

DESIGN AND DEVELOPMENT OF VOICE-CONTROLLED OIL SKIMMER ROBOT

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Keywords:

Voice-Controlled Robot, Oil Skimmer, Arduino Microcontroller, Bluetooth Communication, Oil Spill Cleanup, Embedded Systems, DC Motors, Automation, Environmental Protection, Wireless Control

Introduction:

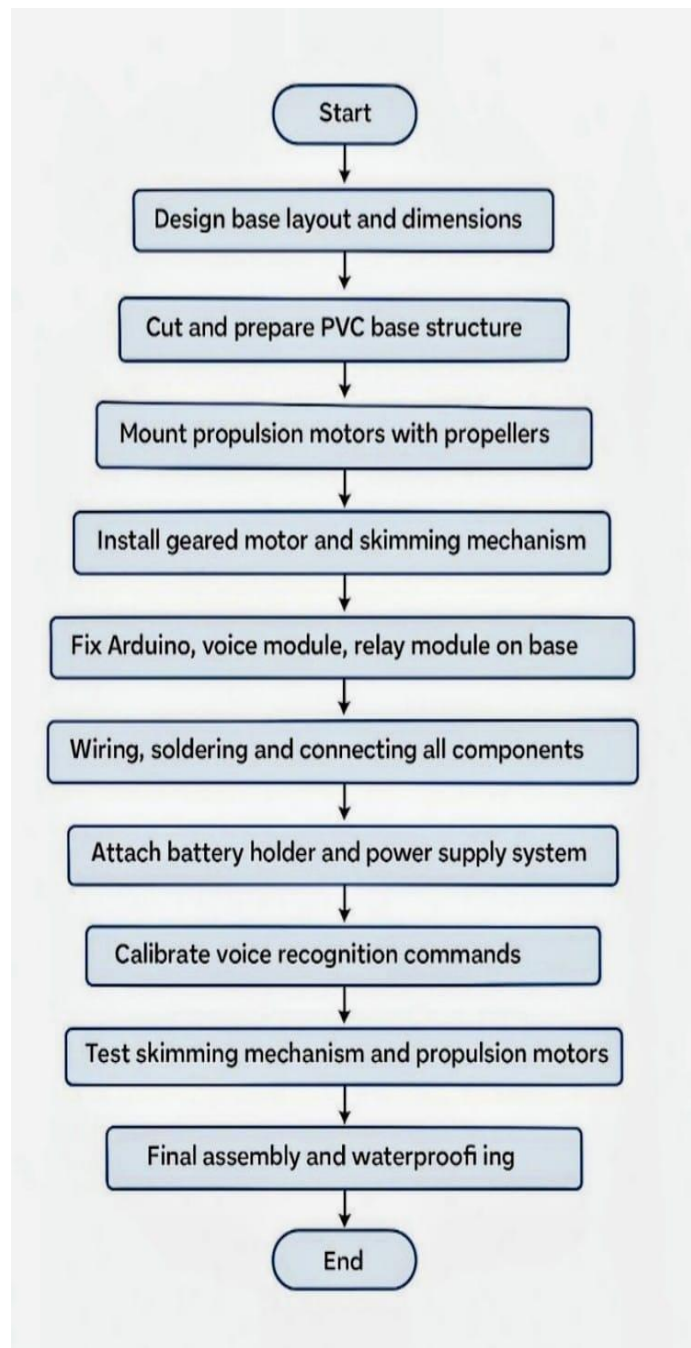
Oil pollution is one of the major environmental issues affecting water bodies such as rivers, lakes, and oceans. It mainly occurs due to oil spills from ships, leakage from pipelines, industrial discharge, and offshore drilling activities. When oil spreads over the water surface, it forms a thin layer that blocks oxygen transfer and sunlight penetration, severely affecting aquatic life and water quality. This leads to long-term damage to ecosystems, marine organisms, and human activities like fishing and tourism.

Traditional methods of oil spill cleanup are mostly manual, time-consuming, and hazardous to human health. These methods require significant manpower and are often inefficient in handling large or difficult-to-reach areas. Therefore, there is a growing need for modern, efficient, and automated solutions to address this problem.

Oil spills are considered one of the most critical environmental challenges faced by marine and freshwater ecosystems across the world. Accidental oil discharge from ships, offshore drilling platforms, pipelines, and industrial activities leads to severe pollution of water bodies. These spills form a thick oil layer on the water surface, blocking sunlight penetration and reducing dissolved oxygen levels, which results in the death of aquatic organisms. The long-term impact includes damage to marine biodiversity, coastal habitats, and human livelihoods dependent on fishing and tourism.

Objectives:

1. To design and develop a voice-controlled oil skimmer robot for efficient removal of oil from water surfaces.
2. To reduce water pollution by implementing an effective oil-water separation mechanism.
3. To minimize human effort and risk by enabling remote operation using Bluetooth and voice commands.
4. To create a cost-effective, eco-friendly, and portable system for small-scale oil spill cleanup.

Methodology:

Result And Conclusion:

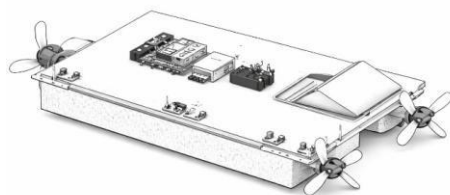
The project proves that a simple, low-cost robotic system can be used for environmental cleanup applications. It reduces human effort and increases safety by allowing remote operation. The system is eco-friendly, portable, and suitable for small-scale water bodies such as ponds and lakes. However, its performance may be limited in rough water conditions and large-scale oil spills. Future improvements can include automation, sensor integration, and enhanced skimming efficiency. Overall, the project successfully meets its objectives and demonstrates the practical use of robotics in pollution control.

Project Outcome and Industry Relevance:

The outcomes of the project indicate that the voice-controlled oil skimmer robot is capable of performing efficient oil recovery in controlled and moderately stable water conditions. The robot responded accurately to voice commands, achieving high command recognition rates across different environments. The motor response time remained consistently low, ensuring real-time control of direction and movement. Skimming efficiency tests demonstrated that the robot could recover a significant percentage of floating oil, proving its usefulness in real-world spill scenarios.

Working Model Vs Simulation/Study:

Simulation Model:



In contrast, a simulation or study-based approach involves only theoretical design, software modeling, or virtual testing without physical implementation. While simulations help in understanding system behavior and design validation, they do not provide real-world performance analysis. The working model developed in this project offers practical insights, improved reliability, and better understanding of challenges such as stability, motor control, and

oil collection efficiency. Hence, the project focuses on real-time implementation rather than simulation.

Working Model:



References:

1. Wireless Oil Skimmer System Based on IoT. Authors: (Shreya Mangesh Lokare, Jui Padmakar Awale, et al.)
2. Design and Fabrication of Oil Skimmer Robot.
3. Optimization Methodology for Skimmer Device Selection for Removal of the Marine Oil Pollution — 2022
4. Development of a novel method for estimating and planning automatic skimmer operation in response to offshore oil spills — 2022
5. IoT-Based Oil Skimmer Robot. Authors: (Pulugujju Rajesh, P. Anjana Reddy et al.)
6. Fabrication of Oil Skimmer Using Belt Conveyor. (Krishna, 2T. Komal Siva Sai Kumar, 3K. Mohan Sai)

7. Assessing Offshore Oil Spills Using Remote Sensing and Geospatial Artificial Intelligence
8. (GeoAI): A Systematic Literature Review — 2024
9. 16. Use of Skimmers in Oil Pollution Response (by a recognized marine-pollution agency)
10. 17. journal Article: Development Of Solar-Powered Automated Floating Type Oil Skimmer 2025

Future Scope:

1. Upgrade communication from Bluetooth to Wi-Fi, GSM, or IoT for long-range control.
2. Integrate GPS for automatic navigation and location tracking.
3. Add ultrasonic, LiDAR, or camera-based sensors for autonomous obstacle detection.
4. Use AI or machine-learning algorithms for intelligent spill detection.
5. Improve skimming mechanism with advanced oleophilic materials.
6. Increase oil collection capacity for larger spill operations.