Remote Controlled Bait Boat

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***Abstract*—** In this paper, we focused on the design and implementation of a remote controlled bait boat for fishing, which is capable of efficiently distributing bait or feed on the water surface. For this purpose, we utilized the ESP32 microcontroller, along with the ESP-NOW communication protocol, which enables wireless control of the boat. Additional technologies include the use of 3D printing to manufacture components of the boat and the development of software to manage its operations. During the development, we faced various challenges, including optimizing the boat's design and ensuring stable communication between the boat and the control device. We overcame these issues through repeated testing and enhancements in the hardware design and software functionality. The result is a functional prototype of the bait boat, which can precisely and reliably place baits in various fishing environments, thus enhancing the efficiency of fishing and minimizing disruption to the aquatic ecosystem.

***Keywords*—** ESP32, ESP-NOW, Remote Control, Bait Boat.

I. Introduction

The advancement of technology has significantly transformed various industries, including recreational fishing, where the integration of automation and wireless communication has opened new avenues for enhancing fishing efficiency and sustainability. This research paper presents the design and implementation of a remote-controlled bait boat, specifically engineered to facilitate the precise distribution of bait on the water surface. Central to this development is the ESP32 microcontroller, a powerful and versatile device that not only manages the boat's operations but also supports the innovative ESP-NOW communication protocol, which allows for seamless and reliable wireless control over considerable distances. This technology is particularly beneficial for fishing, as it enables anglers to deploy bait accurately without disturbing the aquatic environment. Furthermore, the project employs 3D printing techniques to fabricate custom components, thereby streamlining the manufacturing process and allowing for rapid prototyping of the bait boat's design. Throughout the development phase, we encountered various challenges such as optimizing the vessel's design for stability and ensuring uninterrupted communication between the control device and the boat itself. Through iterative testing and enhancements in both hardware and software, we successfully addressed these issues, culminating in a functional prototype capable of operating effectively in diverse fishing scenarios. Ultimately, this research not only contributes to the field of fishing technology but also emphasizes the importance of minimizing ecological impact while maximizing angling success, thus offering a novel solution that aligns with contemporary conservation efforts.

II. Integration

The ESP32 microcontroller plays a crucial role in the operation of bait boats by integrating various functionalities essential for autonomous navigation and control. At the core of its capabilities, the ESP32 MCU facilitates the bait boat's ability to autonomously navigate to predetermined locations, thereby serving as a buoy for divers [1]. This autonomous navigation is made possible through the microcontroller's ability to process and execute complex algorithms that interpret environmental data and adjust the boat's course accordingly. Additionally, the ESP32 enables users to remotely input GPS coordinates via a mobile application, leveraging GPRS connectivity to communicate these coordinates to the bait boat

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[1]. This feature not only enhances the convenience of operating the bait boat but also expands its functionality by allowing precise and remote navigation to locations that may be difficult to reach manually. Furthermore, the ESP32 controls the circuit implemented within the bait boat, ensuring seamless integration of its electrical components and enabling efficient power management and operation [1]. By acting as the central processing unit, the ESP32 coordinates the communication between sensors, motors, and other electronic modules, ensuring that the boat operates smoothly and effectively. These interconnected functionalities underscore the ESP32 microcontroller's pivotal role in enhancing the operational efficiency and versatility of bait boats. To fully leverage these capabilities, ongoing maintenance and software updates are essential to adapt to evolving technological standards and environmental conditions, ensuring continued reliability and performance.

The incorporation of the ESP-NOW communication protocol within the control system of the bait boat significantly enhances its operational efficiency and responsiveness. As ESP-NOW is designed specifically for ESP8266 and ESP32 microcontrollers, it provides an optimal fit for the ESP32 MCU utilized in the bait boat control system [2]. By operating in a peer-to-peer communication mode, ESP-NOW allows the bait boat to communicate directly with other devices, such as GPS modules and control systems, without the need for a traditional Wi-Fi connection or access point [2]. This direct communication is crucial for sensor networks and automation applications, making ESP-NOW ideal for the bait boat's requirements where rapid and efficient data transmission is essential [2]. Furthermore, the protocol's low-latency data transmission capabilities ensure that commands from the mobile application are executed in real-time, allowing for precise navigation and control of the bait boat [2]. Additionally, the absence of a complex network infrastructure requirement enhances the bait boat’s ability to function effectively in diverse environments, including remote or offshore locations [2]. Adopting the ESP-NOW protocol in the bait boat system not only streamlines communication but also maximizes the ESP32's capabilities in wireless communications, thereby improving the overall reliability and performance of the autonomous navigation system [2].

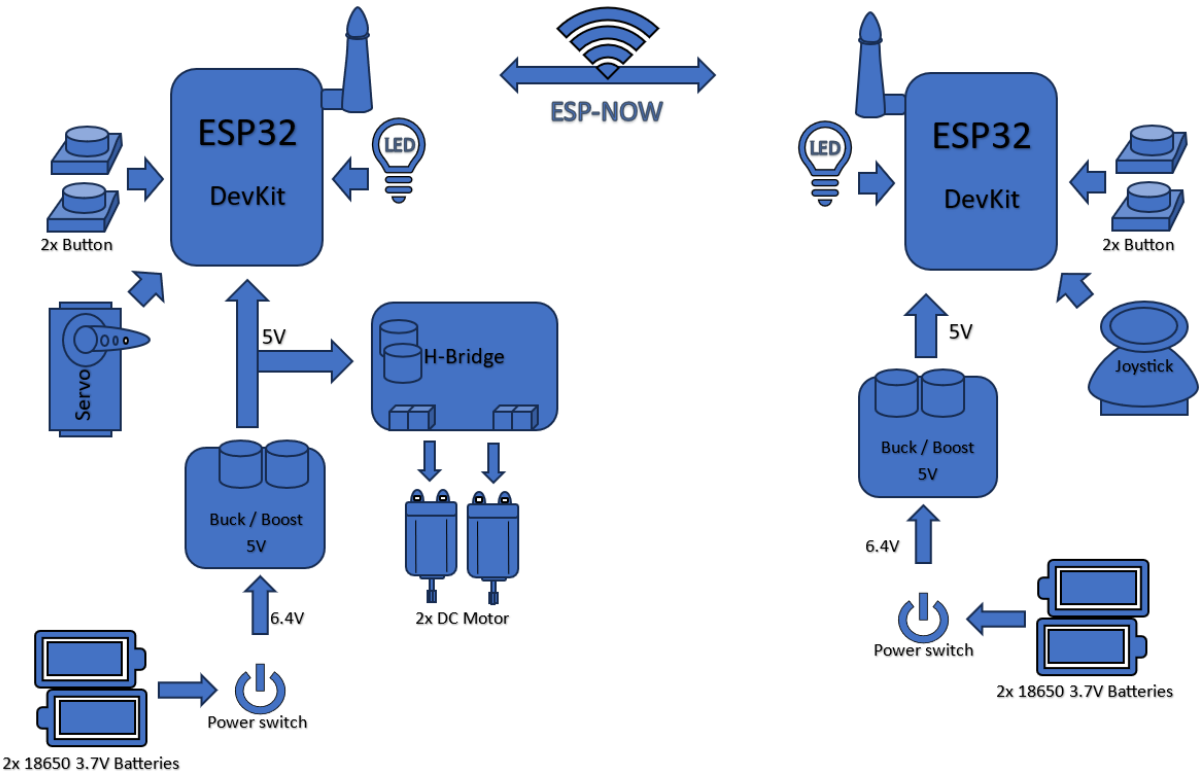

Fig. 1 System block schematic

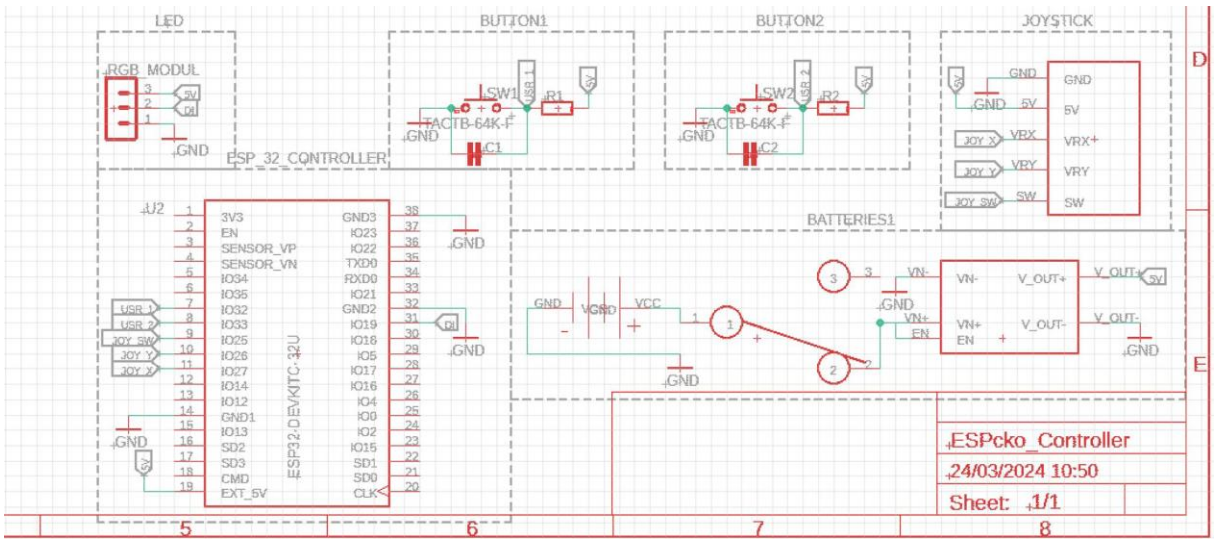

Fig. 2 Driver electric schematic

The integration of 3D printing technologies in the manufacturing of boat components has revolutionized traditional processes, offering enhanced flexibility and functionality. A notable application of 3D printing in this domain is the creation of water jet propulsion systems using PLA (polylactic acid) material, which not only contributes to the environmental sustainability of manufacturing practices due to its biodegradable nature but also allows for precise customization and rapid prototyping [3]. The thermoplastic properties of PLA enable it to be molded into complex shapes, which is essential in fabricating intricate components like hulls that require the integration of electrical systems for efficient propulsion [3]. This integration is evident in the construction of prototype boats, where the 3D-printed hulls are designed to seamlessly incorporate and secure these electrical components, enabling direct connectivity with the propulsion systems [3]. After the installation of these systems, a functionality check is conducted to ensure that the components operate as intended, thereby demonstrating the practical utility and effectiveness of 3D printing in real-world boat manufacturing scenarios [3].

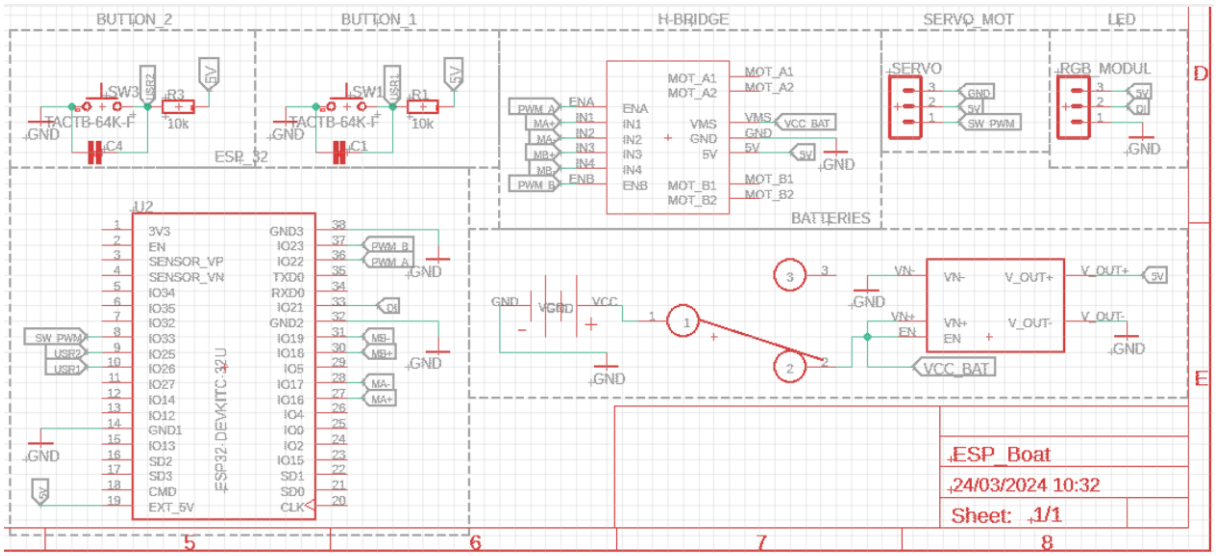

Fig. 3 Boat control board electric schematic

The use of 3D printing in such applications not only accelerates the manufacturing process but also enhances the adaptability of design, allowing for modifications and improvements tailored to specific performance requirements. These advancements underscore the potential of

3D printing to not only complement but also innovate traditional manufacturing methods, highlighting the need for further research and development to fully harness its capabilities in the boating industry.

III. Conclusion

The integration of the ESP32 microcontroller into the design and functionality of remote-controlled bait boats represents a significant advancement in autonomous marine technology, particularly in enhancing navigational precision and operational efficiency. The ability to autonomously navigate to predetermined GPS coordinates, as facilitated by the ESP32's sophisticated processing capabilities, not only streamlines the deployment of bait but also broadens the application scope of such vessels, particularly in recreational fishing and underwater exploration. This work demonstrates how advancements in microcontroller technology, combined with mobile application interfaces, can create systems that are both user-friendly and highly functional, allowing for real-time adjustments based on environmental data. However, despite these promising developments, there are notable limitations that warrant further investigation. For instance, the dependency on GPRS connectivity raises concerns about the reliability of communication in remote areas with poor signal coverage, highlighting a gap in the current implementation that could affect navigational accuracy and operational reliability. Additionally, while 3D printing offers remarkable benefits in terms of customization and rapid prototyping, the long-term durability and performance of 3D printed materials under various marine conditions need thorough evaluation to ensure that these components can withstand the rigors of aquatic environments. Future research should focus on enhancing the robustness of the communication systems, exploring alternative or supplementary technologies for navigation in challenging environments, and assessing the longevity of 3D printed materials in marine applications. By addressing these limitations, the findings from this study can be expanded upon, paving the way for more resilient and versatile autonomous vessels in the boating industry. The potential for innovations stemming from this research not only contributes to academic discourse but also has practical implications for the design and operation of marine technology, emphasizing the need for continuous exploration and development in this rapidly evolving field.

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