

ABSTRACT

Visual documentation of sediment is an essential component in geological research and environmental mapping to identify characteristics such as color, texture, and structure. Traditionally, the documentation process has been carried out manually using smartphone cameras, which often results in inconsistent images due to variations in angles, lighting, and positioning. Although conventional tools like the MSCL-S (Multi-Sensor Core Logger - Standard configuration) are available, the unit is currently damaged, and the cost of repair is prohibitively expensive, making it unsuitable for continuous and efficient documentation.

To address this issue, a system called SedimTrack-IoT was developed, a sediment image scanning tool based on the Internet of Things (IoT). The system consists of a mechanical module driven by a stepper motor with an ESP32 microcontroller as its core, and an Android mobile application built with Kotlin to configure scanning parameters such as track length and motor speed. Device communication is handled using the MQTT protocol over TLS, while data storage is managed via Supabase. After image acquisition, an automatic image stitching process is executed on a desktop using a deterministic offset-based approach with cropping and alignment, implemented via OpenCV.

Test results show that the system achieves linear movement precision of ± 0.1 cm per centimeter of travel, with a data transmission success rate of 96.2% for ESP32 and 100% for the mobile application. The average delay from ESP32 to Supabase was 1.12 seconds, while mobile app communication experienced only 0.07 seconds of latency. The image stitching process successfully completed for scan lengths of 30 cm, 50 cm, and 100 cm, with total processing times under 10 seconds. SedimTrack-IoT has proven capable of performing automated, efficient sediment image documentation, with acceptable Quality of Service (QoS) performance for non-critical IoT systems.

Keywords: *ESP32, image stitching, Internet of Things, sediment documentation, Quality of Service*