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SMART WATER MONITORING SYSTEM USING IOT

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Abstract – Urbanization and population growth increase water demand, requiring effective management of water sources. The use of IoT devices in monitoring water systems is crucial for conserving resources and minimizing human involvement. IoT technology enables real-time data acquisition and surveillance, utilizing wireless sensors and networks. This approach minimizes human involvement and allows for algorithmic decision-making in routine processes. Developing user-friendly IoT tools is essential for efficient real-time water monitoring solutions. The project uses a regulated 5V, 500mA power supply, an unregulated 12V DC relay, a 7805 three-terminal voltage regulator, and a bridge-type full wave rectifier to rectify the AC output of a 230/12V step-down transformer.
Keywords – Arduino, Water Quality, MIT App Inventor, Controller, Firebase, Internet of Things.

1. INTRODUCTION

Rapid development growth has led to a shortage of water supply in developing countries, making it crucial to manage and monitor natural water sources. Water monitoring technologies have made significant progress in recent decades, eliminating manual monitoring, and providing early warning systems for disaster management. However, water supply faces challenges due to inadequate resources and contamination protection. Online water monitoring systems are needed to improve response and public protection in real-time, as laboratory-based systems are too deliberate and insufficient for real-time detection and response. This is due to the potential risks to human health and the need for real-time public protection.

This article presents a hybrid wireless network integration scheme for cloud services-based enterprise information systems (EISs). The proposed framework combines hybrid wireless networks and cloud computing technologies, utilizing frontend, middle, and backend layers connected to IP EISs. It presents a collaborative architecture, cloud services management framework, and process diagram. Access control functionalities provide filtered views on cloud services based on access requirements and user security credentials. The framework will be implemented over Swan Mesh platform, integrating the UPnP standard into an enterprise information system.[1]

Wireless sensor networks (WSNs) are increasingly used in challenging environments, making fault-tolerance a crucial requirement for routing protocols. However, there is another type of failure that can be destructive, causing holes to appear in the network. Previous studies have focused on localization, which can have significant energy and economic costs. This paper proposes two localization-free and energy-efficient algorithms for bypassing holes formed by group collapse. The algorithms, intra-cluster bypass and inter-cluster bypass, aim to heal corrupted communication links in the presence of holes. The algorithms are tested in an ns-2 environment and show significant improvements in fault recovery percentages while consuming minimal energy, even in high collapse ratio environments.[2]

Sensor networks enable real-time analysis of changes in the physical environment, enabling versatile applications. Advancements in science and technology have led to sophisticated wired and wireless sensing technologies. This paper discusses ZigBee, enOcean, wavenis, Z-wave, Wi-Fi, and Bluetooth, as well as their applications and features.[3]

A vehicle monitoring and tracking system is being developed using an embedded Linux board and an Android application to monitor a school vehicle's location from A to B. The system uses GPS/GPRS/GSM SIM900A technology to track the vehicle's current location, send tracking information to a server, and send alert messages to the owner's mobile. The system is placed inside the vehicle and is monitored real-time through a web page. The driver's Android application selects the path from A to B, ensuring safety and secure travel. If the driver drives on the wrong path, an alert is sent to the owner's mobile and speakers are sent to the driver. If the vehicle's speed exceeds the specified limit, a warning message is sent to the owner's mobile. The system also uses gas leakage and temperature sensors to ensure the safety of the driver.[4]

The monitoring of water standards is a complex process with various laboratory testing methods and time-consuming processes. A new approach in IoT-based water quality monitoring is proposed, utilizing wireless device networks and sensor water meters to ensure safe distribution of water. The system monitors water quality through various sensors, such as turbidity, pH, temperature, and conductivity. The Arduino controller accesses the monitored data, and the IoT system collects and enforces water pollution through a strict mechanism. The system alerts the public and concerned subdivisions about water quality, sending updated data to a web server for retrieval or access from anywhere. If sensors fail or become abnormal, a buzzer will be activated, ensuring adaptable good water in the atmosphere.[5]

Aquaculture faces challenges due to variations in environmental conditions, requiring real-time monitoring of water quality parameters like pH, turbidity, and conductivity. Current methods involve manual detection by chemical testers, making real-time monitoring time-consuming. An Arduino-based system has been proposed to analyze and adjust water parameters in real-time. The system consists of sensors measuring pH, conductivity, muddiness, and temperature, processed by a microcontroller, and provided control signals to maintain optimal water parameters for fish life. The measured values are then sent to a user's mobile app via the cloud, ensuring optimal living conditions for fish and maintaining optimal water quality.[6]

The Internet of Things (IoT) faces numerous technical and application challenges in China, including policies, R&D plans, applications, and standardization. The paper presents China's perspective on these challenges and proposes an open IoT architecture with three platforms to address them. The paper also discusses the opportunity and prospect of IoT. This paper explores an intelligent monitoring and diagnosis system for modern mechanical equipment (MME) using embedded technology and fiber Bragg grating sensor (FBGS) technology. The system integrates network and fieldbus gateways, high-speed demodulation, and a new embedded sensor for online state monitoring. The system also proposes embedded sensing signal processing and data transmission, meeting multi-parameter measurement, synchronous sampling, and long-term intelligent monitoring requirements.[7],[8]

This study examines buyer behavior towards online gadget purchases, focusing on factors like frame of mind, abstract standard, perceived conduct control, online store usage, and social trust. IoT (Internet of Things) is a complex technology architecture integrating various information technologies. This paper proposes a six-layer architecture based on network hierarchical structure, discussing key technologies like RFID, WSN, Internet, SOA, cloud computing, and Web Services. The paper designs an automatic recognition system integrating RFID and WSN, and proposes a strategy for IoT technology integration. Fog/edge computing is proposed to integrate with Internet-of-Things (IoT) to enhance user experience and resilience in IoT applications. This approach offers faster response times and higher quality of service due to its distributed architecture and close proximity to end-users. To develop fog/edge computing-based IoT infrastructure, it is essential to investigate architecture, enabling techniques, security, and privacy issues. This paper provides a comprehensive overview of IoT, including system architecture, enabling technologies, security, and privacy issues. The integration of fog/edge computing and IoT is presented, focusing on the relationship between Cyber-Physical Systems (CPS) and IoT, enhancing understanding of state-of-the-art IoT development. The paper also discusses issues in fog/edge computing-based IoT and real-world applications, such as the smart grid, smart transportation, and smart cities.[9],[10],[11]

The internet of things (IoT) aims for a future where intelligent devices and people cooperate, requiring secure M2M for data exchange. This paper advances ideas for designing secure IoT security protocols. This paper reviews European operational warning systems for water-related hazards induced by severe weather conditions, including surface water flooding, flash floods, debris flows, mud flows, landslides, river floods, and coastal floods. It discusses technical features, capabilities, and strengths of each system type, while offering suggestions for improving hazard detection and coordination. The goal is to reduce the impact of natural hazards on society. Dropping water quality in distribution systems affects public health, causing increased contaminants and threats to ecosystems. Real-time monitoring systems, utilizing IoT technology, are needed to reduce contamination and improve efficiency.[12],[13],[14].

The overview of the proposed SWM system is introduced in Section II. Section III presents the design methodology including the hardware setup and desktop application development. The measured data of different sensors and their analysis are described in Section IV. Lastly, Section V is concluded the paper.

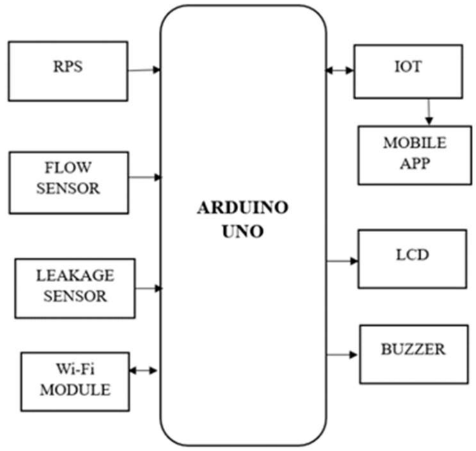

Figure 1. Block diagram of the proposed SWM system.

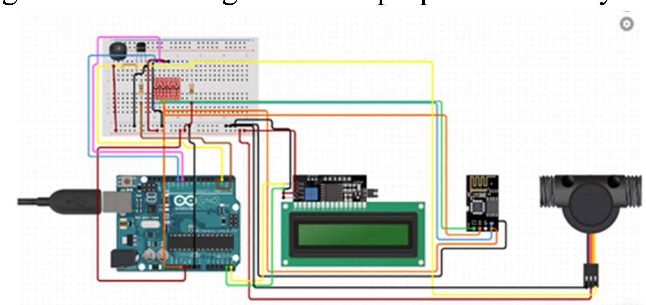

Figure 2. Circuit diagram of the hardware of SWM system.

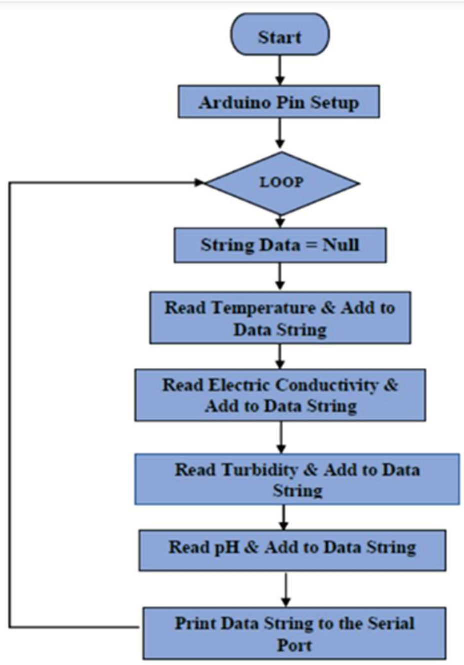

Figure 3. Flowchart of the working procedure of hardware.

2. SYSTEM OVERVIEW

We proposed SWQM algorithm can read data from it and liquid samples delivered by sensors through a microcontroller Use machine learning algorithms to analyze for prediction good water. Proposed block diagram of SWM The system in Figure 1 integrates four sensors with a controller for measuring the four most important physical parameters parameters (pH, temperature, conductivity and turbidity). Water samples. pH sensor SEN0161 is used for measurement Acidity or alkalinity of any solution logarithmic scale.

Rapid development growth has led to a need for water monitoring technologies to manage and monitor natural water supply. These technologies can eliminate manual monitoring and provide early warnings in disaster management. Online systems are needed to improve response and public protection in real-time, addressing contamination concerns and ensuring human health. Water pollution is a significant issue, with high equipment costs and time-consuming processes. Traditional methods have drawbacks like low measurement precision and complexity. To address this, new technologies are being developed to check water quality. However, these systems have high complexity and low performance. Water is a limited resource essential for agriculture, industry, and human existence. Efficient water management is crucial for home and office water management systems. Wi-Fi in IoT projects allows remote interaction with the real world, and recent projects have focused on environmental monitoring systems using wireless communication standards. The Arduino software platform is used for PC management, and microcontrollers are used for mobile communications and monitoring sensors.

Digital temperature sensor DFR0198 Provides accurate readings from –55 to 125ºC. For measurement purposes Electrical conductivity of liquid samples, analog sensor the DFR0300 is used. Recommended identification criteria This sensor is 1 to 15 ms/cm at a temperature of 0- . 40ºC temperature. Turbidity sensor SEN0189 is used in designs a. detect by light the presence of suspended particles. The data obtained from these sensors' controller Arduino-uno takes them to progress Desktop applications. Machine learning algorithms It was used above to describe the quality of the water Based on estimates. Because the system will predict the water test is either "potable" or "non-potable Drink," a fast forest binary classification algorithm They've been working. 60 different water samples have been collected from pipes, filters, soft drinks and other nearby objects. The prediction accuracy of the developed system is compared the data used.

3. DESIGN AND EXPERIMENT

3.1 Circuit Diagram

Figure 2 depicts the schematic circuit diagram of the proposed SWQM system's hardware configuration. The leakage and flow sensors are analogue sensors with three wire colors in the order of red, black, and blue. The red wire indicates positive, so it is connected to the +5V supply, and the black wire indicates ground, so it is connected to the ground or negative terminal of the supply. Finally, the blue wire indicates that it is a data line, so it is connected to the digital or analogue pins of the Arduino controller, depending on the type of sensors and the Figure 3 gives the working procedure of hardware by using flow chart.

3.2 Internet of Things

The project makes use of IoT to control and send data from one device to another through the firebase server and the MIT APP Inventor. We constructed an application to connect with the device to the user using MIT APP Inventor, and at the backend of this project, we utilize Firebase as a server to store the data and reuse it.

MIT App Inventor is a user-friendly, visual programming platform that enables people with little or no coding experience to create mobile applications for Android devices It provides a simple drag-and-drop user interface create and build functional applications You can combine objects with logic blocks that need to be created. This platform enables individuals, especially those new to programming, to bring their app ideas to life without resorting to complicated coding languages. It is designed to make app development easier and more efficient for a wide range of people including students, amateurs and beginners in the world of software development

Firebase is a comprehensive and scalable platform developed by Google for building and managing web and mobile applications. It offers a range of tools and services that streamline various aspects of app development, including authentication, real-time databases, cloud storage, hosting, analytics, etc. Firebase allows developers to focus on building their applications so without having to maintain a complex backend infrastructure. This is especially useful for building apps that require real-time updates, user loyalty, cloud storage, and other backend functionality. With Firebase, developers can accelerate the development process and provide users with a feature-rich and reliable application.

3.3 Developed Android Application

We designed a Web Dashboard based Mobile application using an MIT App Inventor platform with the support of Firebase Server. In this application we display the flow rate and the price indication to that particular flow rate along with that each flow rate column is assigned to the leakage column in this column we display when the leak is happened. In this we separate the leak in different ways like Leake-1 and Leak-2. In this dashboard we display the time and date is also displayed for each flow rate and leakage.

In this dashboard we are also inserted a hyperlink to display the graphical data for this data.

Figure 4. Application Interface

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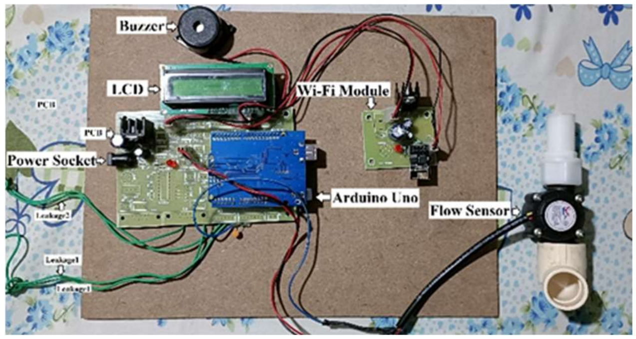

Figure 5. Experimental Setup of SWM system.

4. CONCLUSION

The study used a WI-FI module to wirelessly connect transducers and sensor networks, assuring reliability and practicality in monitoring water parameters. The technology saves the environment while also saving time and money. As the Internet of Things expands, new difficulties emerge, such as controlling cost, energy, and efficiency. The emphasis is on establishing an IoT architecture for water distribution systems that incorporates modern technologies such as cloud and energy harvesting.

By using a WI-FI module, the interfacing is done between transducers and the sensor network on a single chip solution wirelessly. For the monitoring process, the system is achieved with reliability and feasibility by verifying the four parameters of water. The time interval of monitoring might be changed depending upon the necessity. Ecological environment of water resources is protected in this research. The time is reduced, and the cost is low in this environmental management.

As IoT is growing every day with new technologies involved, new challenges arise. The IoT has encouraged people to connect to devices using the internet and the increase in the use of IoT devices motivated people to use smart technologies. The water quality in the distribution system is a serious factor that affects public health and smart water system provides a user-friendly interface to monitor the water quality in houses and take remedial measurements if necessary. One of the main challenges in smart water system is managing the cost, energy and efficiency required for water distribution system. The selection of water quality, quantity and topological parameters is another challenge in the smart water system. So there needs research about these challenges to provide a new cost and energy efficient solution to the smart water system. The future work will focus on developing an IoT architecture in water distribution system with integration of new technologies such as cloud, energy harvesting etc.

Wi-Fi in IoT projects allows remote interaction with the real world, attracting interest in environmental monitoring systems. Arduino software is used for PC management, and a water quality monitoring system using microcontrollers and ADCs is developed. However, the complexity of microcontroller designs increases development time and costs.

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