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IoT Enabled Advancement Water Quality Monitoring System for Pond Management & Environment Conservation (Without WIFI)

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Abstract: *The Advanced Water Quality Monitoring System for Pond Management is designed to provide real-time, remote monitoring of critical water quality parameters in aquatic environments. The system utilizes a network of sensors—including turbidity, TDS, and pH sensors—to continuously measure water quality, with data transmitted wirelessly via LoRa technology to a central receiver. Upon reception, the data is relayed through Bluetooth to a display interface, enabling instant access and review through a Bluetooth serial monitor. This integration of sensor technology with wireless communication ensures efficient, accurate, and user-friendly monitoring, facilitating timely decision-making and improved management of pond ecosystems.*

Keywords: *Water quality, LoRa, Arduino UNO, Bluetooth, sensor monitoring, pond management.*

1. INTRODUCTION

The demand for IoT-based water quality monitoring systems using LoRa (Long Range) technology has been increasing due to its ability to provide real-time, efficient, and cost-effective solutions for monitoring water quality across[7] various environments. For instance Wireless Sensor Networks (WSNs) offer a cost-efficient solution for monitoring water quality in remote areas, enabling real- time data acquisition and reducing labor requirements. Despite their advantages, deploying WSNs in aquatic environments remains challenging due to the susceptibility of electronic components to water intrusion. [3] Recent research has focused on enhancing transmission efficiency, power management, and environmental adaptability for improved performance. However, it [15] highlight that earlier deployments were largely confined to indoor environments, limiting real-world applicability. Moreover other prototype is leveraging the advancements in IoT and Wireless Sensor Networks (WSNs), this study proposes a cost-effective, LoRa-based system for real-time water quality monitoring[5]. Key parameters, including temperature, pH, conductivity, and turbidity, are measured and transmitted via LoRa to agateway for processing, storage, and visualization. The prototype, tested in a real-world setting, demonstrates effective monitoring within a localized area.

2. EXISTING SYSTEM

A novel wireless acquisition system that makes use of theArduino (ESP32) microcontroller has been designed by us forthe water quality monitoring system that we have presented.This cutting-edge instrument is designed to provide accurate remote measurements of important parameters relating towater quality, such as turbidity, Total Dissolved Solids (TDS),and pH. The system collects data from several locations throughout the pond by making use of three individual sensors. The fact that this system may be integrated with an aquatic boat is a significant advantage. This integration makes it possible to collect comprehensive samples from the pond’s center as well as its sides, which improves the accuracy of water quality analysis as a whole. The proposed water quality monitoring system senses the data pH, Turbidity, and, TDS data of the pond and transfers data to the cloud can be assessed by the AquaSpecs app.

Fig 1 shows the framework of the proposed water quality monitoring system.For testing purposes, this device has been tested in four ponds in Chhattisgarh i.e. Birkona Pond, Budha Pond, Dagania Pond, and, Kushalpur Pond.

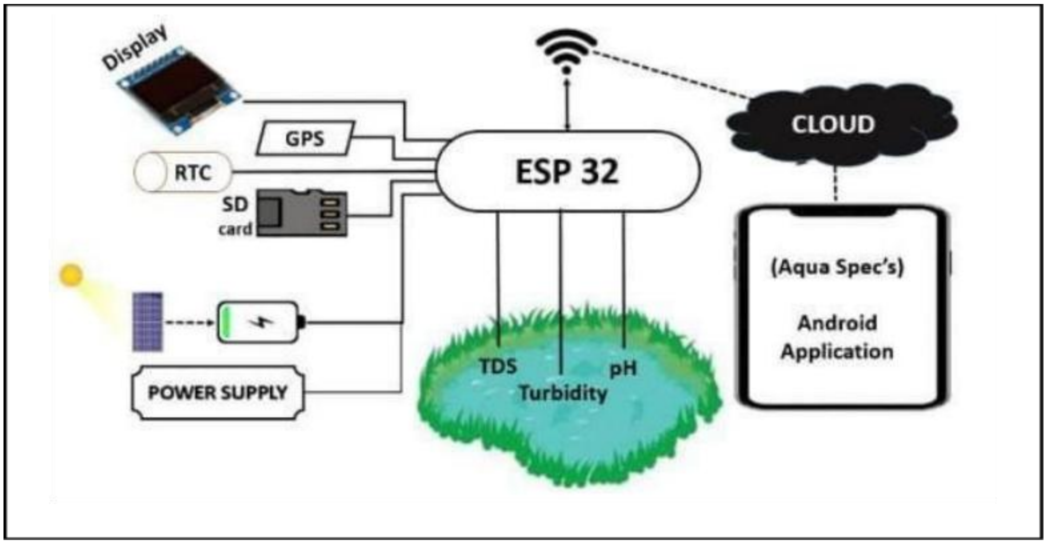

FIGURE 1. Framework of existing system

Some models use Wi-Fi or GSM-based communication, which may suffer from high power consumption and limited coverage in remote areas. Additionally, manual water testing kits are widely used but are labour-intensive and do not provide real-time data. Other advanced solutions involve IoT- based monitoring systems that use cloud integration, but they can be costly and dependent on stable internet connections.

3. PROPOSED SYSTEM

The proposed Advanced Water Quality Monitoring System for Pond Management introduces a more efficient and cost-effective approach using LoRa technology for long-range, low-power communication. This system integrates key water quality sensors with an Arduino UNO, ensuring continuous monitoring of water parameters. The collected data is transmitted wirelessly to a LoRa receiver, which then relays the information via Bluetooth to a Bluetooth serial monitor for real-time visualization. An LCD display provides on-site readings, and buzzers trigger alerts for critical water conditions. The system is designed for stable operation, enhancing remote monitoring capabilities and making it a more reliable and scalable solution for effective pond management.

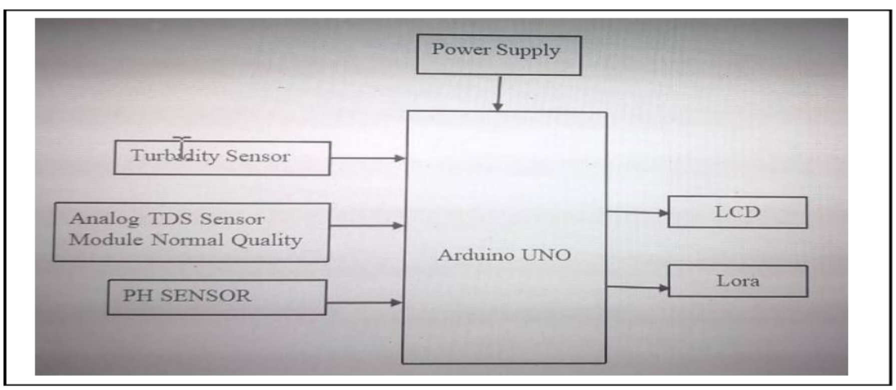

FIGURE 2. Block Diagram of Transmitter side

Fig 2 and Fig 3 defines the relationships between different components.Fig 3 describes the transmission od data between the sensors to microcontroller then to LCD Display.Fig 4 demonstrates the information of LoRa transmitter LCD Display to LoRa Receiver.Finally to the real time monitoring display with the help of bluetooth connectivity.

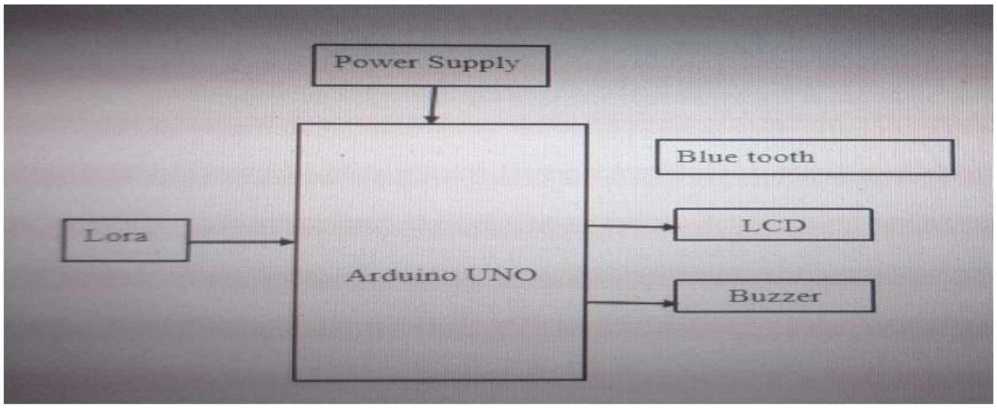

FIGURE 3. Block Diagram of Receiver side

4. RESULTS & DISCUSSIONS

The report presents the results of our water quality monitoring project, which aimed to assess the current state of water quality using LoRa technology and Bluetooth connectivity

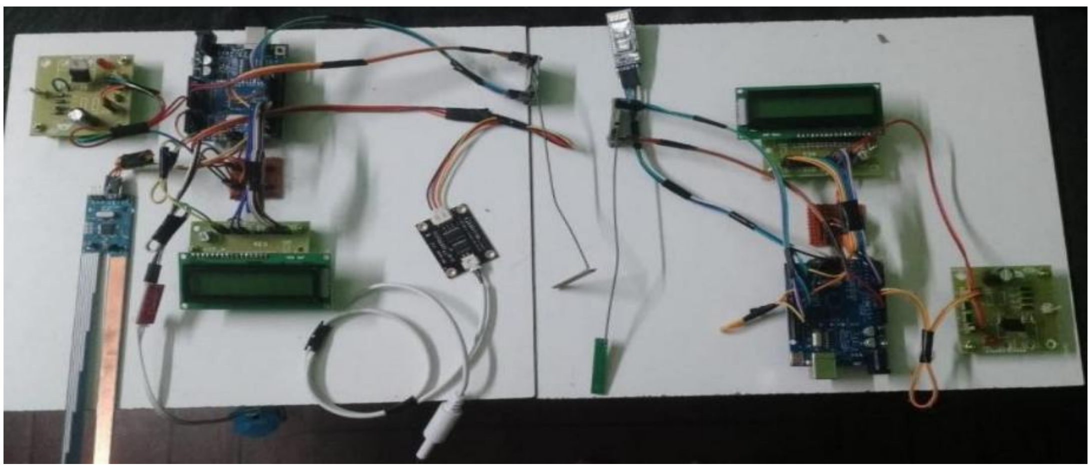

FIGURE 4. Proposed Water Quality Monitoring System.

After power supply ON,sensors transmit the data to Arduino then to the LCD Display of LoRa Transmitter.Finally that data sent to the LCD Display of LoRa Receiver.In that receiver it displays which sensor value is good or not with the values.

FIGURE 5. LCD display of LoRa Transmitter & Receiver

FIGURE 6. LCD Display of LoRa Receiver

To get the values from the LoRa receiver LCD Display to a mobile terminal using the Arduino Bluetooth control app.

FIGURE 7. The screen of Arduino Bluetooth Control

5. CONCLUSION AND FUTURE WORK

This study used DL techniques to propose a model for categorizing and segmenting cattle with lumpy skin conditions. The framework improved the identification of impacted areas by combining CNN-based feature optimization with an enhanced segmentation technique. When evaluated on a well-known dataset, the Extreme Learning Machine (ELM) classifier achieved the most fantastic accuracy of 96%, demonstrating its effectiveness in identifying disease-affected locations. Despite the promising outcomes, computational efficiency remains a limiting factor requiring further investigation. This study provided a model for dividing and offered a framework for classifying, and subsequent investigations will concentrate on improving the segmentation procedure to eliminate unnecessary characteristics and increase training efficiency. These changes enhance the model's usefulness as a tool for automated illness detection in cattle by enhancing its reliability.

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