Optimizing Underwater Depth Mapping Through Drone Based Sonar Technology

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Accurate and affordable underwater depth mapping remains a major challenge in marine research, environmental monitoring, and industrial applications, as conventional ship-based sonar systems and autonomous underwater vehicles (AUVs) are costly, complex, and lacking portability. This study develops a drone-based system that integrates sonar and GPS technologies to address these limitations and generate reliable underwater terrain data. The system consists of a floating drone platform equipped with a sonar sensor capable of measuring depths between 0–100 m, synchronized with GPS modules to capture spatial coordinates. A dual-microcontroller setup was implemented, with one unit dedicated to depth and GPS data acquisition and logging on an SD card, and the other managing flight control and telemetry. Real-time monitoring was supported through a C# ground station dashboard, while MATLAB was used for post-processing to produce high-resolution 3D surface maps. A Python-based filtering script was used to eliminate duplicate points and average depth values for improved accuracy. Field experiments conducted at Kuttiyagolla Lake (0 -100m depth range) collected more than 2,000 data points and confirmed the system's ability to generate accurate 3D visualizations of underwater topography, despite challenges such as waterproofing, GPS delays, and motor mounting stresses. Structural reinforcement with aluminum composite panels, the use of hybrid Ni-MH batteries for extended operation, and an improved motor configuration enhanced durability and performance. Overall, the system demonstrated portability, reliability, and cost-effectiveness, offering a practical alternative to conventional depth mapping methods. The research highlights strong potential for applications in aquatic research, resource management, disaster response, and environmental monitoring, contributing to sustainable and scalable underwater mapping solutions.

Keywords: *3D surface mapping, Drone systems, GPS integration, Sonar technology, Underwater depth mapping*