Smart Hydroboat for Surface Water Monitoring

Vaibhav Nawde, Parag Palaspagar, Shreya Tayde, Saloni Nevare, Prof.A.R.Pathare
Dept. of Electronics and Telecommunication Engineerin PRMIT&R Amravati, India

Abstract— **Due to excessive sources of pollutants, it has become difficult to ensure the safety of water. The main causes for water quality problems are over use and exploitation of natural resources. Water quality is affected due to sewage discharge from industries and other man-made pollutants. Water quality monitoring is defined as the collection of information at specific locations and regular intervals to provide information which may be used to define current conditions and established trends etc. The paper "Water Pollution Monitoring RC Boat System" is designed as a prototype solution to address water pollution through real-time monitoring and collection of floating waste. The system is developed using a NodeMCU microcontroller integrated with an ultrasonic sensor to detect the level of collected trash inside the bucket. A DC motor-driven conveyor belt mechanism is employed for collecting floating waste from the water surface. Web server allows monitoring of trash levels and ON/OFF control of the conveyor belt via relay. The entire system is battery-operated using a compact 3.7V Li-ion battery with holder, ensuring portability and independence from external power sources.**

Keywords- **Water Quality Monitoring, Water Pollution, Real-Time Monitoring, Floating Waste.**

I. INTRODUCTION

Water pollution has become one of the most critical environmental challenges, caused primarily by the discharge of plastic waste, debris, and other pollutants into rivers, lakes, and ponds. These pollutants not only degrade water quality but also harm aquatic life and disrupt the ecosystem balance. Conventional cleaning methods are often manual, labor-intensive, and inefficient, making it necessary to develop innovative and automated solutions for waste collection and monitoring.

To address this issue, the proposed paper introduces a Water Pollution Monitoring RC Boat System, a compact and cost-effective prototype designed to monitor and collect floating waste from water bodies. The system employs a NodeMCU microcontroller as the central unit, along with an ultrasonic sensor to measure the level of collected trash. A DC motor-driven conveyor belt mechanism is integrated to pick up floating waste, and the process is remotely monitored using the web server. Powered by a 3.7V Li-ion battery, the system ensures mobility and independence from external power sources. This paper serves as a prototype model that highlights the potential of using IoT-based technologies for real-time water pollution monitoring and waste management.

II. LITERATURE REVIEW

1] Tejashri Kolhe et al., in this paper the author presented a system that integrates sensors on a mobile platform to detect and monitor water pollution in real time. Their study highlighted the use of sensor arrays for parameters such as turbidity and water level, combined with IoT-based data transmission for remote monitoring. While previous systems were often stationary or limited in coverage, this mobile RC boat design allows better spatial monitoring of water bodies. The authors also discussed challenges in sensor accuracy, power management, and real-time data reliability, emphasizing the need for low-cost and efficient solutions for practical water pollution management.

2] Mohamed Aslam et al., The author proposed a system that enables real-time assessment of water quality using sensors for pH, turbidity, TDS, electrical conductivity, and temperature. The system employs a remote-controlled boat to navigate water bodies and collect data, eliminating the need for manual sampling and laboratory analysis. With IoT integration, the data is transmitted remotely, allowing continuous monitoring and timely interventions. Experimental results demonstrated the system's effectiveness in accurately monitoring water quality, making it a cost-effective and efficient solution for environmental monitoring and water resource management.

3] Aashline S. et a., In this paper the author states that the system allows the boat to navigate water bodies, collect data on parameters such as turbidity and pH, and transmit it remotely for continuous monitoring. Similar to previous studies, this approach reduces manual labor, improves spatial coverage, and

provides timely insights for water quality management, demonstrating the effectiveness of combining mobile platforms with IoT and sensor technologies for environmental monitoring.

4] Atharv Laxman Metkari et al., In this paper the author proposed a system that measures key water quality parameters such as pH, turbidity, TDS, electrical conductivity, and temperature in real time. The remote-controlled boat navigates water bodies to collect data, eliminating the need for manual sampling and laboratory testing. IoT integration enables continuous remote monitoring, allowing timely interventions and informed decision-making. Experimental evaluations demonstrated the system's accuracy and effectiveness, highlighting its potential as a cost-effective and efficient solution for environmental monitoring and sustainable water resource management.

5] Abhinav Raj et al., In this paper the author developed a system for real-time water quality monitoring, measuring parameters such as pH, turbidity, and temperature. The remote-controlled boat navigates water bodies, overcoming the limitations of stationary monitoring systems, while IoT integration enables continuous remote data transmission and timely interventions. Experimental evaluations demonstrated the system's accuracy, mobility, and cost-effectiveness, making it a practical solution for scalable environmental monitoring and sustainable water resource management.

6] Sanika P Ghute et al., In this paper the author developed a system that designed for real-time assessment of water quality parameters such as pH, turbidity, and temperature. The system utilizes an ESP32 microcontroller to collect data from various sensors, which is then transmitted to a mobile application and stored in a Google Sheet for easy access and analysis. This approach offers a cost-effective and efficient solution for monitoring water quality in lakes, rivers, and reservoirs, providing valuable data for environmental management and decision-making.

7] Anandavelu.K et al., In this paper the author presents an innovative approach to monitoring water pollution. The study introduces a remote-controlled (RC) boat equipped with sensors to measure key water quality parameters such as pH, turbidity, and temperature. This system aims to provide real-time data on water quality, enabling timely interventions to address pollution issues. The integration of IoT technology allows for remote monitoring and data analysis, enhancing the efficiency and effectiveness of water pollution management strategies.

8] Aniket N. Barure et al., In this paper the author states that for real-time water pollution monitoring, integrating sensors to measure pH, turbidity, dissolved oxygen, and temperature. The system employs an Arduino UNO microcontroller, brushless DC motors, and Bluetooth communication for remote control via a mobile app. Experimental evaluation at various locations, including Tathawade and Morya Goswami Temple, demonstrated the system's effectiveness in assessing water quality parameters, providing valuable data for environmental monitoring and management.

9] Divya Panchmukh et al., The author developed a system for real-time water pollution monitoring, integrating sensors to measure Total Dissolved Solids (TDS), Electrical Conductivity (EC), and temperature. The system employs a NodeMCU ESP8266 microcontroller, interfacing with a 2.4 GHz remote control for navigation. Additionally, a GPS module provides real-time location tracking, while a GSM module sends location updates via SMS. Data is transmitted to open-source IoT platforms like Blynk or ThingSpeak for visualization. This approach offers a cost-effective and efficient solution for monitoring water quality in various aquatic environments, facilitating timely interventions to address pollution issues.

10] Jayti Bhatt et al., In this paper the author proposed a system that employs sensors to measure parameters such as pH, turbidity, conductivity, dissolved oxygen, and temperature. The system utilizes a microcontroller to process the sensor data, which is then transmitted remotely to a core controller via Zigbee protocol. The processed data is accessible through a cloud computing platform, enabling real-time monitoring and analysis. This approach offers a scalable and efficient solution for continuous water quality assessment, facilitating timely interventions to ensure safe drinking water supply.

III. METHODOLOGY

The proposed "Water Pollution Monitoring RC Boat System" is designed as an IoT-based prototype that combines real-time monitoring and floating waste collection. The system is centered around a NodeMCU microcontroller, which acts as the main control unit for integrating sensors, motors, and wireless communication. An ultrasonic sensor is mounted inside the waste collection bucket to

continuously monitor the trash level, providing real-time data on the amount of waste collected.

A DC motor-driven conveyor belt mechanism is installed at the front of the boat to collect floating garbage from the water surface and transfer it into the bucket. The conveyor belt operation is controlled via a relay module, which can be remotely switched ON/OFF through the relay. The Blynk app is used to monitor thrash level, allowing the user to make informed decisions about system operation.The system is powered by a 3.7V Li-ion battery.

❖ BLOCK DAIGRAM

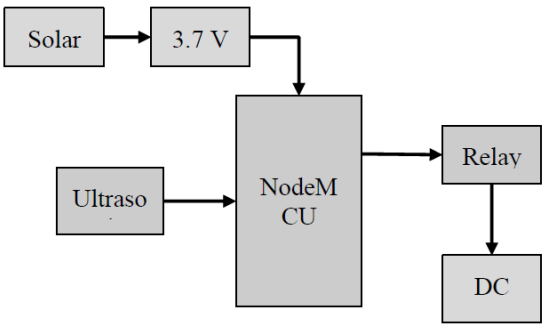

Fig. 1 Shows the Block Diagram of the System

DESCRIPTION

In this block diagram, NodeMCU is used as a microcontroller. The 3.7 V Battery is used for power supply. As an input device we have used an Ultrasonic Sensor. The output devices consist of Relay and DC Motor.

❖ FLOW CHART

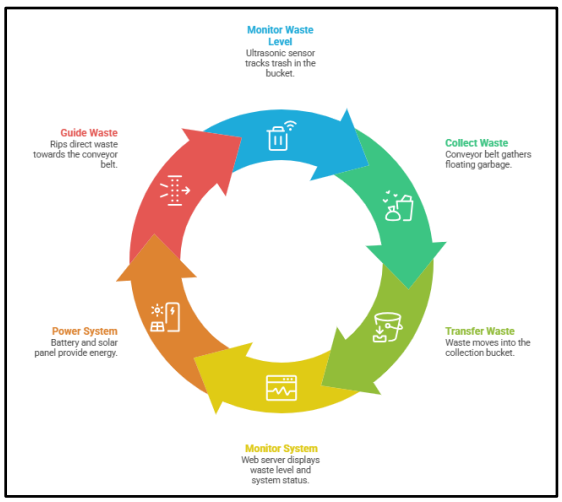

Fig. 2 Shows the Flowchart of the System

WORKING

The proposed Water Pollution Monitoring RC Boat System works by integrating IoT technology with a waste collection mechanism to perform real-time monitoring and cleaning of water surfaces. The system is powered ON using a 3.7V Li-ion battery, while the solar panel continuously charges the battery to ensure uninterrupted and eco-friendly operation. During movement, the rips (guiding barriers) mounted on both sides of the boat help channel floating waste toward the conveyor belt, enabling efficient collection and minimizing the loss of debris. The NodeMCU microcontroller initializes and connects to the Wi-Fi network and web server for remote access. The boat is then controlled remotely, allowing it to move across the water surface.

A DC motor-driven conveyor belt mounted at the front of the boat collects floating waste such as plastics and debris and transfers it into a storage bucket. The operation of the conveyor belt is controlled through a relay module, which can be switched ON or OFF via the web server. Meanwhile, an ultrasonic sensor placed inside the bucket continuously measures the level of collected waste and sends real-time data to the NodeMCU. This data is then displayed on the web server, enabling the user to monitor the trash level and take necessary actions when the bucket is full.

Overall, the system performs simultaneous waste collection and monitoring, providing an efficient, remotely controlled solution for small-scale water pollution management.

V. SYSTEM REQUIREMENT

HARDWARE REQUIREMENT

1] NodeMCU
2] Ultrasonic Sensor
3] DC Motor
4] Conveyor Belt
5] PVC Pipe
6] 3.7V li-on Battery
7] Battery Holder
8] Relay
9] Solar Panel

SOFTWARE REQUIREMENT

1] Arduino IDE
2] Proteus

V. EXPERIMENTAL SETUP & RESULT

EXPERIMENTAL SETUP

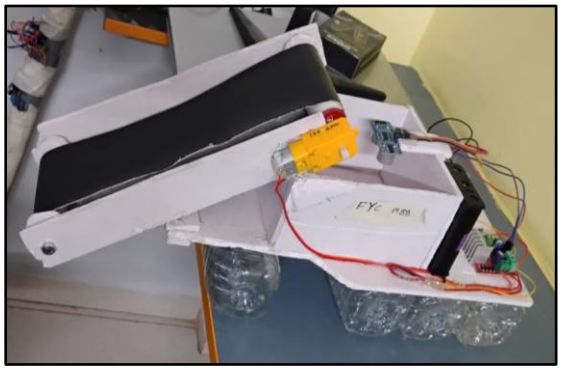

Fig. 3 shows the front view of the experimental setup of the system

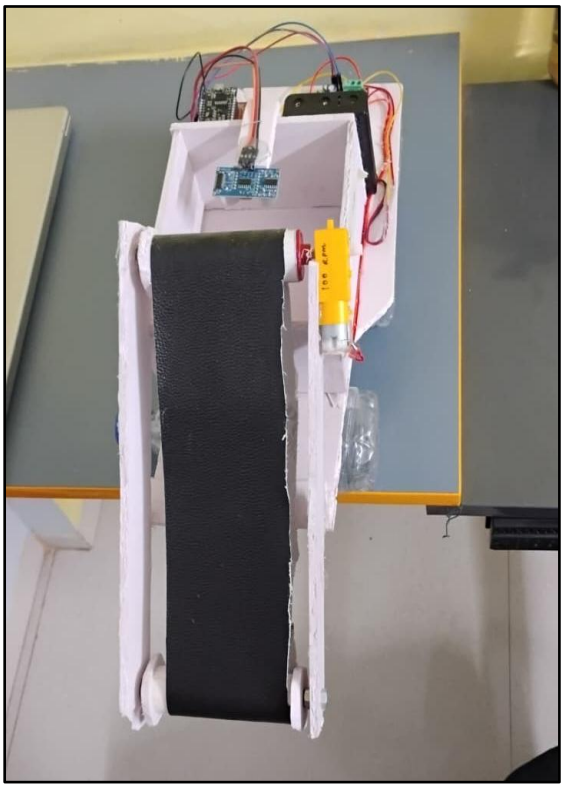

Fig. 4 shows the top view of the experimental setup

RESULT

The proposed system successfully demonstrated efficient floating waste collection along with real-time monitoring capabilities. The conveyor belt mechanism effectively gathered small floating debris such as plastics and leaves and transferred it into the storage bucket without major loss. The ultrasonic sensor provided accurate and continuous measurement of the trash level, allowing users to monitor the system status in real time through the web server.

The NodeMCU microcontroller ensured smooth integration and communication between all components, resulting in reliable system performance. Additionally, the remote control feature made it easy to operate the conveyor belt as needed. The system also showed low power consumption while running on a 3.7V Li-ion battery. Overall, the prototype proved to be a practical, efficient, and cost-effective solution for small-scale water pollution monitoring and cleaning.

VI. CONCLUSION

The Water Pollution Monitoring RC Boat System provides an innovative, low-cost, and efficient approach to addressing water pollution in small and medium-sized water bodies. By integrating NodeMCU-based IoT monitoring, ultrasonic sensors, and a DC motor-driven conveyor belt, the system enables real-time trash level detection and automated waste collection. Remote operation through the web server enhances usability and reduces the need for manual intervention, making it safe and convenient. The battery-operated prototype ensures portability and independence from external power sources, making it suitable for deployment in lakes, ponds, and other small or medium-sized water bodies. The system can serve as a practical model for sustainable water pollution control and future advancements in smart environmental monitoring technologies.

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