

ABSTRACT

The availability of efficient and reliable communication protocols is a critical aspect in the development of Internet of Things (IoT) systems, particularly in environments with limited or no internet connectivity. This study designs and implements a temperature monitoring system based on the ESP-NOW wireless communication protocol using a many-to-one configuration, employing ESP32-C3 modules and DS18B20 temperature sensors, with an aquarium temperature monitoring scenario as a case study. The system is equipped with real-time temperature display on a TFT ST7789 screen, data logging features to an SD card and internal memory (LittleFS), as well as a web-based configuration portal for local system setup. Quality of Service Performance testing shows excellent communication results, with a maximum latency of 0.86 ms, jitter below 3 ms, and 0% packet loss at distances up to 50 meters. Furthermore, the system maintains a 100% Packet Delivery Ratio (PDR) up to 25 meters under Line-of-Sight (LoS) conditions, and remains stable at 5 meters even with physical obstacles such as glass or brick walls. These results demonstrate that ESP-NOW is a reliable, efficient, and low-power communication solution for localized temperature monitoring systems that do not rely on internet connectivity, particularly in indoor environments with physical or network limitations.

Keywords: *Aquarium, DS18B20, ESP32-C3, ESP-NOW, Internet of Things, many-to-one, Quality of Service, Temperature Monitoring.*