RANCANG BANGUN *REPEATER PORTABLE* 2.4 GHZ PADA JARINGAN WIFI BERBASIS MIKROKONTROLER ESP32

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ABSTRAK

Jaringan internet kini telah menjadi kebutuhan dasar seperti makanan dalam kehidupan manusia. Akses internet melalui *smartphone* sangat mudah, baik melalui jaringan data seluler maupun Wi-Fi di berbagai lokasi seperti sekolah, kampus, kantor, dan rumah. Meskipun teknologi Wi-Fi telah maju, masalah jangkauan sinyal sering menyebabkan kehilangan koneksi. Penggunaan *Repeater* Wi-Fi berbasis mikrokontroler ESP32 menjadi solusi ekonomis untuk memperkuat sinyal tanpa biaya besar. Penelitian ini bertujuan untuk merancang WiFi *Repeater portable* berbasis mikrokontroler ESP32, dan menguji performa WiFi *Repeater* menggunakan parameter QoS (*Quality of Service*) seperti *delay, jitter, packet loss, dan throughput*. Metode penelitian melibatkan penggunaan ESP32, *Flashing Tool*, *Wireshark*, dan pengujian streaming video YouTube dengan kualitas 720p dalam skema Line of Sight (LOS) dan Non-Line of Sight (NLOS) dengan interval pengujian 1 meter. Dan pengambilan data menggunakan *software Wireshark*. Hasil penelitian menunjukkan bahwa WiFi *Repeater portable* berbasis mikrokontroler ESP32 berhasil dirancang menggunakan komponen mikrokontroler ESP32, modul TP4056, dan baterai 18650. Performa pengujian menunjukkan bahwa WiFi *Repeater* ini mampu mentransmisikan data hingga jarak 12 meter tanpa kehilangan paket (Packet Loss 0%) baik dalam kondisi LOS maupun NLOS. Pada jarak 13 meter, koneksi terputus akibat melemahnya kekuatan sinyal. Nilai *throughput* cenderung menurun seiring bertambahnya jarak, dengan nilai tertinggi pada jarak 0 meter dan terendah pada jarak 12 meter, khususnya pada kondisi NLOS akibat hambatan fisik seperti dinding. *Delay* dan *jitter* juga meningkat dengan bertambahnya jarak, terutama pada kondisi NLOS. Secara keseluruhan, WiFi *Repeater* ini dinilai sangat baik untuk *Packet Loss*, bagus hingga sedang untuk *jitter*, dan sangat baik dalam *delay* hingga jarak 12 meter, menjadikannya solusi efektif untuk meningkatkan jangkauan jaringan WiFi dalam kondisi tertentu.

Kata kunci: WiFi *Repeater*, ESP32, parameter QoS, cakupan sinyal, performa jaringan

DESIGN AND CONSTRUCTION OF A 2.4 GHZ PORTABLE REPEATER WITH ESP-32 BASED MICROCONTROLLER FOR WIFI NETWORKS

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ABSTRACT

Wireless networks have become an indispensable part of modern life, comparable to basic necessities such as food. The widespread use of smartphones has facilitated easy internet access through cellular data networks and Wi-Fi in various settings. However, the limitations of Wi-Fi signal range often lead to connectivity disruptions. This research proposes a cost-effective solution to address this issue by designing a portable Wi-Fi Repeater based on the ESP32 microcontroller. The performance of the designed Repeater was evaluated using Quality of Service (QoS) metrics including delay, jitter, packet loss, and throughput. The experimental setup involved an ESP32 development board, a Flashing Tool, and Wireshark for data collecting. YouTube video streaming in 720p resolution was employed to assess the Repeater's performance under both Line of Sight (LOS) and Non-Line of Sight (NLOS) conditions, with measurements taken at one-meter intervals. The results indicate that the developed Wi-Fi Repeater successfully extended the wireless network coverage up to 12 meters without experiencing any packet loss. Beyond this distance, the connection was compromised due to signal attenuation. Throughput was observed to decrease with increasing distance, particularly in NLOS environments where physical obstructions caused significant signal degradation. Similarly, delay and jitter exhibited an increasing trend with distance, especially in NLOS scenarios. Overall, the Wi-Fi Repeater demonstrated excellent performance in terms of packet loss, good to moderate jitter performance, and very low delay up to 12 meters, making it a viable solution for enhancing wireless network coverage in specific scenarios.

Keywords: WiFi Repeater, ESP32, QoS parameters, signal coverage, network performance