

ABSTRACT

The increasing number of vehicles in the TULT (Telkom University Landmark Tower) area has made it difficult to find available parking slots, leading to unregulated parking space usage. To address this issue, a smart parking system based on IoT has been developed, integrating Firebase Realtime Database, WS2812B LED indicators, and a Flutter-based mobile application to provide real-time parking information while supporting slot reservations and QR Code-based check-in/check-out management. This system operates by updating parking slot status directly in Firebase, which is then displayed in the user application and reflected on LED indicators controlled by the ESP32-S3. Key features include real-time slot monitoring, reservations, parking status notifications, and admin overrides to resolve parking conflicts. Testing results show that the system can display parking status with an average latency of under 200 ms, while the LED indicators maintain good visibility under various lighting conditions. User experience evaluation through the System Usability Scale (SUS) resulted in a score of 73.86, indicating a good level of usability. Based on these findings, this IoT-based smart parking system can serve as an effective solution for optimizing parking management in campus environments.

Keywords: Firebase, IoT, Smart Parking, WS2812B, ESP32-S3, Hybrid App.