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Inter-Collegiate / Institute / Department Research Convention

Category: Engineering and Technology **Slot No.:** **Level:** UG

MONITORING SYSTEM

ABSTRACT

This project focuses on developing a Python-based GUI application for real-time network scanning and monitoring, providing a versatile platform for network analysis and management. Built using Tkinter, the application offers features such as real-time discovery of nearby Wi-Fi networks, displaying key details like SSID, BSSID, signal strength, security type, and estimated distance. It integrates WeatherAPI to adjust signal strength measurements based on environmental factors such as temperature and humidity, ensuring more accurate analysis. The application performs MAC address lookups to identify device vendors and models and visualizes network data through a radar-style interface and dynamic graphs for parameters like signal strength and distance. Additionally, it logs network data into a CSV file for future reference and supports USB Wi-Fi card detection for extended functionality. Leveraging multithreading for seamless updates and interactive features, this tool is highly suited for applications in network optimization, IoT management, and wireless communication research.

INTRODUCTION

Wi-Fi has become essential for personal and professional use. Increasing devices and access points make network performance management challenging. The need for a real-time Wi-Fi signal monitoring system motivated this project.

Aims to assist network administrators in:

- Monitoring signal strength.
- Estimating access point distances.
- Identifying potential network issues.

AIM & OBJECTIVES

The aim of the project is to develop a real-time signal monitoring system that detects, analyzes, and visualizes signal strength to optimize network performance and improve coverage.

To create a Wi-Fi visualization tool capable of:

- Locating devices using radar technology.
- Displaying device status (active, idle, disconnected).
- Providing distance metrics for each connected device.

METHODOLOGY

A. Wi-Fi Scanning

The tool uses the PyWiFi library to scan for Wi-Fi networks, capturing details like SSID, BSSID, frequency (GHz), signal strength (dBm), and estimated distance using the Free-Space Path Loss (FSPL) model. It also identifies the make and model of network devices via the BSSID.

B. Signal Strength Adjustment

Signal strength is refined by accounting for environmental factors such as temperature and humidity, fetched via an API. These adjustments produce an "affected signal strength" for more accurate results.

C. User Interface

A Tkinter-based GUI dynamically displays real-time scan results, categorizing networks into strong, moderate, and weak signals. A radar-style visualization shows the relative positions of detected networks.

D. Weather Integration

Real-time environmental data (e.g., temperature, humidity, wind speed) is integrated via a weather API to analyze how outdoor conditions impact Wi-Fi signals.

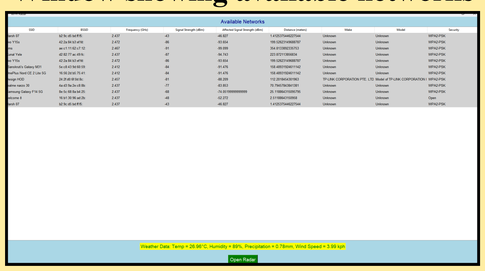
E. Multithreading for Continuous Scanning

Multithreading ensures uninterrupted performance by running Wi-Fi scanning in the background, allowing the GUI to remain responsive and update automatically.

DESIGN & Technology Stack

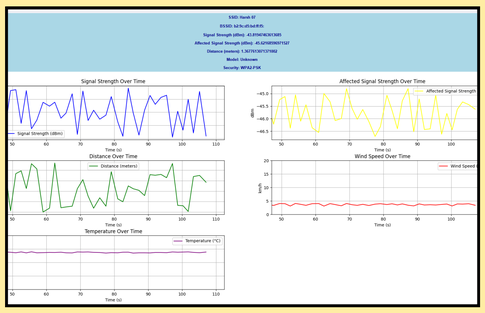
RESULT

Window showing available networks



The user interface systematically displays real-time Wi-Fi network data in a structured and intuitive format. A table presents key details with columns for SSID, BSSID, Frequency (GHz), Signal Strength (dBm), Affected Signal Strength (dBm), Distance (meters), Make, Model, and Security, enabling organized analysis.

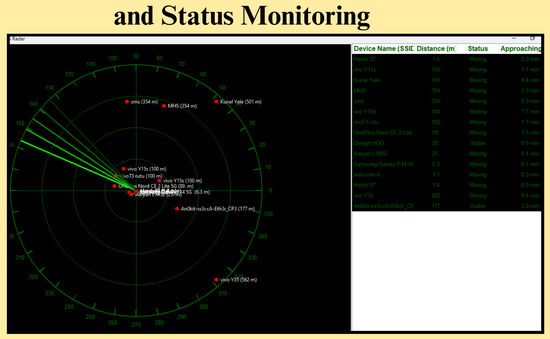
Time Series Analysis



The image shows a Wi-Fi Radar interface that maps nearby Wi-Fi-enabled devices as red dots on a circular grid, with distances measured in meters and connected to the center by green lines. A table on the right displays each device's SSID, distance, status (Moving or Stable), and approaching time. This interface provides real-time visual tracking and data for efficient Wi-Fi network monitoring and management.

The window displays five time-series graphs that track network and environmental factors. The first graph shows signal strength (in blue) over time, followed by the affected signal (in yellow), which reflects signal degradation due to interference. The distance (green) graph represents the distance from the access point, while the temperature (purple) and wind speed (red) graphs capture environmental conditions over time. Key network details, such as SSID, BSSID, and Security, are displayed at the top. This setup allows for real-time monitoring of Wi-Fi performance and external influences, helping to identify patterns or issues.

Real-Time Wi-Fi Device Localization and Status Monitoring



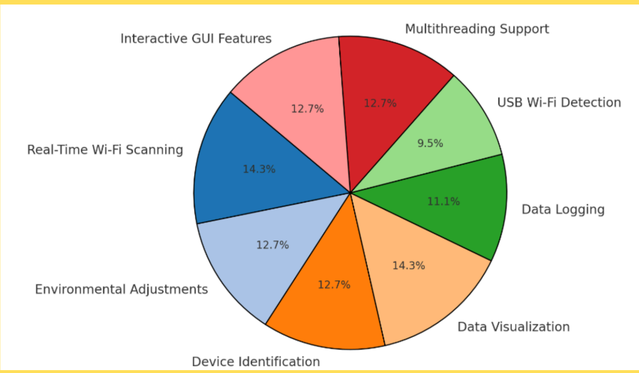
CONCLUSION

This project showcases a real-time Wi-Fi monitoring system that detects Wi-Fi signals and tracks connected devices. By visualizing these devices on a radar-like interface, the system offers key information, including distance and SSID. This innovative approach enhances the understanding of network behavior, enabling more efficient Wi-Fi resource management and ultimately improving user experience and connectivity.

FUTURE PROSPECT

- Enhanced Distance Accuracy: Use advanced algorithms or machine learning for precise device tracking.
- Triangulation with Multiple Access Points: Improve positioning accuracy by integrating triangulation techniques.
- 3D Visualization: Implement a 3D radar view for better device distribution analysis.
- IoT Integration: Connect with IoT devices for automated security alerts and smarter network management.

Feature Contribution in wifi-Scaning Application



Refrences

- Sadhana Lolla and Amy Zhao, "WiFi Motion Detection: A Study Into Efficacy and Classification," 2019 IEEE Integrated STEM Education Conference (ISEC).
- Bo Tan, Karl Woodbridge, Kevin Chetty, “A Real-Time High Resolution Passive WiFi Doppler Radar and Its Application”, 2014 International Radar Conference.