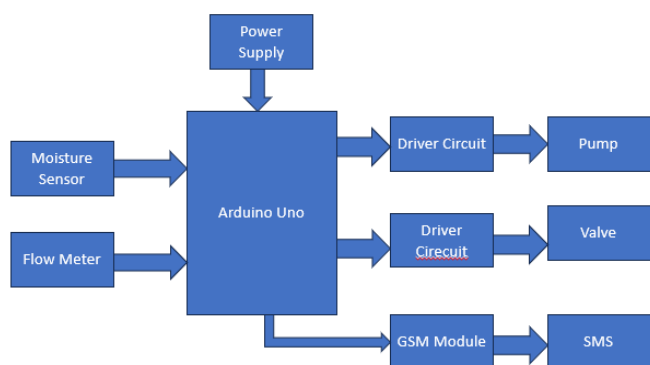


Fig. 1: Block diagram of the existing system

#### 4. Proposed System

This paper proposes the design and implementation of an integrated IoT-based water quality monitoring and management system aimed at ensuring the availability of clean and safe water resources as shown in Fig. 2. The proposed system utilizes advanced sensor technologies, wireless communication protocols, and IoT platforms to enable real-time monitoring, analysis, and control of key water quality parameters. Central to the proposed system is the integration of pH and turbidity sensors into a Node MCU microcontroller, facilitating continuous and accurate measurement of water quality. The collected data is transmitted wirelessly to an Internet of Things (IoT) application, where it is visualized, analyzed, and stored in real-time. This allows stakeholders, including water management

authorities, environmental agencies, and end-users, to remotely monitor water quality and receive timely alerts in the event of any deviations from acceptable standards.

Furthermore, the proposed system incorporates smart and filtration mechanisms to ensure efficient distribution and enhancement of water quality throughout the delivery process. A multi-stage filtration system removes impurities and contaminants, ensuring that the water delivered to end-users meets stringent quality standards and is safe for consumption and various other applications. The system also leverages the Blynk IoT platform to enable seamless integration with mobile devices, allowing users to monitor water parameters, receive real-time alerts, and remotely control the system. Overall, the proposed IoT-based water quality monitoring and management system offers a comprehensive solution to the challenges associated with ensuring clean and safe water resources. By leveraging advanced technologies and innovative solutions, the system enables proactive monitoring, efficient distribution, and continuous improvement of water quality, thereby contributing to the sustainable management of water resources and the well-being of communities.

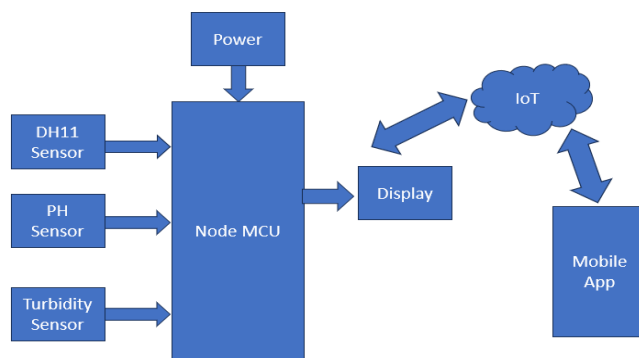


Fig. 2: Block diagram of the proposed system

#### 5. Result and Discussion

The result of integrating pH and Turbidity sensors into a Node MCU for water quality monitoring, coupled with the IoT Blynk app, along with the filtration system, yields a comprehensive and efficient water quality checking system. This system ensures real-time monitoring of crucial water parameters, including levels,

pH levels, and turbidity, enabling proactive management and intervention in case of anomalies. The Node MCU acts as the central control unit, collecting data from the sensors and transmitting it to the IoT Blynk app for visualization and analysis. Furthermore, the inclusion of a facilitates the transfer of water to designated usage points, while the filtration system enhances water quality by removing impurities and contaminants. At the destination point, another sensor provides feedback on water quality, allowing for continuous monitoring and optimization of the system. Overall, this integrated solution ensures the delivery of clean and safe water for various applications, promoting sustainability and enhancing user confidence in water quality. The results for various cases are shown in Table. 1.

**5.1 Test Case Analysis**

**Test case - 1:**

Salt Water (Highly Contaminated) (Fig. 3)

- pH:1.8
- Temperature: 32°C
- Humidity: 61%
- Turbidity: 60 NTU



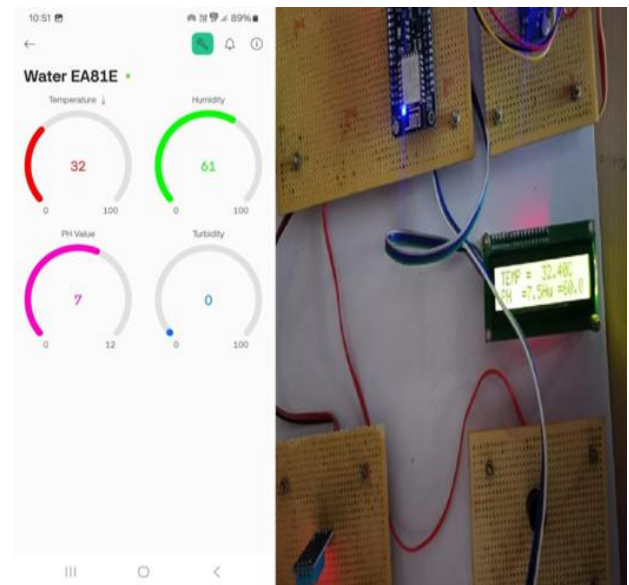
**Fig. 3:** Test result for salt water condition

**Test Case - 2:**

Ground Water (Natural Water Source) (Fig. 4)

- Sensor Readings:
- pH: 7.5
- Temperature: 32°C

- Humidity: 61%
- Turbidity: 0 NTU

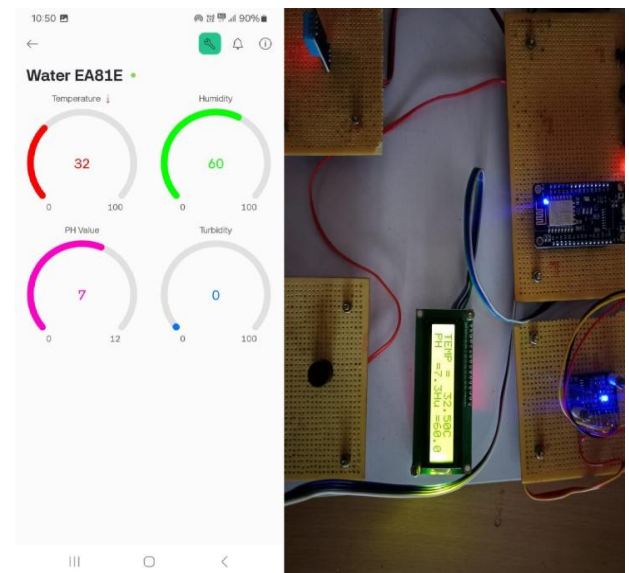


**Fig. 4:** Test result for groundwater condition

**Test Case - 3:**

Mineral Water (Purified Commercial Sample) (Fig. 5)

- Sensor Readings:
- pH: 7.3
- Temperature: 32°C
- Humidity: 60%
- Turbidity: 0 NTU



**Fig. 5:** Test result for mineral water condition

**Table. 1:** Sensor results for various water conditions

Test Case	pH	Turbidity (NTU)	Humidity (%)	Temp (°C)	Blynk Status	Result
Salt Water	1.8	60	61	32	Alerts Triggered	Unsafe Contaminated
Ground Water	7.5	0	61	32	Normal Reading	Safe Normal Water
Purified Water	7.3	0	60	32	Optimal Values	Safe Purified Quality

## 6. Conclusion

In conclusion, the integration of pH and Turbidity sensors into a Node MCU for water quality monitoring, coupled with the IoT Blynk, and filtration system, presents a robust solution for ensuring the availability of clean and safe water resources. By continuously monitoring key water parameters and leveraging IoT technology, this system enables proactive management and intervention to maintain water quality standards. The real-time data visualization provided by the Blynk app enhances transparency and allows stakeholders to make informed decisions regarding water usage and management. Furthermore, the inclusion of a facilitates efficient water distribution, while the filtration system enhances water quality before usage. The feedback loop provided by the sensor at the destination point enables continuous monitoring and optimization of the system. Overall, this integrated solution offers a comprehensive approach to addressing water quality challenges, promoting sustainability, and safeguarding public health and environmental well-being. Continued research and development in this field will further advance our ability to monitor and manage water resources effectively in the face of evolving environmental and societal pressures.

## Conflict of Interest

Authors declared “No conflict of Interest”

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