

ABSTRACT

Oil pollution in the ocean caused by spills from shipping and oil industry activities poses serious threats to marine ecosystems and coastal communities. Conventional methods such as oil skimmer, membranes, and oil dispersants have several limitations, including low effectiveness in separating non-homogeneous mixtures, high operational costs, and the use of chemicals that may lead to secondary pollution. Therefore, this study develops an oily water separation system based on density differences integrated with Internet of Things (IoT) technology. The system is designed using an ESP32 microcontroller as the main controller, supported by ultrasonic and LDR sensors for liquid detection. The separation process occurs automatically through natural density differences, while monitoring and remote control are enabled via Firebase and a Flutter-based application.

Experimental results show that the system achieves oil separation efficiency of 85% – 93.7% and water separation efficiency of 65.3% – 85% under three mixture ratios (3:2, 3:3, and 2:3). Each separation cycle is completed within 6 – 8 minutes, and the system can be monitored from distances of over 10 Km with communication latency of 1 – 5 seconds. With its simple, economical, and environmentally friendly design, the system is promising for oily wastewater management in ships, industries, and coastal areas.

Keywords : *Oil and water separation, density, ESP32 microcontroller, IoT, automation.*