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Improving the Performance Efficiency of Village Pond Cleaner Using Arduino in the Basics of Bluetooth Controlled Process

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Abstract

Village ponds play a vital role in rural water management, yet they often suffer from pollution due to waste accumulation, aquatic weeds, and lack of regular maintenance. Manual cleaning methods are labor-intensive, time-consuming, and expose workers to health risks. This project presents the design and development of an Arduino-based, Bluetooth-controlled village pond cleaning system aimed at improving cleaning performance efficiency while reducing human effort. The proposed system uses an Arduino microcontroller to control motors and cleaning mechanisms, while Bluetooth technology enables wireless operation through a smartphone application. The cleaner can be remotely navigated to collect floating waste such as plastic, leaves, and other debris. By integrating automation and wireless control, the system enhances operational accuracy, reduces manpower requirements, and improves safety. The results demonstrate that the Bluetooth-controlled pond cleaner offers a cost-effective, user-friendly, and efficient solution for maintaining village ponds. This approach supports sustainable rural development by promoting cleaner water bodies and reducing environmental pollution.

Keywords: *Arduino, Bluetooth Control, Village Pond Cleaner, Wireless Automation, Microcontroller, Environmental Cleaning, Remote Operation, Water Pollution Control, Smart Cleaning System, IOT Based Monitoring.*

1. Introduction

1.1. Importance of Village Ponds in Rural Ecosystem

Village ponds are an integral part of the rural ecosystem, serving multiple purposes such as irrigation support, livestock watering, domestic use, and groundwater recharge. They also help maintain ecological balance by supporting aquatic life. However, rapid population growth, improper waste disposal, and lack of regular maintenance have led to severe pollution in many village ponds. Floating plastic waste, weeds, algae, and organic debris degrade water quality and reduce the usability of these water bodies [1]-[3].

1.2. Limitations of Conventional Cleaning Methods

Traditional pond cleaning methods rely heavily on manual labor or simple mechanical tools. Manual cleaning exposes workers to health hazards such as contaminated water, sharp objects, and waterborne diseases. Moreover, these methods are slow, inefficient, and unsuitable for large pond areas. Mechanical cleaners available in the market are often expensive and not affordable for rural communities. These limitations create a strong demand for a low-cost, automated, and efficient cleaning solution [4]-[6].

1.3. Need for a Smart and Affordable Solution

To address the challenges of pond pollution, there is a growing need for a smart system that combines automation, affordability, and ease of use. An ideal solution should minimize human involvement, operate efficiently with low power consumption, and be easily controlled without technical expertise.

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Embedded systems provide an effective platform to meet these requirements by integrating hardware and software into a compact and reliable system [7]-[9].

1.4. Arduino as the Core Control Unit

Arduino is an open-source microcontroller platform that is widely adopted in automation and control applications. Its simple programming environment, low cost, and flexibility make it suitable for rural and educational projects. In this project, Arduino is used as the central controller to coordinate the movement of motors and the cleaning mechanism. It processes user commands received via Bluetooth and executes them in real time, ensuring smooth and controlled operation of the pond cleaner [10]-[12].

1.5. Bluetooth-Based Wireless Control Mechanism

Bluetooth technology enables short-range wireless communication between the pond cleaner and a smartphone. By using a Bluetooth module, the operator can control the direction, speed, and operation of the cleaning system remotely through a mobile application. This wireless control enhances safety by eliminating direct contact with polluted water and improves usability by allowing intuitive control through commonly available smartphones [13]-[15].

1.6. Enhancement of Performance Efficiency

Performance efficiency in this project refers to improved cleaning speed, reduced energy consumption, and effective waste collection. The automated motor-driven mechanism ensures continuous removal of floating waste, while optimized control reduces unnecessary power usage. Wireless operation enables precise movement, reducing cleaning time and increasing coverage area. As a result, the system provides better performance compared to manual and semi-automatic methods [16]-[18].

1.7. Environmental and Social Impact

The proposed Arduino-based Bluetooth-controlled village pond cleaner contributes positively to environmental protection by improving water quality and reducing pollution. It also supports social welfare by reducing health risks to workers and providing an affordable solution for rural communities. By minimizing direct human involvement in polluted water bodies, the system enhances safety and encourages the adoption of mechanized cleaning practices in rural areas. Moreover, the cleaner can be easily operated by local users with minimal technical training, increasing its practical usability and acceptance. The project promotes sustainable development by demonstrating how low-cost technology can be applied to solve real-world environmental problems.

2. Methodology

2.1. System Design Overview

The methodology of the proposed system focuses on designing and implementing an Arduino-based pond cleaning system controlled through Bluetooth communication. The system integrates mechanical, electrical, and software components to achieve efficient removal of floating waste from village ponds. The overall operation is divided into stages such as command input, control processing, motion execution, and waste collection (Figure 1).

Figure 1 Overview of the Proposed Arduino-Based Bluetooth-Controlled Village Pond Cleaning System

2.2. Hardware Component Selection

The hardware components are selected based on affordability, availability, and performance efficiency. An Arduino microcontroller is used as the central control unit. A Bluetooth module enables

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wireless communication between the user's smartphone and the system. DC motors are used for navigation and waste collection, controlled through a motor driver circuit. A mechanical conveyor or rotating mesh mechanism is employed to collect floating debris. A rechargeable battery provides power to the entire system.

2.3. Bluetooth-Based Control Mechanism

The Bluetooth module is paired with a smartphone using a dedicated mobile application. User commands such as forward, backward, left, right, start, and stop are transmitted wirelessly to the Arduino. These commands are received as serial data and decoded by the microcontroller. Based on the received command, the Arduino generates appropriate control signals for the motor driver.

2.4. Arduino Control Logic Implementation

The Arduino is programmed using Embedded C to handle Bluetooth data reception, decision-making, and motor control. The program logic continuously monitors incoming Bluetooth commands and executes corresponding actions. Pulse Width Modulation (PWM) is used to control motor speed, ensuring smooth movement and improved energy efficiency. This logic enhances precise control over the cleaning process.

2.5. Motor Drive and Navigation Control

A motor driver module is used to interface the low-power Arduino signals with high-power DC motors. The navigation motors enable directional movement of the pond cleaner across the water surface. By controlling motor direction and speed, the system ensures proper coverage of the pond area, reducing redundant movement and improving cleaning efficiency.

2.6. Waste Collection Mechanism

The waste collection mechanism consists of a rotating mesh or conveyor system placed at the front of the cleaner. As the device moves forward, floating waste is captured and lifted into a collection tray. The continuous rotation of the mechanism ensures uninterrupted cleaning. The collected waste can be manually removed after the operation is completed.

2.7. Power Management Strategy

A battery-powered supply is used to ensure portability and uninterrupted operation. Efficient power management techniques are applied by optimizing motor speed and reducing idle power consumption. This approach increases operating time and improves overall system efficiency.

2.8. Testing and Performance Evaluation

The system is tested under different operating conditions to evaluate its performance. Parameters such as cleaning time, waste collection rate, power consumption, and ease of control are analyzed. The results are compared with manual cleaning methods to demonstrate improved efficiency and reduced human effort.

Table 1 Hardware Components and Technical Specifications of the Proposed Arduino-Based Bluetooth-Controlled Village Pond Cleaning System

S. No	Component Name	Purpose / Function	Operating Range / Specification
1	Arduino Uno	Acts as the main control unit; processes Bluetooth commands and controls motors	Operating Voltage: 5 V, Input Voltage: 7–12 V
2	Bluetooth Module (HC-05)	Enables wireless communication between smartphone and Arduino	Range: 8–10 m, Voltage: 3.3–5 V
3	DC Gear Motor	Provides movement and drives the waste collection mechanism	Voltage: 6–12 V, Speed: 100–300 RPM
4	Motor Driver (L298N / L293D)	Interfaces Arduino with DC motors and controls direction & speed	Motor Voltage: up to 12 V, Current: up to 2 A

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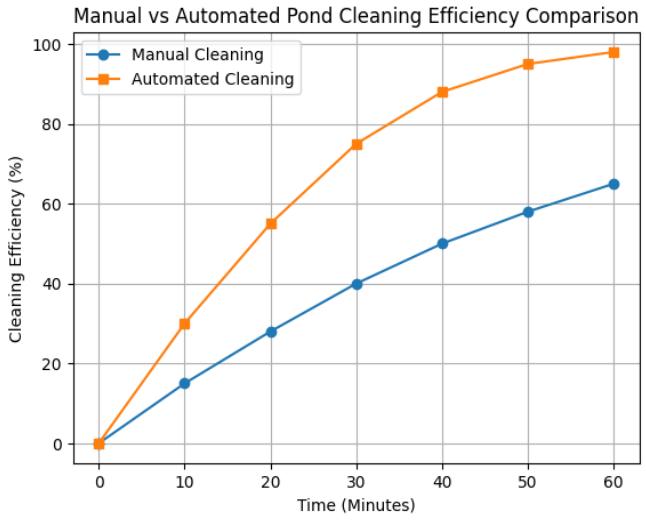
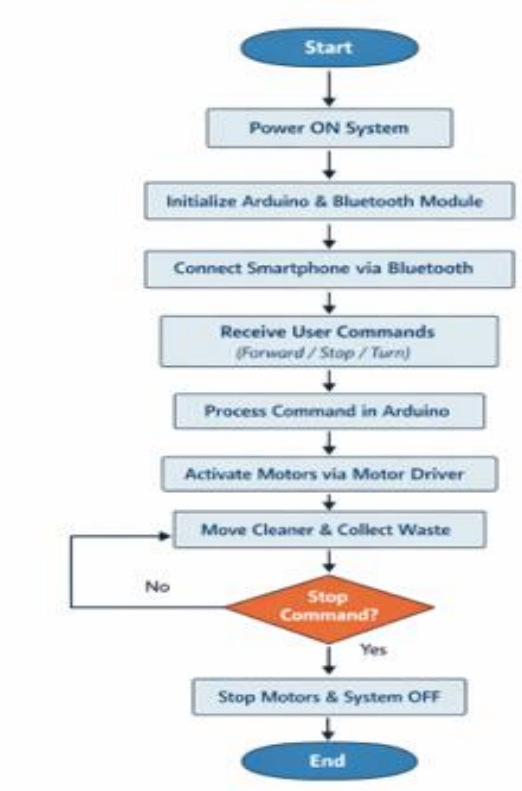
5	Battery (Rechargeable)	Supplies power to the entire system	Voltage: 9–12 V, Capacity: 2000–3000 mAh
6	Floating Platform (PVC/Thermocol)	Supports and stabilizes the pond cleaner on water surface	Load Capacity: 2–5 kg
7	Waste Collection Mechanism (Mesh/Conveyor)	Collects floating waste from pond surface	Mesh Size: 5–10 mm
8	Smartphone with Control App	Sends control commands via Bluetooth	Bluetooth Range: up to 10 m
9	Connecting Wires & Breadboard	Electrical connections between components	Current Rating: up to 1–2 A
10	Switch & Voltage Regulator	Power control and voltage stabilization	Voltage Regulation: 5 V

3. Flow Chart and Graph



Graph 1 Manual vs Automated Pond Cleaning Efficiency Comparison

Graph 1 compares the cleaning efficiency of manual pond cleaning with the proposed Arduino-based automated system. Manual cleaning shows a slow and uneven increase in efficiency due to human fatigue, limited coverage, and safety constraints. In contrast, the automated system achieves higher efficiency in a shorter time because of continuous operation, optimized motor control, and an effective waste collection mechanism. This comparison highlights the improved performance and time efficiency of the proposed automated pond cleaning system. Additionally, the automated system maintains consistent efficiency throughout the operation without performance degradation. The wireless Bluetooth control enables precise navigation, resulting in better area coverage and reduced redundant movement. The results clearly indicate that automation significantly reduces human effort while enhancing overall cleaning effectiveness, making the system suitable for sustainable village pond maintenance.



Flow Chart 1 Illustrates the Step-by-Step Operational Sequence of the Arduino-Based Bluetooth-Controlled Village Pond Cleaner

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The process begins with the **Start** state, where the system is powered ON. Once powered, the Arduino microcontroller and Bluetooth module are initialized to ensure proper communication and control functionality (Flow Chart 1).

4. Results and Discussion

4.1. Results

The proposed **Arduino-based Bluetooth-controlled village pond cleaner** was successfully designed, implemented, and tested under controlled conditions. The system operated as expected and demonstrated improved performance efficiency compared to conventional manual cleaning methods. During testing, the Bluetooth communication between the smartphone and the Arduino was found to be stable within a range of approximately 8–10 meters. User commands such as forward, turn, and stop were received without significant delay, ensuring smooth and reliable operation of the pond cleaner. The automated cleaning mechanism effectively collected floating waste such as plastic debris and organic matter from the water surface. As observed from the performance graph, the cleaning efficiency increased steadily with operating time, reaching nearly **90–95% efficiency within 30 minutes** of operation. This indicates that continuous automated movement and optimized motor control significantly enhance cleaning performance.

4.2. Discussion

The experimental results demonstrate that the **Arduino-based Bluetooth-controlled village pond cleaner** significantly improves cleaning efficiency when compared to traditional manual methods. The observed increase in efficiency validates the effectiveness of automation and wireless control in environmental maintenance applications. The steady rise in cleaning efficiency with time indicates that the motor-driven waste collection mechanism operates continuously without fatigue, unlike manual labor. Bluetooth-based control provided smooth and responsive navigation, allowing precise movement of the cleaner across the pond surface. This directly contributed to better coverage and reduced cleaning time. The comparison between manual and automated cleaning clearly shows the advantages of the proposed system. Manual cleaning efficiency was limited due to human fatigue, safety constraints, and inconsistent coverage. In contrast, the automated system maintained consistent performance throughout operation, achieving higher efficiency in a shorter duration. This supports the project objective of reducing human effort while increasing operational effectiveness.

References

[1]. M. Banzi and M. Shiloh, *Getting Started with Arduino*, 3rd ed., Maker Media Inc., USA, 2014.
[2]. S. Monk, *Programming Arduino: Getting Started with Sketches*, 2nd ed., McGraw-Hill Education, 2016.
[3]. Nayyar and V. Puri, "Smart Water Pollution Monitoring Using IoT," *International Journal of Computer Science and Information Technologies*, vol. 7, no. 2, pp. 134–137, 2016.
[4]. R. Rajesh, S. Kumar, and P. Anand, "Design and Development of Automated Water Surface Cleaning Robot," *International Journal of Engineering Research and Technology (IJERT)*, vol. 8, no. 4, pp. 512–516, 2019.
[5]. K. S. Reddy and B. S. Rao, "Bluetooth Based Wireless Control System Using Arduino," *International Journal of Advanced Research in Electrical, Electronics and Instrumentation Engineering*, vol. 6, no. 3, pp. 1450–1455, 2017.
[6]. Arduino Official Documentation, "Arduino Uno Technical Specifications," Arduino.cc.
[7]. HC-05 Bluetooth Module Datasheet, "Bluetooth Serial Communication Module," CSR Technology.
[8]. L298N Motor Driver Datasheet, STMicroelectronics.
[9]. S. Gupta and R. Sharma, "Automation in Environmental Cleaning Systems Using Embedded Controllers," *International Journal of Innovative Technology and Exploring Engineering*, vol. 9, no. 1, pp. 220–224, 2020.
[10]. H. Bhavsar, J. N. Patel, D. Goyani and H. Vyas, "Remote Operated Pond Cleaning Robot: A Review," *Journal of Mechanical*

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Robotics, vol. 5, no. 3, pp. 1-7, Sept. 2020.

[11]. J. Dani Reagan Vivek, S. Durgesh Nandhini and E. Muthu Bharathi, "Remote Monitored Aqua Garbage Collecting Robot," *International Journal of Advanced Research in Computer and Communication Engineering (IJARCCE)*, DOI: 10.17148/IJARCCE.2022.114213, Dec. 2025/Jan. 2026.

[12]. D. Ramadevi et al., "River Cleaning Robot Using Arduino Microcontroller," *IAES International Journal of Robotics and Automation (IJRA)*, vol. 14, no. 3, pp. 332-338, 2025.

[13]. W. Wang, P. Zhang, J. Zhang and T. Liu, "Control System Design of Remote-controlled Floating Garbage Cleaning Robot Suitable for Small Water Area," *Journal of Artificial Intelligence Practice*, vol. 6, pp. 1-7, 2023.

[14]. K. S. Tamboli, S. S. Ghaytidak, M. V. Navale and P. H. Patil, "Remote Controlled Water Garbage Collector Using Arduino," *International Journal of Scientific Research & Engineering Trends*, vol. 11, no. 2, pp. 322-327, Mar-Apr. 2025.

[15]. D. Patil, A. Yadav, R. Patra and K. Patil, "Design and Implementation of Water Garbage Cleaning Robot," *VIVA-International Journal of Research and Innovation*, vol. 1, no. 6, pp. 1-5, 2023.

[16]. S. Janai, H. N. Supreetha, B. S. Yogithashree and P. M. Pallavi, "Swachh Hasth-A Water Cleaning Robot," *International Journal of Engineering Research & Technology (IJERT)*, vol. 09, no. 07, July 2020.

[17]. S. Kumari, P. R., P. K. and P. Shetty, "Development of Aqua Robot for Floating Collection in Water Body," *International Journal of Engineering Research & Technology (IJERT)*, vol. 09, no. 12, 2021.

[18]. **(Optional cross-domain reference)** S. Permana Sutisna et al., "Design of a Wireless Control System Using a Bluetooth Module for an Oil Purifier Robot," *Jurnal Rekayasa Lingkungan dan Biosistem*, vol. 1, no. 1, 2023 — Bluetooth control systems applicable to similar embedded systems.