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IMPROVING THE PREFORM EFFICIENCY OF VILLAGE POND CLEANER USING ARDUINO IN BASICS OF BLUETOOTH CONTROLLED PROCESSES

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Abstract: This project presents the development of a Bluetooth-controlled pond cleaner utilizing Arduino technology to enhance the efficiency of maintaining village ponds. Traditional pond cleaning methods often rely on manual labor and basic machinery, leading to inefficiencies and inconsistent results. Our proposed solution integrates an automated cleaning system that can be operated remotely via a smartphone application, allowing users to monitor and control the cleaning process in real-time. The system comprises essential components, including a waterproof chassis, DC motors for movement, a Bluetooth module for communication, and monitor water quality. Powered by a rechargeable battery the pond cleaner is designed for sustainability and ease of use in rural environments. Key advantages include increased efficiency, reduced labor costs, and improved water quality, benefiting both local ecosystems and community health. The application of this innovative technology is versatile, extending to urban water bodies, aquaculture, and environmental monitoring. By fostering community involvement and environmental stewardship, this project aims to promote sustainable practices in pond maintenance and enhance the overall health of aquatic ecosystems.

Index Terms **- Component, formatting, style, styling, insert.**

I. INTRODUCTION

The source of life is water. Approximately 97% of the water on Earth is in the form of oceans, making it unfit for human consumption even though 70% of the planet is covered with water. The remaining 3% is kept in reserve in a variety of locations, including lakes, rivers, glaciers, and underground aquifers. People are fed through the irrigation of their crops using river water. Rivers also bring prosperity and preserve the local nature. Regrettably, the majority of lakes and rivers are being contaminated. There are three categories for polluted water damage.

They are known as grey water, black water, and clear water. A leaky tap or a broken water supply line are the sources of clean water. This water can become either grey or black depending on temperature, time, and interaction with nearby pollutants if it is not treated promptly. Sewage is disposed of by drainage pipes, and sadly, human life may occasionally be lost when clearing clogs in the drainage systems.

Due to these several natural and man-made circumstances water gets polluted. With the help of the conveyer belt system that are installed in our module, such agents will be effectively removed. As anticipated, cleaning is completed effectively with the aid of our main components: the automatic the conveyor system.

II. Review Of Literature

Mr. Prof. N.G. Jogi et al: This paper emphasis on that mentioned that the Ganges in India is one of the most polluted rivers. About 29 crore litres of sewage is dumped in the Ganges along with toxins. They have suggested the usage of pedal operated boat with the conveyor attached to it for collecting garbage from the lake. With the help of this conveyor it is possible to collect the garbage like plastic bags, plastic bottles, beverage cans, food wrappers, paper bags, straws, (marine debris) etc. With this methodology no fuel is involved.

Mr. P. M. Sirsat: This paper emphasis on design and fabrication details of the river waste cleaning machine. This machine has designed to clean river water surface. The remote operated river cleaning machine has designed which helps in river surface cleaning effectively, efficiently and eco-friendly. The "River waste cleaning machine" is used where there is waste debris in the water body which are to be removed. This machine consists of DC motors, RF transmitter and receiver, propeller, PVC pipes and chain drive with the conveyor attached to it for collecting wastage, garbage & plastic wastages from water bodies.

Mr. Abhijeet.M. Ballade: The proposed system explains that, Due to increase in water pollution in the form to waste debris; it is hampering the life of aquatic animal and make their life in danger. So that to reduce the water pollution we are trying to make river cleanup machine."River cleanup machine" a machine which involves the removing the waste debris from water surface and safely dispose from the water body. The river cleanup machine works on hydropower to extract waste water debris, plastics & garbage from water.

III. Research Methodology

This section outlines the systematic approach followed to conceptualize, design, and implement the Bluetooth-controlled pond cleaning system. The methodology integrates hardware prototyping, software development, and performance testing through an iterative engineering cycle.

A. System Design Strategy

The research began with problem identification through surveys of existing village pond maintenance practices. The challenges—manual labor intensity, irregular cleaning, and lack of access to advanced machinery—guided the development of a cost-effective and semi-automated solution. The goal was to achieve remote controllability, ease of operation, and environmental impact reduction.

B. Component Selection

The hardware and software components were selected based on performance, availability, compatibility, and power efficiency.

- Microcontroller: Arduino UNO was chosen for its open-source environment and ease of use.
- Communication: HC-05 Bluetooth module was selected for wireless command transmission from mobile devices.
- Actuation: DC motors (12V, 300 RPM) were used for propulsion and conveyor movement; servo motors were used for precise directional control.
- Frame & Materials: Lightweight materials like PVC and acrylic were selected for floating support.
- Power: A 12V rechargeable battery pack powers the complete system.

C. System Integration and Prototyping

The Arduino microcontroller served as the central controller interfacing with all peripheral devices. The connections were tested using a breadboard setup, and control logic was coded in the Arduino IDE using C/C++ syntax. A mobile application (Arduino Bluetooth Controller) was configured to send command strings to control forward (F), backward (B), left (L), right (R), and stop (S) actions.

The mechanical chassis was assembled on a floating base, with motors and belts mounted and aligned to collect debris. The conveyor mechanism was powered by a dedicated motor synchronized with the cleaner's motion.

D. Control Algorithm Development

The control logic was programmed using the following logic flow:

1. Initialize serial communication at 9600 baud rate.
2. Wait for character input from the Bluetooth module.
3. Compare received character with predefined command set.
4. Activate or deactivate specific motor pins based on input.
5. Continuously monitor command inputs in the main loop.

E. Testing and Evaluation

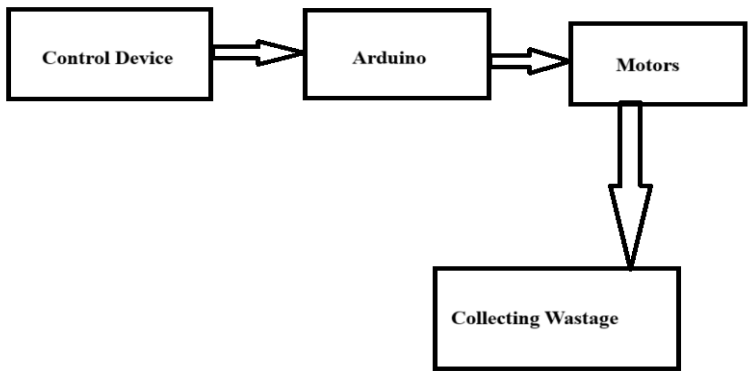
A prototype was tested in a simulated pond environment:

- Communication Range Test: Verified stable Bluetooth signal within 10–12 meters.
- Debris Collection Test: Evaluated ability to collect leaves, wrappers, and other floating waste.
- Motor Load Test: Assessed torque and performance under different waste weights.
- Power Efficiency Test: Monitored operating duration per charge and system efficiency.

Each test was repeated under varying conditions to ensure reliability and repeatability.

F.Block Diagram

The system circuit integrates inputs from Bluetooth and smartphone with Arduino outputs to DC motors and conveyor. The flowchart represents decision-making based on connectivity and waste presence, guiding the control logic.



IV. RESULTS AND DISCUSSION

The developed Bluetooth-controlled pond cleaning prototype was tested under various conditions to evaluate its performance, efficiency, and usability. Initial tests demonstrated that the system was able to successfully collect floating waste, such as leaves, plastic wrappers, and organic debris, from a simulated water body. The primary objective of the system—remote control via Bluetooth—was achieved, with the prototype responding to commands from a smartphone application effectively. The Bluetooth communication module (HC-05) allowed for control within a range of up to 12 meters under ideal conditions. However, certain environmental factors, such as interference from nearby metal structures, occasionally caused temporary disruptions in signal. Once the interference was removed, the system reestablished its connection quickly, ensuring reliable performance.

The operational capability of the pond cleaner was assessed by measuring the maximum floating waste load it could handle, which was found to be approximately 1.5 kilograms. This load corresponds to typical debris

encountered in rural pond environments, which often include fallen leaves and plastic trash. The conveyor belt, driven by DC motors, performed well, operating at a speed of 0.8 to 1.2 meters per minute, which proved to be sufficient for moderate waste collection within a reasonable time frame. The system's battery, when fully charged, operated for approximately two hours before requiring recharging.

The efficiency of debris collection was another important factor evaluated during testing. On average, the system was able to remove about 85% of the surface debris within its operational range, significantly reducing the time required for manual cleaning. Traditional cleaning methods, often involving manual labor with tools like nets, typically require 45–60 minutes for similar tasks, while the automated pond cleaner achieved the same result in just 15–20 minutes. This reduction in time highlights the system's effectiveness in improving operational efficiency. In terms of safety, the automated system significantly outperformed manual cleaning, as it eliminates the need for direct human contact with the water, thereby reducing the risk of injury or exposure to contaminants.

However, there were several limitations observed during the trials. The system is limited to cleaning floating debris on the surface of the water and is not designed to handle submerged waste or sludge. Additionally, while the prototype's user interface is intuitive, it is not fully autonomous—requiring manual control to navigate the pond, which can be a drawback in larger or more complex water bodies. Furthermore, mechanical wear and tear from the continuous operation of the conveyor belt and exposure to water can lead to maintenance challenges over time. The system also relies heavily on battery power, and longer usage durations would necessitate frequent recharging, which could be inconvenient in areas with limited access to electricity.

Despite these limitations, the environmental and social impact of the pond cleaner is significant. In rural areas where pond maintenance is often neglected due to the high labor costs and inefficiency of manual methods, the system could provide a sustainable solution to improving water quality. Cleaner ponds would reduce the prevalence of waterborne diseases, improve the health of aquatic ecosystems, and restore the usability of these water bodies for agricultural and domestic purposes.

In conclusion, the Bluetooth-controlled pond cleaner prototype has shown substantial promise in improving the efficiency, safety, and environmental quality of rural pond maintenance. While there are areas for improvement, such as expanding its capabilities to handle submerged waste and enhancing its autonomy, the system provides a valuable first step towards automation in rural environmental management. The integration of renewable energy sources like solar panels and IoT-based remote monitoring could further elevate the system’s effectiveness and scalability.

V.CONCLUSION AND FUTURE SCOPE

The issue of water logging brought on by plastic, paper, and metal encourages the proliferation of pests and makes diseases like malaria and typhoid more prevalent. This poses a threat to human life. The suggested approach reduces the need for fuel-operated garbage collectors while cleaning the trash found in both small and large lakes. Additionally, it helps aquatic animals live longer lives and requires fewer human efforts to keep the lake clean.

The Village Pond Cleaner project holds immense potential for the future, addressing critical environmental and community needs. Expanding its reach to more villages can amplify its impact, ensuring cleaner water bodies across rural areas. By integrating advanced cleaning technologies and eco-friendly solutions, the project can achieve greater efficiency and sustainability. Encouraging community participation through educational programs can instill a sense of ownership among villagers, promoting the long-term maintenance of ponds. Additionally, collaboration with government schemes and NGOs can provide the necessary support and funding to scale the initiative further. Research and development efforts can enhance the understanding of pond ecosystems, enabling more effective cleaning strategies. The project could also contribute to economic growth by supporting fish farming and eco tourism, creating new opportunities for rural livelihoods. Ultimately, this initiative has the potential to become a model for sustainable water management and environmental conservation, paving the way for a healthier and more vibrant rural ecosystem.

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