

Wi-Fi Analyzer for Users to Optimize Current Network

BY

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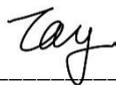
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I would like to express my sincere thanks and appreciation to my supervisors, Encik Syed Muhammad Bin Syed Omar who has given me this bright opportunity to engage in an mobile application development project. It is my first step to establish a career in IC design field. A million thanks to you.

ABSTRACT

This project is a mobile application development for Wi-Fi analyze purpose. It is an Android application which displays the parameters of the connected Wi-Fi network. The parameters include Service Set Identifier (SSID), Strength, Signal Level, Signal Strength, Speed, Internet Protocol (IP) Address, Media Access Control (MAC) Address and Frequency. The main objective is to analyze the connection, collect the data, and diagnose the issues that are causing a poor Wi-Fi signal. The impact of this project is that when the Wi-Fi network come with some issues related to network implementation, security, and maintenance. For example, the location of your router, the channel you choose for data transmission, and the capacity of the signal to reach all intended users can all have a significant impact on the flexibility and usefulness of your Wi-Fi network. The usage of tools like a Wi-Fi signal analyzer can be quite helpful for maintaining the Wi-Fi network's top performance. The emphasis of this project is laid on collecting the data from network's various access points and channels and present it in a comprehensible manner via visual reports and dashboards. The development tool used in this project is the Android Studio and Java.

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LIST OF SYMBOLS

dbm Decibel-milliwatts

LIST OF ABBREVIATIONS

<i>WLAN</i>	Wireless Local Area Network
<i>MAC</i>	Medium Access Control
<i>SSID</i>	Service Set Identifier
<i>BSSID</i>	Basic Service Set Identifier
<i>IP</i>	Internet Protocol
<i>WLAN</i>	Wireless Local Area Network
<i>MAC</i>	Medium Access Control
<i>SSID</i>	Service Set Identifier
<i>BSSID</i>	Basic Service Set Identifier
<i>IEEE</i>	Institute of Electrical and Engineers

CHAPTER 1

Introduction

1.1 Problem Statement

I. Information Complexity

Even if the information is complete and accurate, the analysis is meaningless if the information is displayed in a complex and difficult to understand manner. Because the data obtained from the analysis is usually parameterized by numbers, displaying these parameters directly may make it difficult for the user to understand. Therefore, after the application has obtained the information of the network, it should turn the data into well-structure formats, making it easier to interpret data.

II. Flood of information

When the application starts to detect available access points in the vicinity, if there are many available access points in the vicinity, it will display information about all the access points in the range, which may cause a flood of information. Users usually analyze their own Wireless Fidelity (Wi-Fi) signals, however, the presence of multiple unnecessary information can cause inconvenience to users. The application should implement the 'filter' function to filter out the information that the users desired.

III. Power Consumption

When the Wi-Fi analyzer is scanning and analyzing, it consumes a lot of power from the phone because it is real-time scanning. But most of the users do not need the real-time analysis, they just need a one-time analysis, and it is sufficient for them to identify their Wi-Fi network.

IV. Channel Interference

The majority of Wi-Fi analyzers only display which channel is the Wi-Fi located in but not the interference of the channel. The devices or the Wi-Fi network of neighbors may use the same channel and interfere with the connection. The application should have the feature to analyze which channel has the least interference and do a rating for each channel.

1.2 Research Objectives

The main objective of the project is to develop a convenient, user-friendly, and accurate Wi-Fi Analyzer mobile application for the users, helping them to optimize and ensure their network is functioning properly.

Sub-Objectives

1) Display the data in well-structure format

A well-structured format allows the users to understand the information quickly. Users can view the real-time signal strength in the timeline graph. Then, the signal strengths with the Wi-Fi channel are also can be viewed as a bar chart, both formats are to make users easier to understand the sequence of the signal.

2) Provide filter function

Implementing the FILTER function allows the user to filter a range of data based on the criteria they define. For example. SSID, Wi-Fi Band, Signal Strength, and security settings. This function is to save time for the users and makes them feel convenient.

3) Provide the stop scanning option

Rather than continuously scanning the signal, provide the stop scanning option to allow the users can pause the scanning of the application whenever they want. This function can prevent high-power consumption from the user's phone.

4) Provide channel rating

The interference of the Wi-Fi signal is a common thing nowadays, it will weaken the signal and slow down the speed of the connection. The channel rating helps users to find out the best channels with less interference and rate them with the grade so that the users can change to the best channel through the router to enjoy a high-speed connection.

1.3 Project Scope and Direction

This proposed project will focus on developing an android mobile application for users to analyze their Wi-Fi network. The development tools used in this project is Android Studio, Java and android device. The main functions development is totally based on the Wifi Manager and Connectivity Manager API classes to achieve the operations that related to the Wi-Fi. The deliverable at the end of the purposed project is an application that allows users to enhance their existing Wi-Fi network by scanning nearby networks, identifying busy channels, and measuring signal strength.

1.4 Contributions

The main goal of the project is to assess the connection, gather data, and pinpoint the issues that are causing poor Wi-Fi signal. Wi-Fi analyzers collect data from your network's many access points and channels and present it in a comprehensible manner via visual reports and dashboards.

Then, it will provide users or network administrators with a variety of network information. Admins can utilize the information obtained to fine-tune existing settings and boost the network's performance. The key statistics offered by the application include: SSID, Band and Channel, Security Settings, and Signal Strength.

Network administrators or users may utilize a Wi-Fi analyzer to locate troubled nodes, endpoints, and other issues, as well as do root cause investigation. Admins can resolve the issue by examining possible remedies, such as moving to a different channel to relieve congestion.

Lastly, it's not cost effective for home users and small companies to invest in a costly hardware wireless analyzer when they can just download one of the finest Wi-Fi analyzer applications and do Wi-Fi analysis on their Android devices. Wi-Fi analyzer applications are inexpensive, simple to use, and give precise enough information to meet the needs of most users.

1.5 Background Information

Wi-Fi stands for Wireless Fidelity. Wi-Fi networks operate on radio frequency in the 2.4 GHz or 5.8 GHz bands. The Wi-Fi technology is based on the IEEE 802.11 series standards, which include 11a, 11n, 11ac, and 11ax, which define WLAN. The standard specifies the PHY and MAC layers.

A Wi-Fi network is essentially an internet connection shared by a wireless router with several devices in a house or company. The router connects to the internet modem directly and functions as a hub, broadcasting the internet signal to all of the Wi-Fi enabled devices. For example: Smartphone, Laptop, PC, Printer, etc. Users can stay connected to the Internet as long as they stay within the network's service area.

Wi-Fi analyzers were once primarily utilized by major businesses and organizations that required to cover a vast region with a robust Wi-Fi signal. Wi-Fi networks are ubiquitous these days, and our expectations of them have never been higher. It's difficult for home users, small companies, and schools to provide dependable coverage and the fastest data transfer speeds without learning how to utilize a Wi-Fi analyzer.

Based on above, Wi-Fi analysis becomes an important part to analyze the Wi-Fi status, in order to optimize it. Therefore, the intention of this project is to do the Wi-Fi analysis with a wireless network analyzer to disclose which Wi-Fi channels are the least used and give a wealth of additional data for through Wi-Fi optimization

CHAPTER 2

Literature Reviews

2.1 Previous Works on Deep Learning

There are several Wi-Fi analyzers in the market. This chapter will review on those application and trying to identify their strength, weakness and how to solve their weakness. Additionally, relevant studies can provide valuable insights and understanding to make the project better, such as methodology or data analysis methods to use. There are 5 related applications included 'SpeedTest Meter', 'IP Tools', 'Who Is On My WiFi?', 'Wifi Master' and 'Wifi Analyzer and Surveyor'.

Application 1: SpeedTest Meter – Wifi Analyzer

The first existing mobile application I studied is SpeedTest Meter – Wi-Fi Analyzer. This application allows the users to measure the speed between the device and the server, using internet connection like Wi-Fi. After the test, the application will show the connected network IP address and name on the top. Besides that, it will also display the download speed, upload speed, ping, and the time period graph at the bottom.

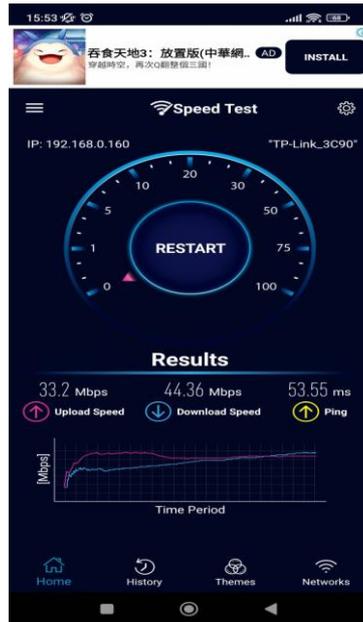


Figure 2.1 Snapshot of SpeedTest Meter Strengths

Referring to Figure 2.1, the main strength of the SpeedTest Meter application has speed test function with high accuracy. When user conducting the speed test, there will be a meter and display the real time measurement animation of the signal. Besides that, the application has a very good-looking design which is hi-tech style. Refer to Figure 2.2, users can choose their favorite color theme to change the color of the design, make it more attractive and aesthetic to user.



Figure 2.2 Themes Function of SpeedMeter Application Weaknesses

The SpeedTest Meter application has a number of weaknesses. The first weakness is the network section at the bottom. This section has the ability to detect all available Wi-Fi networks and display them in a list. However, this feature has a bug in that it displays duplicate Wi-Fi networks in the same list. Refer to Figure 2.3, there are 3 TPLink_5G Mesh in the list, which is a serious problem for the Wi-Fi Analyzer application, it means that the feature is not yet complete. It will be confusing for the user to use it. The second weakness is that the icon beside the network name is not able to show the signal strength, all icons are displayed uniformly with a very strong signal even if the signal is weak. Lack of information provision for the network, only network name, and IP address is provided.



Figure 2.3 Network Scanning Function of SpeedTest Meter

Application 2: IP Tools

IP Tools is a network toolkit that helps you speed up and set up your networks. It provides for the rapid diagnosis of any computer network problems, as well as the detection of IP addresses and the enhancement of network performance. For IT professionals and network administrators, this is a useful app for them.

Strengths

The Wi-Fi analyzer from IP Tools allow the users gain a complete and accurate image of your network's current state. The analysis and the optimization that provided by the analyzer are fast, simple, and accurate. Users may get detailed information about the network in seconds, for example: SSID, BSSID, Signal Strength, Frequency and even more.

Weaknesses

Refer to the Figure 2.4, the weaknesses of the IP Tools Wi-Fi Analyzer are obvious. The first weakness is the signal timeline graph in the application. The SSID of the network is placed directly in front of the timeline graph, blocked the view of the timeline graph. Additionally, the real time scanning timeline graph is not able to stop, it will continuously be scanning until the users close the whole application. Next, the second weakness is the lack of effort in the design layout of the application, information is simply displayed on the interface with black color background and white color font only. Users are difficult to find the important point of the information, wasting their time to find out the information they want.

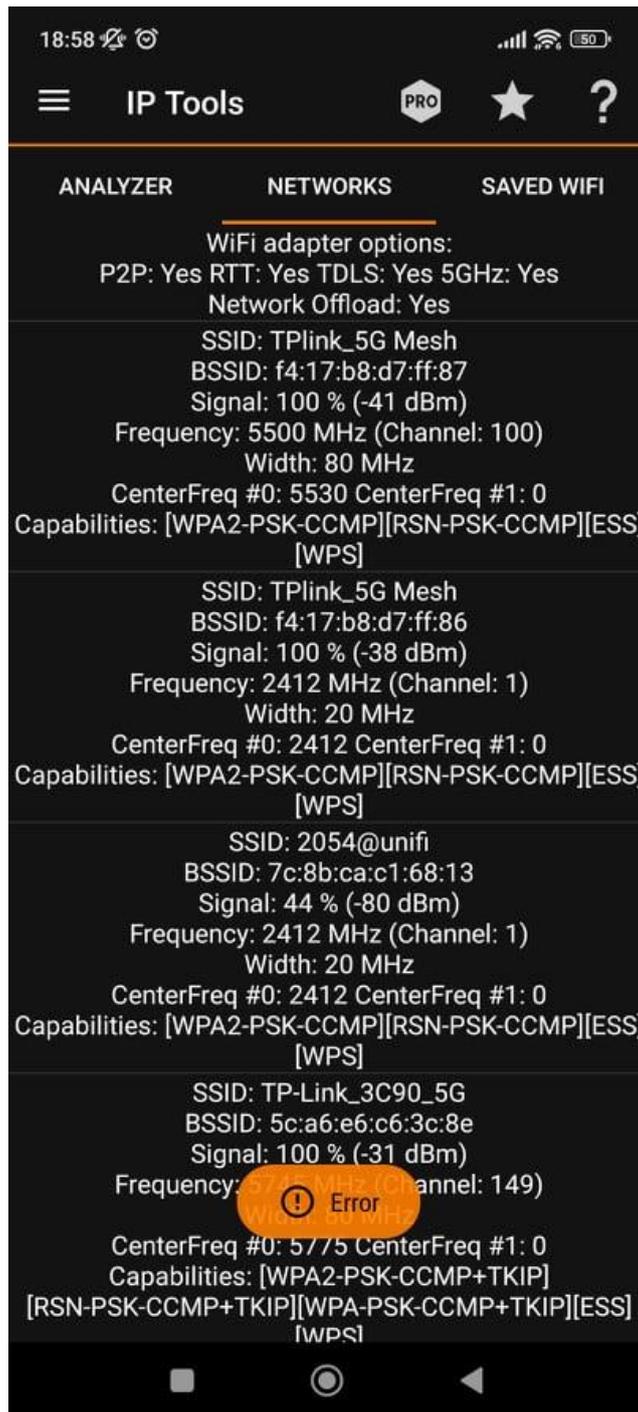


Figure 2.4 Network Scanning of the IP Tools Application

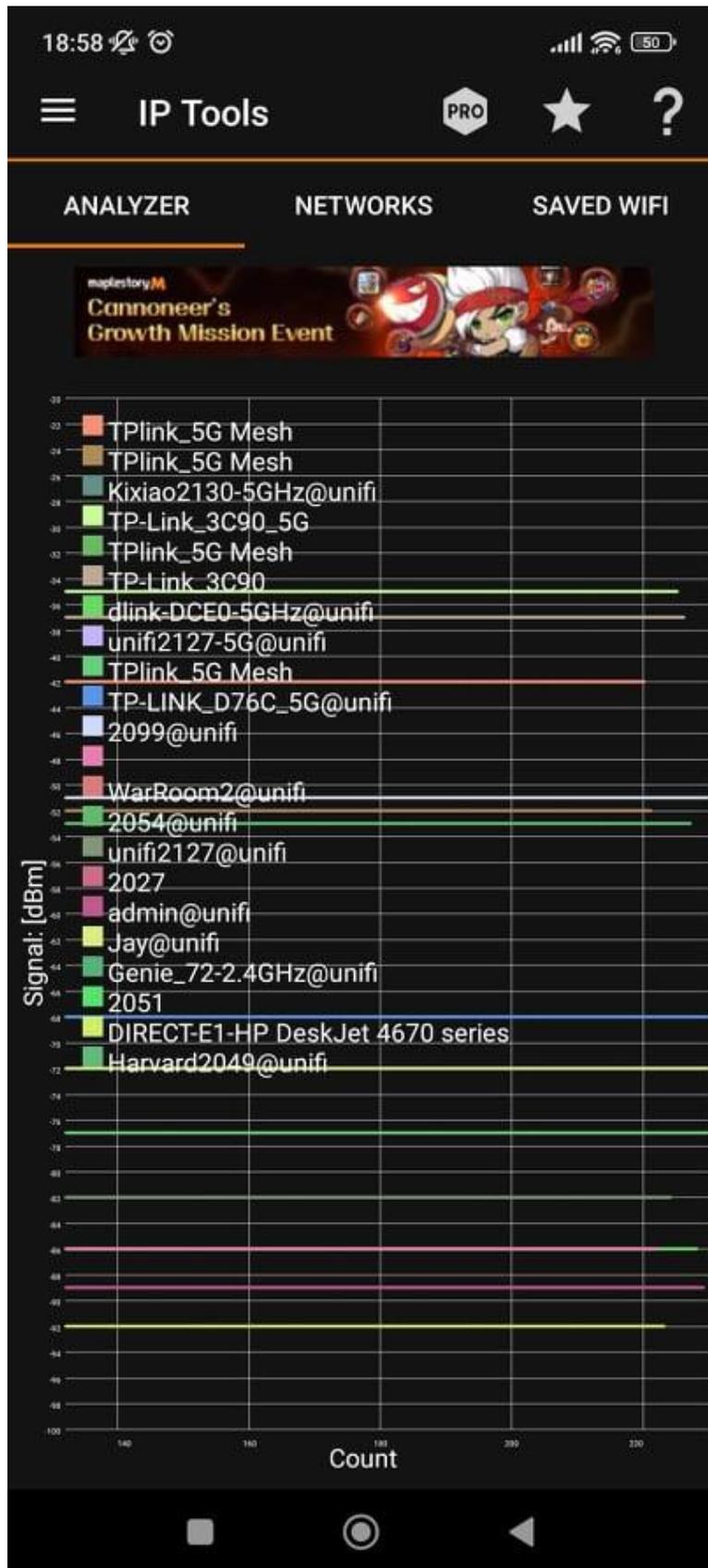


Figure 2.5 IP Tools Timeline Graph

Application 3: Wi-Fi Master

Wi-Fi Master application is a handy and Wi-Fi analyzer tool. It provides many features of Wi-Fi, included speed test, Wi-Fi analyzer, Wi-Fi Signal Strength Meter and Detect Who Is on My Wi-Fi? These features help users boost the Wi-Fi and manage the Wi-Fi easily.

Strengths

The strength of the Wi-Fi Master application is the detection feature. The Wi-Fi analyzer can quickly scan the user's Wi-Fi and determine the information. Furthermore, refer to Figure 2.6, with the Wi-Fi Network Master app, you can see how many and which devices are connected to your wireless router in seconds, along with their IP, MAC, and vendor information. The benefit of these features is that the user's Wi-Fi network is highly secure because users can always monitor the number and information of the connected devices.

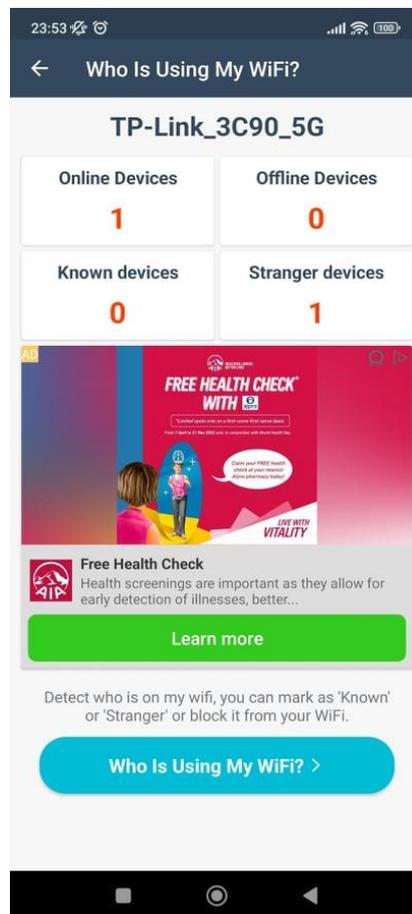


Figure 2.6 Wi-Fi Master ‘Detecting Who Is Using My Wi-Fi’ Feature

Weaknesses

There are a lot of advertisements in the application, it starts as soon as the application is opened. On top of that, When the users choose an option, it will directly enter into a random 15-20 seconds advertisement video before accessing the function, which is quite annoying to the users who need to use the tools to analyze the network.

Application 4: Wi-Fi Analyzer and Surveyor

This application is a common Wi-Fi analyzer, it has implemented the base functions which is similar to the previous existing system like IP Tools. Monitors the signal strength, Interference and channel graph.

Due to this application is highly similar, we will compare it to the previous existing work to find out its strengths and weaknesses.

Strengths

Compared to the existing previous application Wi-Fi Master, the strength of Wi-Fi Analyzer and Surveyor application is that this application is totally ads free. The application does not contain any advertising, so that the users will have a good user experience on using the application. In addition, compared to the IP Tools application, The layout design is simple but highlighted with the point using the color changes (Refer to Figure 2.7). It makes the user can understand the information straight to the point and saving the time.

Weaknesses

The weaknesses of the Wi-Fi Analyzer and Surveyor application is that the information provided by the application is not sufficient to the users to optimize their Wi-Fi network. For example, as shown as Figure 2.8, the Wi-Fi details only show that the channel number of the respective Wi-Fi network, it does not display how much of access point is currently connecting to the channel. When others are on the same Wi-Fi channel, users may experience interference with their Wi-Fi network.



Figure 2.7 Wi-Fi Analyze and Surveyor Channel Graph



Figure 2.8 Wi-Fi Details Given by The Wi-Fi Analyzer and Surveyor

2.2 Proposed solution for the weaknesses

First, in order to solve the weaknesses of the application, the SpeedTest Meter – Wifi Analyzer app needs to fix and complete the Wi-Fi scanning function to prevent misleading the information. Other than that, because the application is mentioned that it is a ‘Wi-Fi Analyzer’, it should be providing more Wi-Fi information to the users. For example Channel, Bandwidth, Signal Level, and Frequency.

Next, for the IP Tools application, the layout of the timeline graph should be rearranged, to prevent the text from blocking the view of the graph. Then, implement a stop scanning function, giving users the option to stop scanning to save the power of the device. IP Tools application should also optimize the user experience design. For example: adding some colors to highlight the important information and filter function to filter the information for the users.

Besides that, the Wi-Fi Master application is full of ads and the ads already annoy the users when accessing the application. It’s human nature to implement ads in the application because the company and developers need to earn income from the application. Make ads less annoying at least it doesn’t affect the user experience. For instance, the ads should not automatically take over the whole screen and keep the ads as simple as possible.

Lastly, the Wi-Fi Analyzer and Surveyor application should provide the feature to show the channel's rating, and let the users know which channel is less interference so that users can optimize their network by switching to the best channel.

2.3 Critical Remarks of Previous Works

Benefits	SpeedTest Meter – Wi-Fi Analyzer	IP Tools	Wi-Fi Master	Wi-Fi Analyzer and Surveyor	The Wi-Fi Analyzer of this project
Real time timeline graph	No	Yes	Yes	No	Yes
Good User Experience Design	No	No	No	Yes	Yes
Information Filter	No	No	Yes	Yes	Yes
Detect who is on my Wi-Fi	No	No	Yes	Yes	No
Ads Free	No	No	No	Yes	Yes

Table 2.1 Caparison Between Previous Existing Application

CHAPTER 3

Proposed Method/Approach

3.1 Design Specification

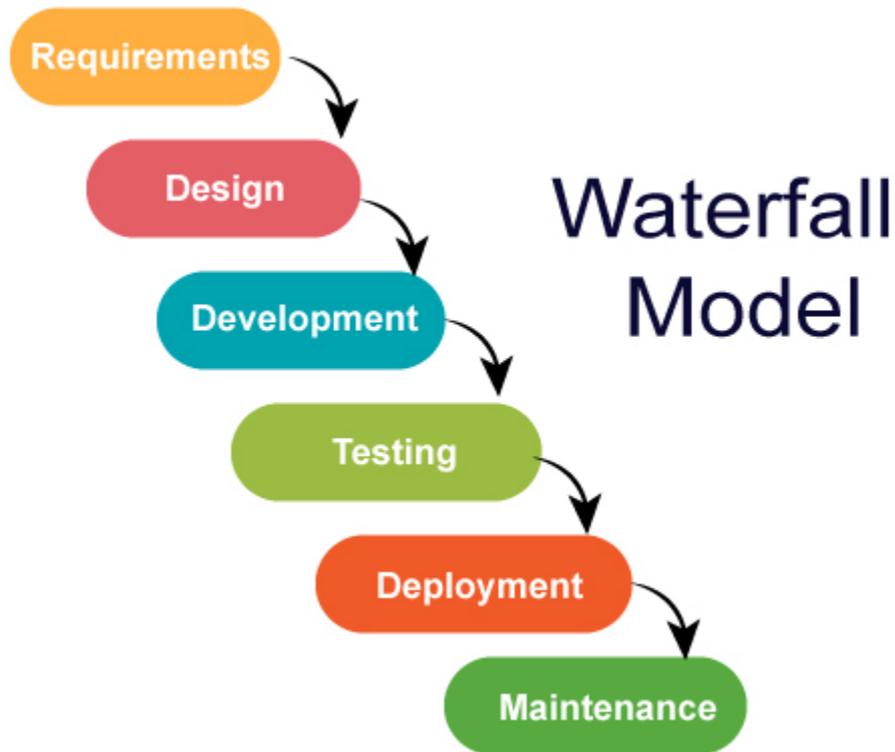


Figure 3.1 Water Fall Model

The most suitable methodology for the proposed project is the waterfall model methodology. The waterfall model included 5 phases which are analysis, design, implementation, testing and maintenance. The reasons of the choosing this methodology are because the prerequisites, stages, and activities are all clearly laid out. As a result, project managers find it simple to plan, schedule, use resources, and specify targets. The procedure is made simple and straightforward to grasp because each phase has a deliverable. Furthermore, The whole process is well-documented and well-scripted so that the developer can understand the application requirement easily, most importantly, it can save the time because each phase is separate and completed within a given time-frame. So, the waterfall model is the best development methodology in this project compared to others due to stable development for the application.

Stage 1 – Requirement analysis

In order to create a good application that can meet the expectation of the users. All project requirements are examined in this phase, documented in a specification document, and a feasibility analysis is conducted to determine the viability of these requirements. Any restrictions and limitations (such as time and financial restraints) that may have an impact on the development process must be considered. After the analysis, all the requirements should be well written in a document.

Stage 2 – Design

This stage involves creating the system design, which outlines the hardware and system specifications, including data layers, programming languages, system architecture, user interface, etc. The developer needs to study the various required tools and skills to build and develop the application of the project.

Stage 3 – Implementation

The source code is written during this stage according to specifications. The physical design requirements are translated into a functional code. The system is built up of smaller programs, or components, which are then combined. Unit testing is the process of testing each unit's functioning prior to integration.

Stage 4 – Testing

During this stage, the code will be tested by the tester. Tester runs test cases manually or automatically to run through all potential bugs in the program. The client is also involved in the testing stage to guarantee that all specifications are met. To provide quality assurance, any flaws and problems discovered during this step are corrected.

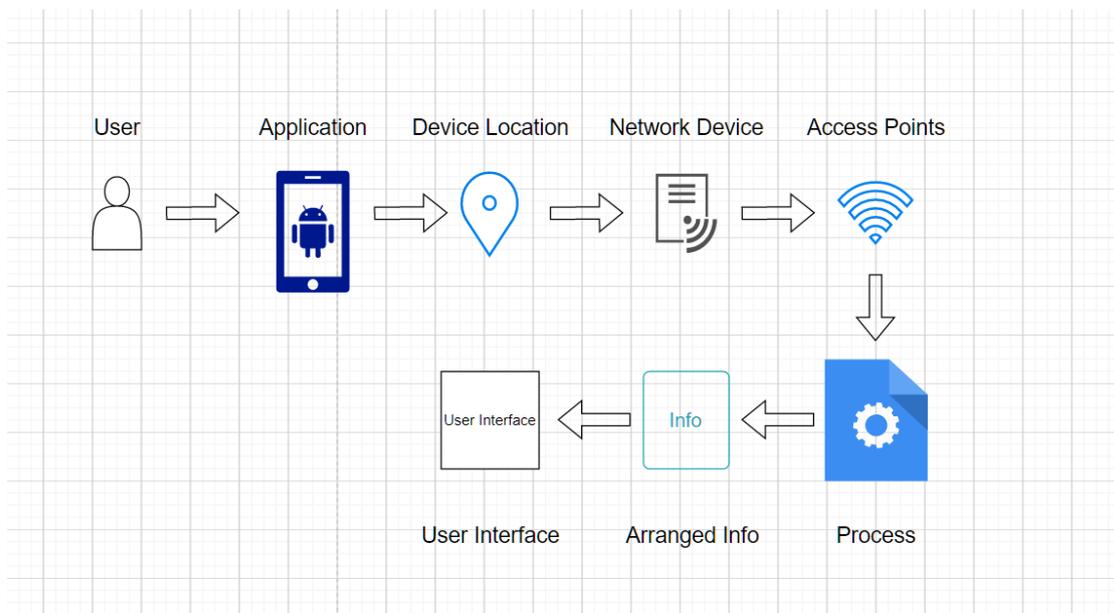
Stage 5 – Deployment

This stage involves deploying the software into a live environment in order to evaluate its functionality. The application is made available to end users once it has been implemented. This step may also involve teaching actual users to explain the system's advantages.

Stage 6 – Maintenance

Following the deployment phase, the application must next be supported and maintained to ensure smooth operation. The major goal of this stage is to address any problems, faults, or bugs that the client and users may encounter when using the product.

3.1.1 System Architecture Diagram



The figure above is the system architecture diagram of the Wi-Fi Analyzer. First, the user will launch the application with the Android smartphone. Because the application is developed based on the android operating system. After that, the device location permission is required for the application to run, this is a must setting by the android for the Wi-Fi scanning function in android. After that, the system will use the network device in the android device to scan the available access points around and collect the information for example: SSID, Wi-Fi Signal, Speed etc. After collecting the information, it will run the process to rebuild the data into a

well-structured and arranged format. At the end, the data will output to the user interface in order to analyze.

3.1.2 Use Case Diagram

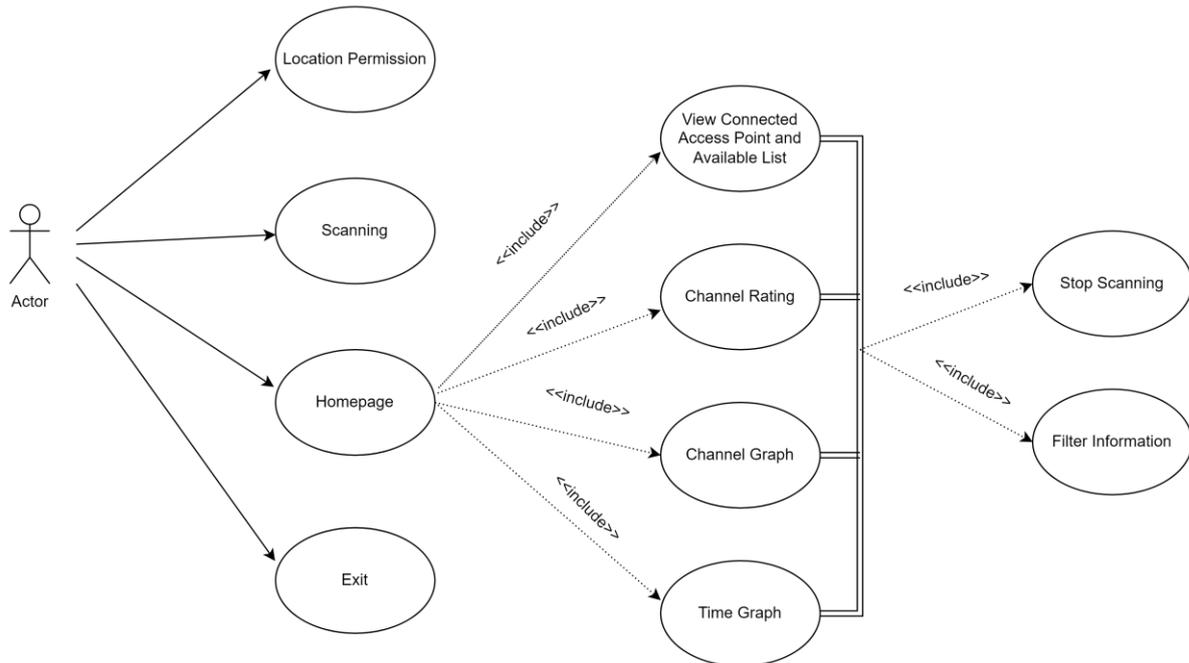


Figure 3.5 Use Case Diagram

The graph above is the use case diagram of the application. First, the application will prompt the user to allow the location permission before using the Wi-Fi analyze application. After permission is given to the application, the scanning will be started to scan the available access points available to gain the information. After the scanning done, it will lead to the homepage. The homepage has 4 main functions which are view connected access point information and available access points list, channel rating, channel graph, and timeline graph. In all of the main functions, users can stop the scanning based on their needs to prevent battery loss. Then, users can filter the condition of the access point they want to analyze efficiently. Lastly, Users can choose the function and end the application based on their needs.

3.2 Timeline

Project 1

Final Year Project 1 (14 weeks)

Task	W1	W2	W3	W4	W5	W6	W7	W8	W9	W10	W11	W12	W13	W14
1	■													
2		■												
3			■	■										
4					■	■								
5							■	■	■					
6										■				
7											■	■		
8													■	
9														■

Table 3.3 Gantt Chart of Project 1

Task 1: Learning Android Studio mobile application development

Task 2: Revise the project objective, scope, and literature review.

Task 3: Start to design the application interface with hand drawing

Task 4: Learning the API classes that related to the Wi-Fi on Android Studio

Task 5: Implement the functions of the application

Task 6: Application Testing

Task 7: Improve the source code and bug fix

Task 8: Report

Task 9: FYP 1 submission

Project 2

Final Year Project 2 (14 weeks)

Task	W1	W2	W3	W4	W5	W6	W7	W8	W9	W10	W11	W12	W13	W14
1	■	■												
2			■	■										
3					■	■								
4							■	■						
5									■	■				
6											■	■		
7												■	■	
8													■	■
9														■

Table 3.4 Gantt Chart of Project 2

Task 1: Study and investigate the remaining functions

Task 2: Planning and design the functions

Task 3: Implement the functions

Task 4: Improve the layout and design of the application interface

Task 5: Testing the overall application (performance, accuracy, reliability)

Task 6: Improve the code and bug fix

Task 7: Final Testing

Task 8: Report

Task 9: FYP 2 submission

CHAPTER 4

System Design

4.1 System Flow Chart

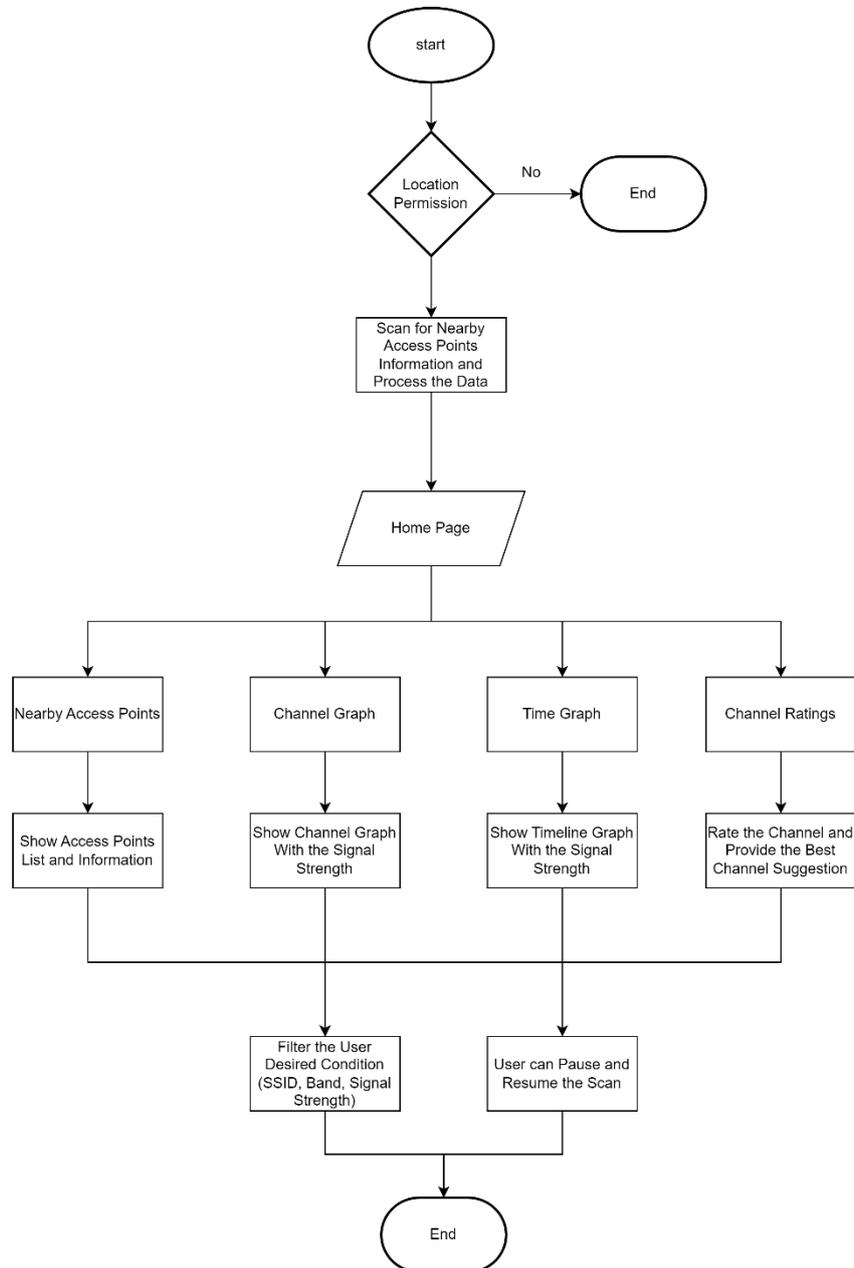


Figure 3.4 Flow chart

The flow chart in Figure 3.4 above shows the mobile application overview. First, once the application starts, it will request the permission of Media/Files and GPS from the user. Users must allow both permissions in order to use the application or else the application will not function. This application needs GPS permission to identify the Wi-Fi signal strengths. After that, it will go to the homepage of the Wi-Fi Analyzer application. On the homepage, users can choose 4 functions, 'Access Points', 'Channel Rating's, Channel Graph, and 'Time Graph'. The 'Access Points' function is to show the information of the available access points around with their SSID, frequency, speed, channel located, IP address etc. Then, the 'Channel Rating' is to do compare between all of those available channels with the number of the access points connected, after the comparison the system will rate the channel according to the numbers and recommend the best channels that users can switch to.

Furthermore, the 'Channel Graph' is to visualize the data of the Wi-Fi signal strength in the different channels for the available access points around, so the users can find the best channel in the graph. The last one 'Time Graph' is also the same as the 'Channel Graph', it visualizes the data of the Wi-Fi signal in every scan count, so that the users can analyze whether the Wi-Fi signal is stable or not.

Lastly, users can do a filter to get the specific condition of the information in every function above. For example. Specific SSID, specific signal strength and security. Users can also decide when to stop and resume the scanning if they need to prevent power consumption. After the analyzing is done, the system ends.

4.2 Technology involved

For the technology that is applied in this project. The Kotlin programming language is chosen in this project development in Android Studio. It is because Kotlin is fully interoperable with Java, which means that developers can use both languages in the same project. This allows developers to leverage existing Java code and libraries while also taking advantage of the modern features and syntax of Kotlin.

4.2.1 The Four Most Important Android Class in Project

android.net.wifi.ScanResult:

is a class in Android that represents the result of a Wi-Fi network scan. It contains information about the access point, such as its SSID, BSSID, signal strength, and frequency.

android.net.wifi.WifiInfo:

It is a class in Android that represents the current state of the device's Wi-Fi connection. It contains information about the current network, such as its SSID, BSSID, signal strength, and IP address.

android.net.WifiManager:

It is a class in Android that provides access to the device's Wi-Fi functionality. It allows developers to interact with the device's Wi-Fi hardware, such as scanning for networks, connecting to networks, and managing Wi-Fi configurations.

android.net.ConnectivityManager:

It is a class in Android that provides access to the device's network connectivity. It allows developers to check the status of the device's network connection, such as whether it is connected to Wi-Fi or mobile data, and to manage network connections, such as enabling or disabling airplane mode. It also provides information about the device's network capabilities, such as whether it supports Wi-Fi calling.

4.3 System Components Specification

- Android Device
- Version: Android 9.0 or above
- Wi-Fi available
- Location service available



Figure 4.2 System Components Specification

Chapter 5

System Implementation

5.1 Hardware Setup

The hardware involved in this project is laptop and android mobile device. A computer issued for the development of the mobile application. A mobile device is used for testing and deploying the mobile application.

1. Laptop

- Device used to develop the android application on Android Studio

Description	Specifications
Model	ASUS TUF GAMING FX504
Processor	Intel Core i5-8300H
Operating System	Windows 11
Graphic	NVIDIA GeForce GTX 1050 4GB DDR4
Memory	8GB DDR4 RAM
Storage	1TB SATA HDD

Table 5.1 Specification of Laptop

2. Android Smartphone

- Device used to test throughout the application
- Wi-Fi Supported

Description	Specifications
Model	Xiaomi 11T Pro
Processor	Snapdragon 888
Operating System	Android 12
Memory	12GB RAM
Storage	256 GB

Table 5.2 Specification Android Smartphone

5.2 Software Setup

1. Android Studio



Figure 3.2 Android Studio

5.3. Programming Language

1. Kotlin



Figure 3.3 Kotlin

5.4 Setting and Configuration

In the development of the mobile application in Android Studio. We need to choose a emulator to emulate a device with appropriate API level to run and test the application without needing to have each physical device. Below is the settings and configurations of the emulator I used in the development.

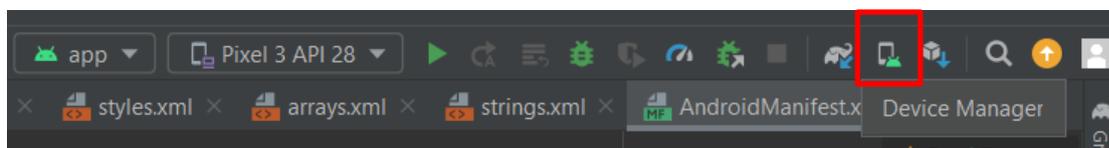


Figure 5.3 Setting and Configuration (1)

First, navigate to the 'Device Manager' on the top left side in the Android Studio.

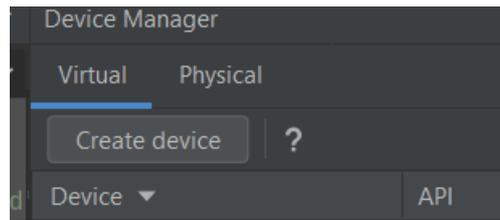


Figure 5.4 Setting and Configuration (2)

After that, select the 'Create Device' to create the device emulator.

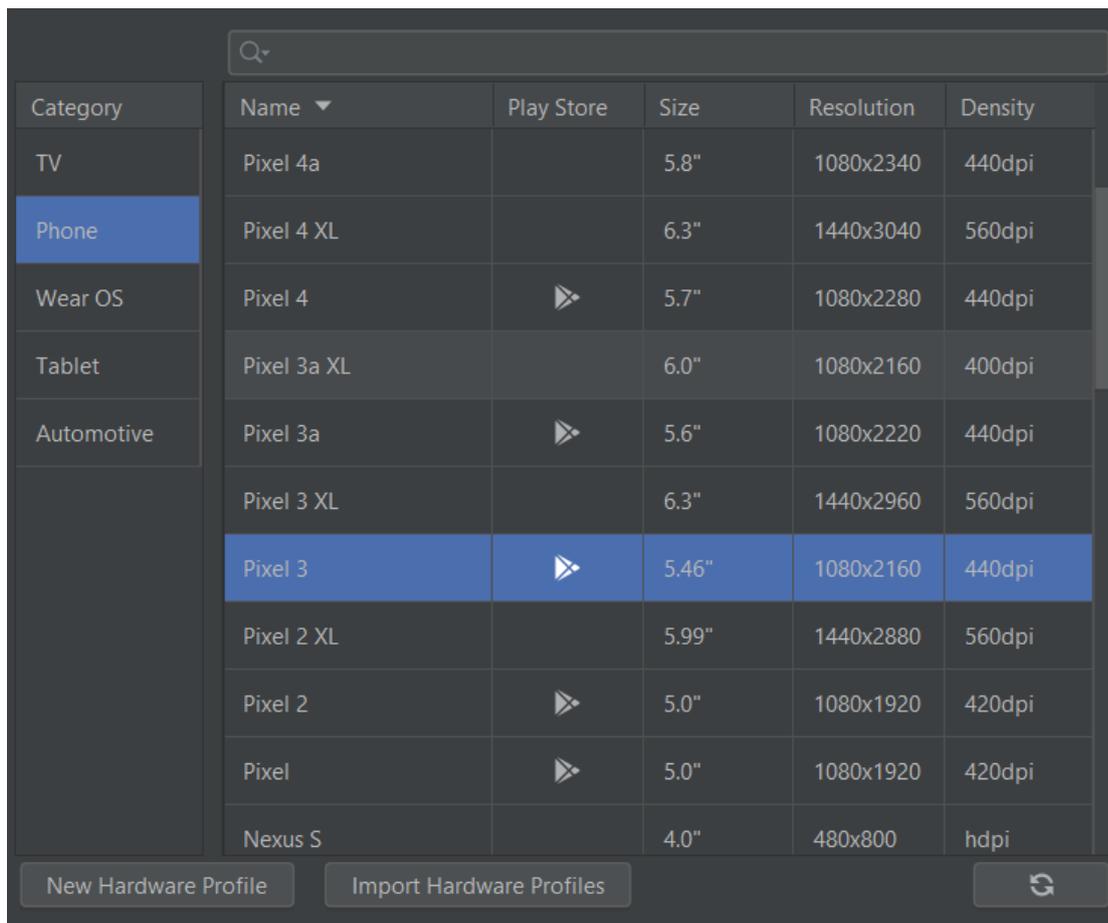


Figure 5.5 Setting and Configuration (3)

In this project, I choose the phone model 'Pixel 3' for the emulator to emulate.

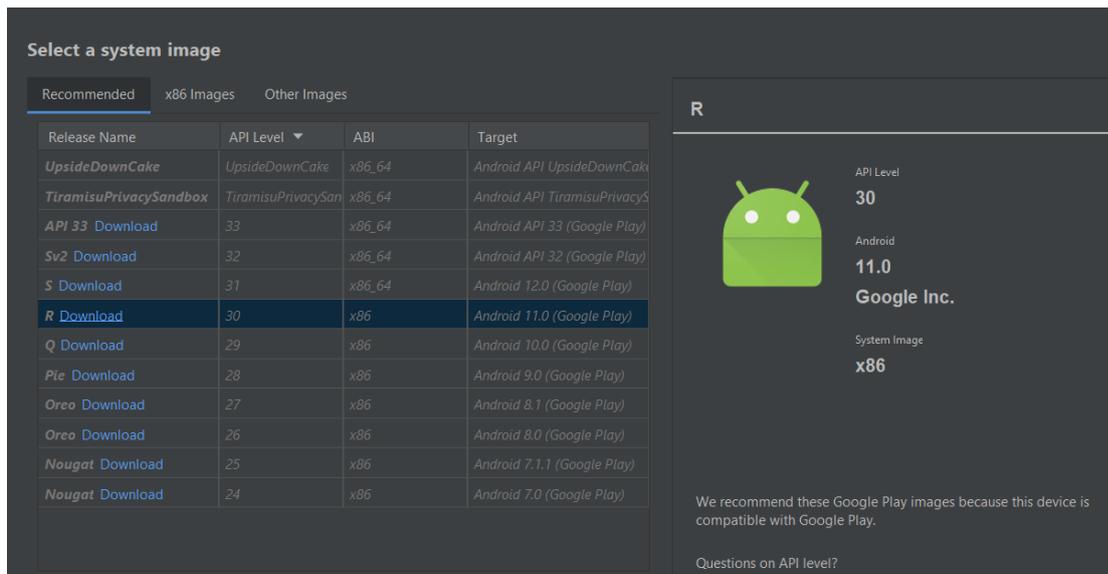


Figure 5.6 Setting and Configuration (4)

For the system image that used in this emulator is 'R' which is Android 11 with API level 30, and the system is 'x86'. Select the 'Download' to download the system image.

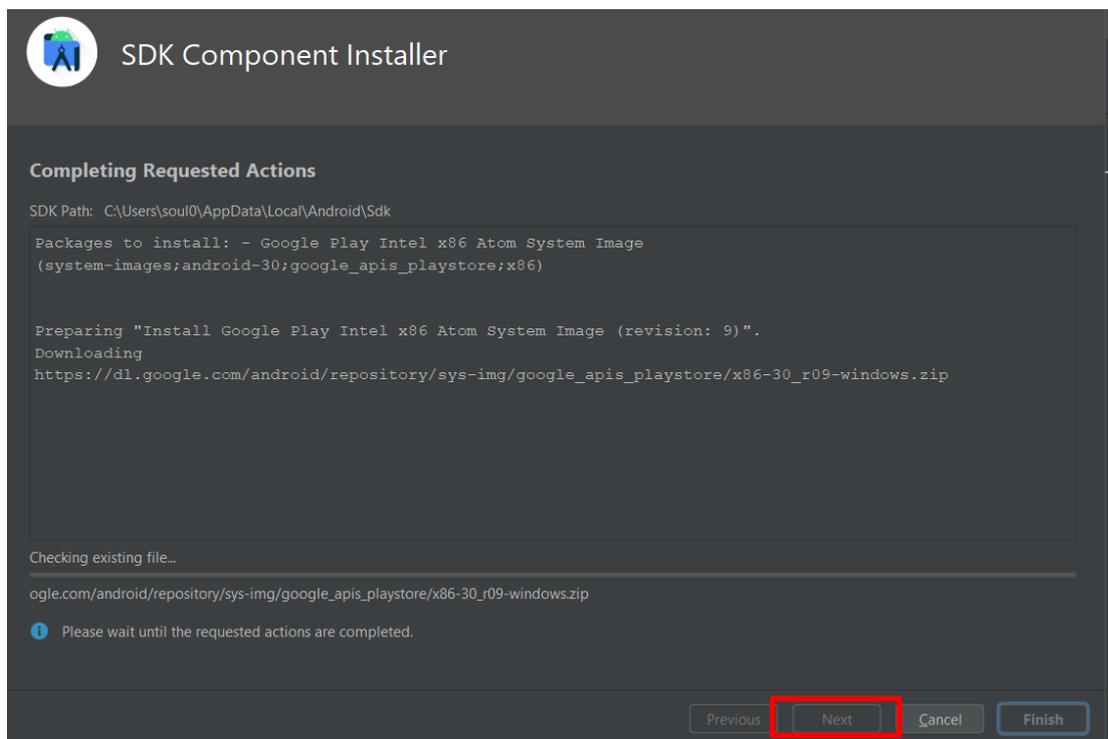


Figure 5.7 Setting and Configuration (5)

After the installation is done, click 'Next'.

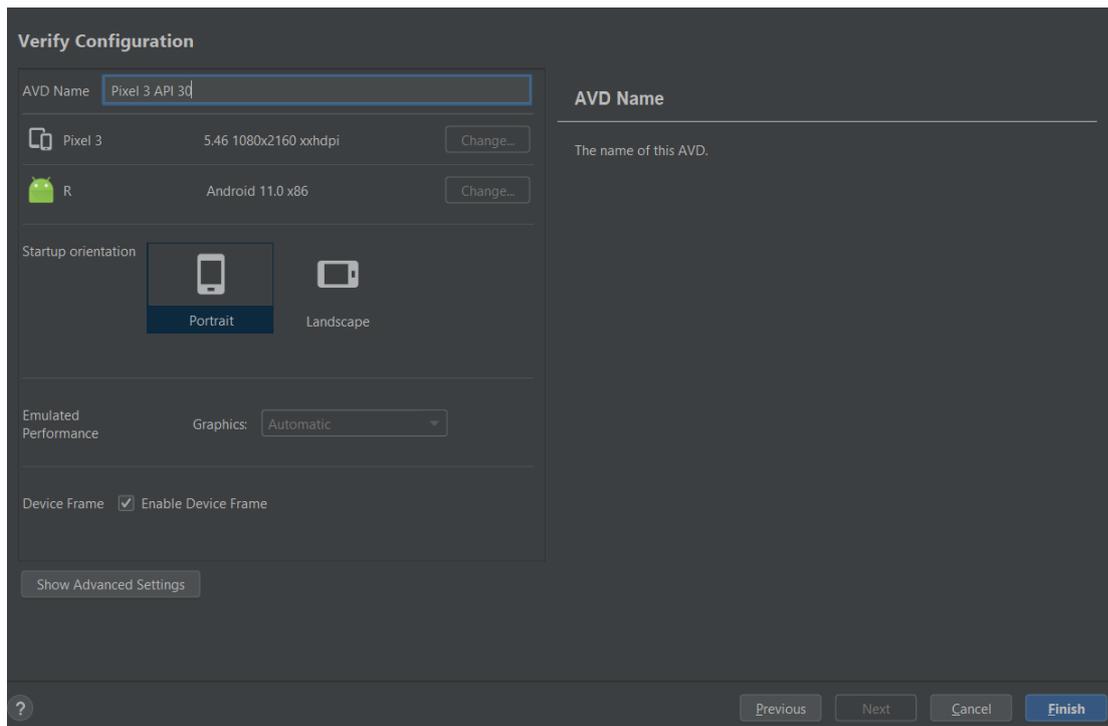


Figure 5.8 Setting and Configuration (6)

After verifying the configuration, click 'Finish' to create the device.

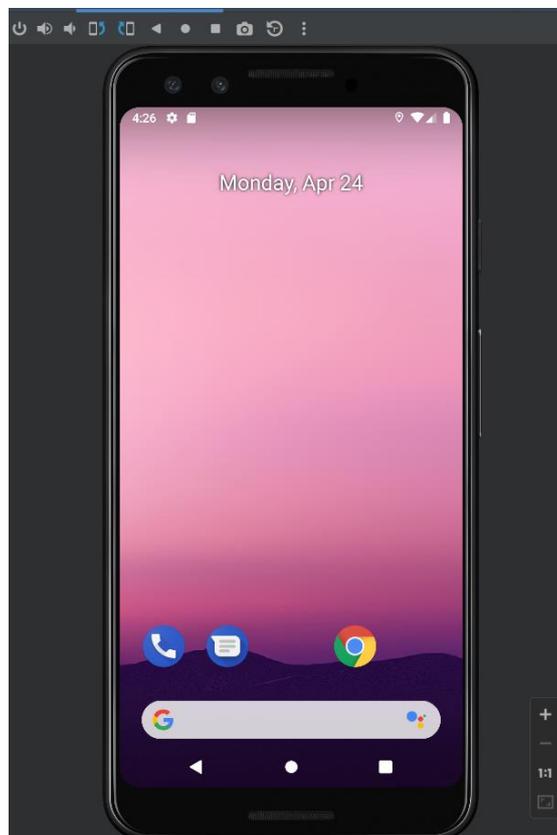


Figure 5.9 Setting and Configuration (7)

At the end, Your emulator has successfully create the virtual device, and we can test the application in the virtual device.

5.5 System Operation

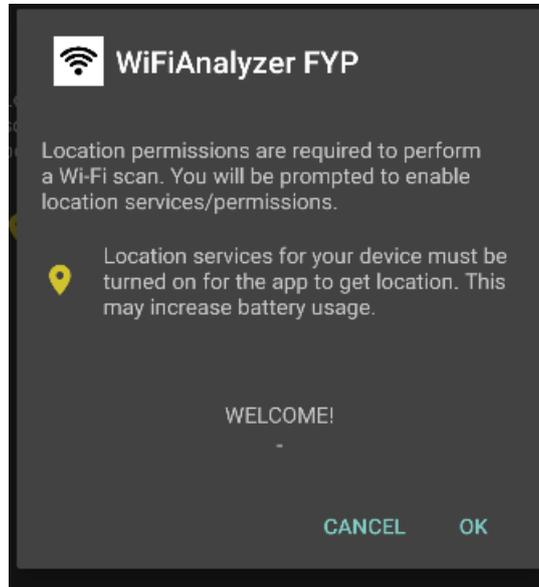


Figure 5.10 Location Permission

The figure 5.10 above is the location permission requirement, when users first time launch the application, it will prompt the user the allow the location permission for the application, this is because the Wi-Fi scanning function in android needs to use location function to process it. If users do not allow the permission, the system will automatically terminate.

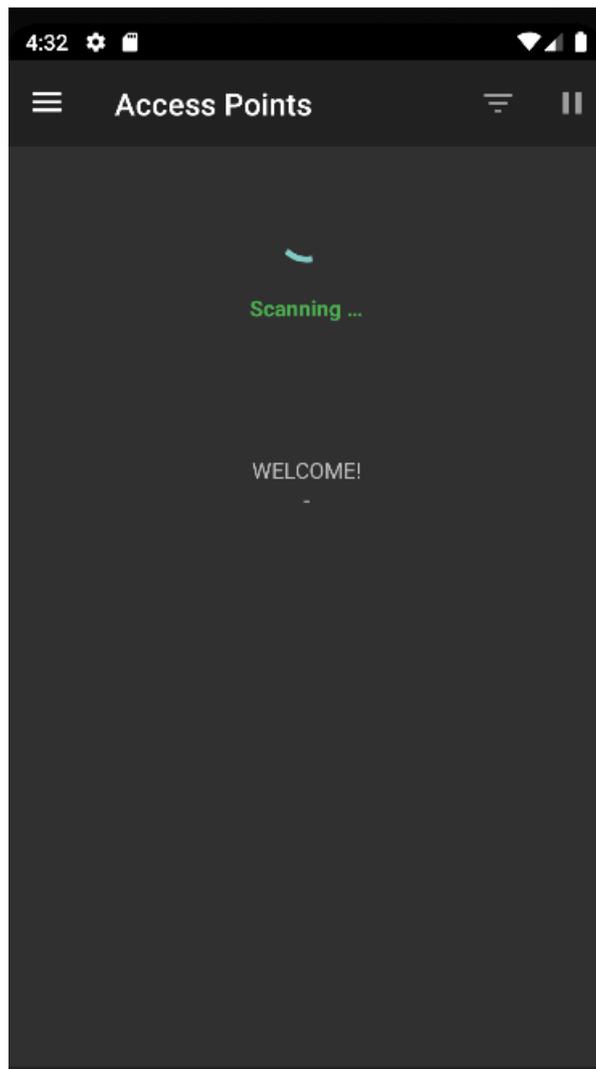


Figure 5.11 Scanning the available access point

After the location permission is allowed and enabled, the system will start processing. Scanning the access point within the range and gathering all the available access point information. The figure 5.11 above is showing the scan function is processing, users need to wait the scanning done then can proceed further.

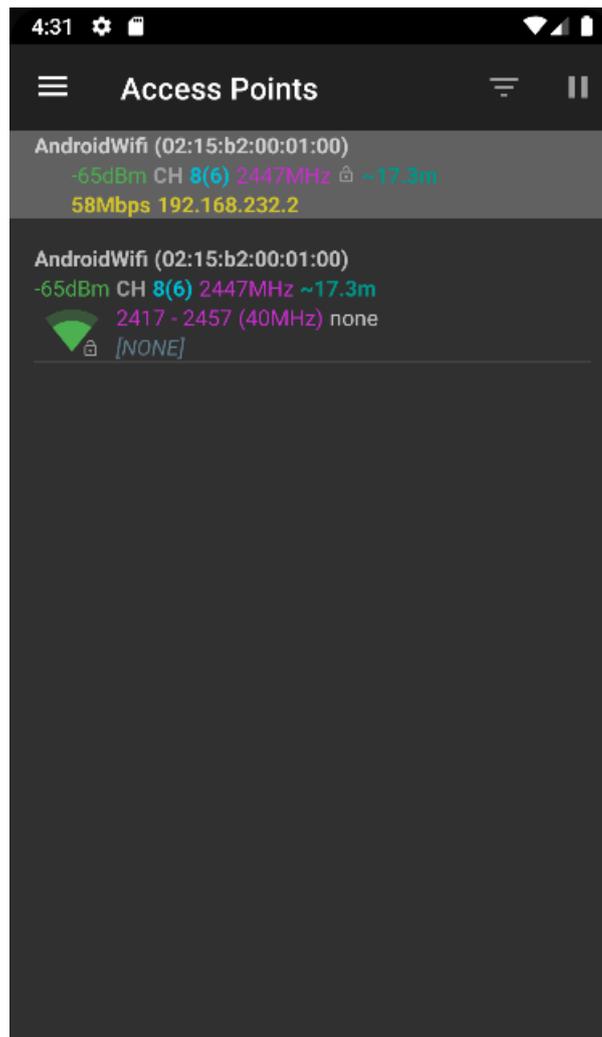


Figure 5.12 Access Points Information

The figure 5.12 above shows that, after the scanning is done, the first page on top highlighted area will show the connected Wi-Fi information included Signal Strength, SSID, MAC Address, Channel, Speed, Frequency, Security, and IP Address. Other than that, the below will show the list of the available access points and information. One of the important things need to mention that is in Android Studio, it will only show one access point which is 'AndroidWifi', because it is a emulator, it can't scan the access point in physical.

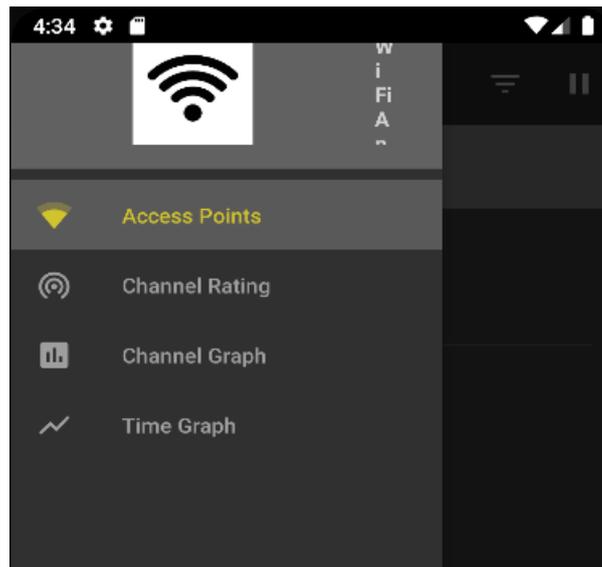


Figure 5.13 Menu Options

The figure 5.13 above is the menu option of the application, it contains the Access Points, Channel Rating, Channel Graph and Time Graph. Users can choose whichever they need to access.

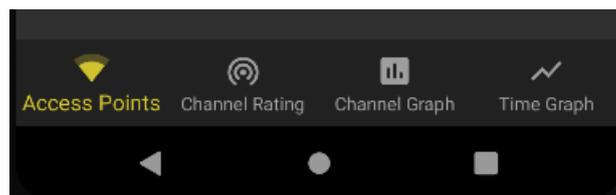


Figure 5.14 Menu Options (Bottom)

The figure 5.14 above is also a menu but located at the bottom of the application interface. Users can access it more efficiently.



Figure 5.15 Channel Rating

The figure 5.15 above is the 'Channel Rating' section of the application. In Channel Rating, it will show all the available channels and the connected access point counts. Users can check which channels have the least access point counts and change to that channel to have the network with less interference. The application will also suggest the best channels for users to switch.

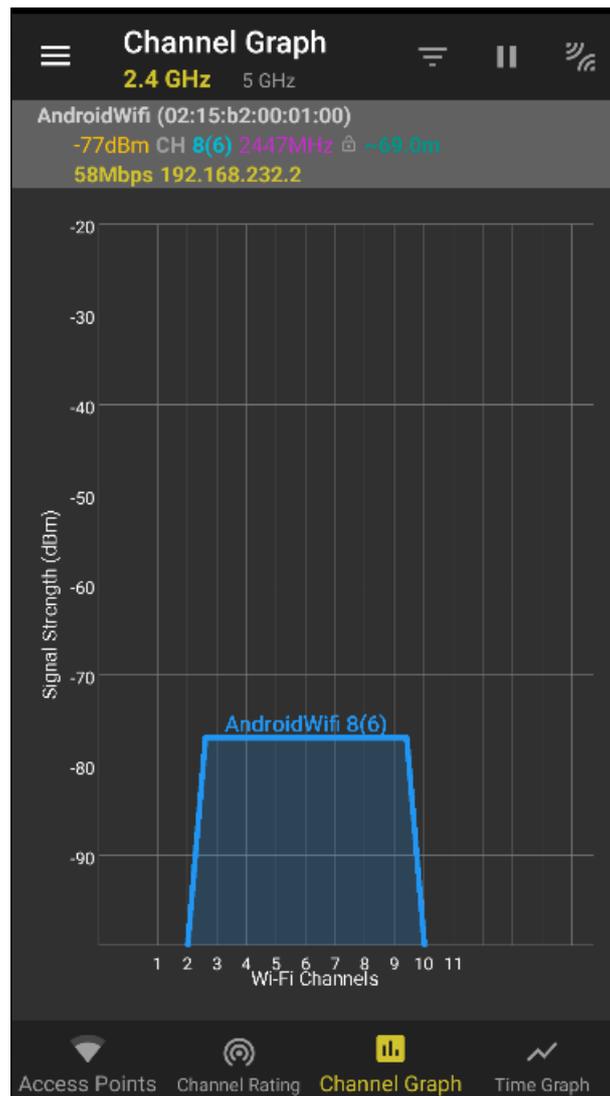


Figure 5.16 Channel Graph

The figure 5.16 above is the ‘Channel Graph’ section. The graph will visualize all of the available access points signal strength and their located Wi-Fi channels. Users are allow to analyze the access point around with the graph.

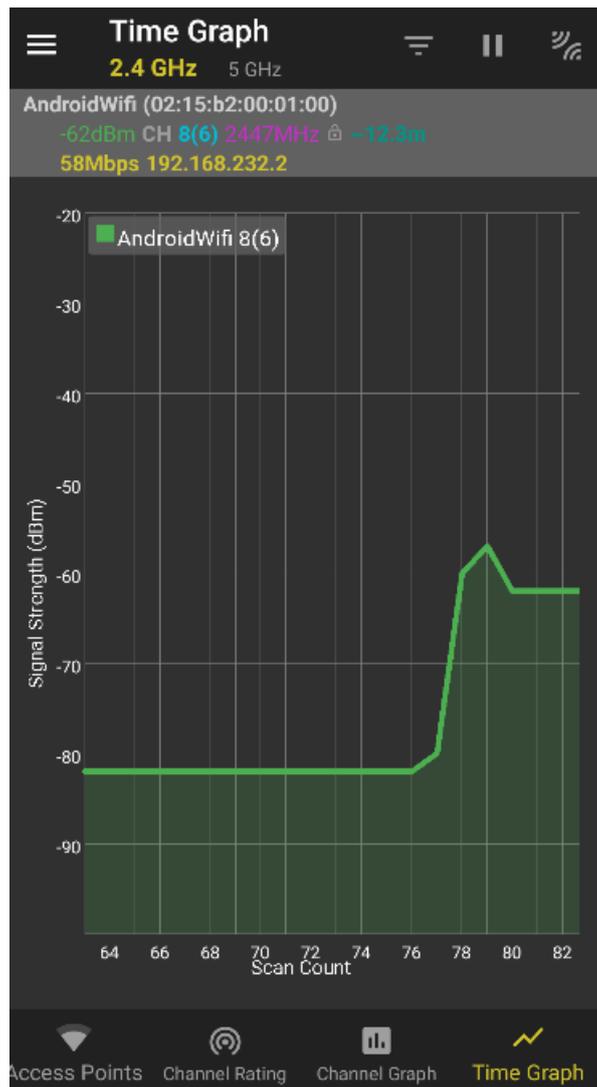


Figure 5.17 Time Graph

The figure 5.17 above is the 'Time Graph' section of the application, The timeline graph will visualize the available access point signal strength with the scan count in every 5 seconds. With the timeline graph, users can check the Wi-Fi signal stability with analyzing the timeline graph.

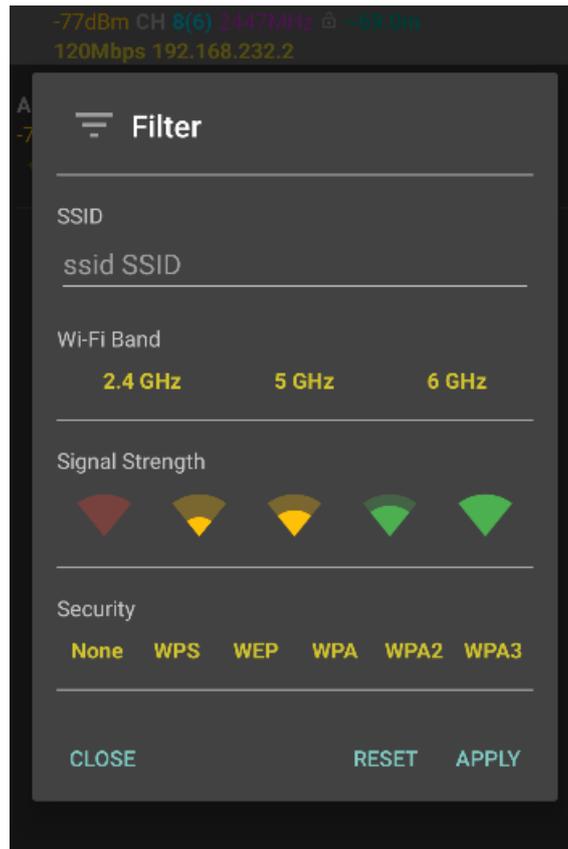


Figure 5.18 Filter Function

Besides that, the figure 5.18 above shows the ‘Filter’ Function of the application. Users can filter the desired condition they want to display in all of the sections. Users can filter with the SSID, Wi-Fi Band, Signal Strength and security of the access point.

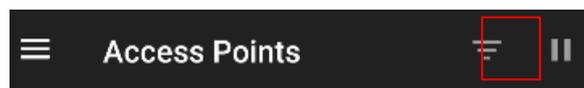


Figure 5.19 Stop Scanning Function

Lastly, the figure 5.19 above is the stop scanning function of the application. Users can pause the scanning and resume it whenever they want. The reason of doing this is to prevent the battery consumption issues for the users.

5.6 Implementation Issue and Challenge

There are a few challenges that have been encountered during the implementation of this Wi-Fi analyzer application project. First and foremost, this is the first time for me to develop an android application, so I need to learn the Android Studio software and the flow of creating an android mobile application in a short time.

The next issue is the android class that is related to the Wi-Fi information and the Wi-Fi connectivity, which are WifiManager, ConnectivityManager, WifiInfo and ScanResult. These classes are to perform all the Wi-Fi related functions and they are very difficult to master because there are too many functions in a class.

The last issue is the user experience of the mobile application, the layout and the flow of a mobile application is difficult to design because the mobile application interface is smaller. As a developer I need to consider whether the user can have a good user experience when using the application or not when developing the system interface.

CHAPTER 6

System Evaluation and Discussion

6.1 Testing Setup and Result

Table 6.1 Wi-Fi Scanner Testing

No.	Validate Feature	Actual Result	Success/Fail
1	Scan available Access Points	Successfully Scan	Success
2	Get SSID	“AndroidWifi”	Success
3	Get Signal Strength	-57dBm	Success
4	Get MAC Address	02:15:b2:00:01:00	Success
5	Get Channels	CH8	Success
6	Get Frequency	2447MHz	Success
7	Get IP Address	192.168.232.2	Success
8	Get Network Speed	58Mbps	Success
9	Display Available Access Points List	Successfully display	Success

Table 6.2 Channel Rating Testing (2.4GHz)

No.	Validate Feature	Actual Result	Success/Fail
1	Show Connected Access Points Info	Successfully Display	Success
2	Rate the Channels According to the Access Point Count	Successfully Rate the Channel with the least access point count	Success
3	Recommend the Best Channels Available	Successfully recommend the best channels based on the Rating	Success

Table 6.3 Channel Rating Testing (5GHz)

No.	Validate Feature	Actual Result	Success/Fail
1	Show Connected Access Points Info	Successfully Display	Success
2	Rate the Channels According to the Access Point Count	Successfully Rate the Channel with the least access point count	Success
3	Recommend the Best Channels Available	Successfully recommend the best channels based on the Rating	Success

Table 6.4 Channel Graph Testing (2.4GHz)

No.	Validate Feature	Actual Result	Success/Fail
1	Show Connected Access Points Info	Successfully Display	Success
2	Showing the real time Channel Graph with the Available Wi-Fi Channels and Signal Strength	Successfully visualize the graph	Success

Table 6.5 Channel Graph Testing (5GHz)

No.	Validate Feature	Actual Result	Success/Fail
1	Show Connected Access Points Info	Successfully Display	Success
2	Showing the real time Channel Graph with the Available Wi-Fi Channels and Signal Strength	Successfully visualize the graph	Success

Table 6.6 Time Graph Testing (2.4GHz)

No.	Validate Feature	Actual Result	Success/Fail
1	Show Connected Access Points Info	Successfully Display	Success
2	Showing the real time Timeline Graph with the Scan Count and Signal Strength	Successfully visualize the timeline graph	Success

Table 6.7 Time Graph Testing (5GHz)

No.	Validate Feature	Actual Result	Success/Fail
1	Show Connected Access Points Info	Successfully Displayed	Success
2	Showing the real time Timeline Graph with the Scan Count and Signal Strength	Successfully visualize the timeline graph	Success

Table 6.8 Stop Scan Function Testing

No.	Validate Feature	Actual Result	Success/Fail
1	Stop the Wi-Fi Scanning	Successfully Stop	Success

Table 6.9 Filter Function Testing

No.	Validate Feature	Actual Result	Success/Fail
1	Filter with the SSID	Successfully filtered	Success
2	Filter with the Signal Strength	Successfully filtered	Success
3	Filter with the Security	Successfully filtered	Success
4	Reset the Filter to Default	Successfully Reset	Success

6.2 Project Challenges

The challenges that faced in the development of the project is the Wi-Fi analyzer apps typically require access to the device's Wi-Fi hardware, location permission and network-related permissions, which may raise security concerns. Ensuring that the app properly handles permissions and adheres to security best practices is crucial to protect user data and privacy.

The second challenge of the project is the real-time data collection. Collecting real-time data from Wi-Fi access points, such as signal strength, channel information, and network details, can be challenging due to the dynamic nature of Wi-Fi networks. Ensuring accurate and up-to-date data collection requires handling frequent changes in network conditions and efficiently processing large amounts of data.

The last challenge is performance optimization. Wi-Fi scanning and data processing operations can consume significant system resources, such as CPU, memory, and battery, which may impact the app's performance and battery life. Optimizing the app's performance and power consumption requires careful management of resources and efficient algorithms.

6.3 Objective Evaluation

Referring to Chapter 1, there are four main objectives need to be achieved by this development project. Based on the system testing results, it can be said that the system successfully meets all objectives stated. This can be observed from:

1. The Wi-Fi scanner of the application has successfully got the access point information correctly and displays it in the well-structured format in this project, which is access point list, channel graph and timeline graph. Users can analyze and understand the data easily.
2. The filter function of the application in this project is functioning successfully, Users can filter the desired access point specification and view it. This function increases the user's efficiency when analyzing the data.
3. The stop function is provided for the users to stop the scanning when they need. Users can also resume the scanning if they want. The reason for doing this function is to prevent the power consumption for the user's device.
4. The channel rating returns the result of the better channels that are having least connected access point. Users can know about the channels and condition of their access point located. The system will provide the recommendation of the channels that users can switch to. Switching to the channel that has less connected access point can have less interference of the network signal.

CHAPTER 7

Conclusion

In conclusion, In Chapter 1, we know that there is various type of existing Wi-Fi analyzer application has been presented. From the previous study of the existing system, we know that most of the existing systems are not really providing the functions that can really help the users to analyze the Wi-Fi network. The problems with a Wi-Fi analyzer application are the complexity of the information, and the raw data of the Wi-Fi information are very complex for ordinary people. The next problem is the power consumption, most of the existing Wi-Fi analyzer applications are real-time scanning and it is unable to stop when users are using the application. Next is Wi-Fi channel interference, which happened when two or more access points within a network are on the same channel, so this is a common problem. Channel interference will cause a low speed and unstable Wi-Fi network.

In Chapter 2, the first proposed solution to solve the problems is to display the data in a well-structured format using graphs and charts to provide a clear view of the Wi-Fi connection status, and most importantly, easy to understand. The second solution is to provide the stop scanning option for the users in order to prevent unnecessary power waste. Then, the third solution is to provide a filter function, to filter the main useful information related to the Wi-Fi to save the users time and make them easy to understand. The last solution is to provide the channel rating to the users, the reason is to help the users to find out the best channels with the least interference so that the users can switch to the best channel and have a good Wi-Fi network experience. After the study, we can find the limitations and benefits from these existing applications and use it in this project.

In Chapter 3, the approach that will be taken in this project is Water Fall Model. The waterfall model included 5 phases which are analysis, design, implementation, testing and maintenance. The reasons for choosing this methodology are because the prerequisites, stages, and activities are all clearly laid out. As a result, project managers find it simple to plan, schedule, use resources, and specify targets. The system architecture and use case diagram is also provided.

In Chapter 4, The flow chart is used to illustrate the process that will be taken for analyzing the Wi-Fi access point. The technologies involved in the project, which is Kotlin programming language and four of the important android class which is ScanResult, WifiInfo, WifiManager and ConnectivityManager are also explained in this Chapter. It also mentioned the system component specification of this project application.

In Chapter 5, the hardware setup in this project is my laptop and smartphone and the software setup is Android Studio. The programming language used in this project is Kotlin and it can fully be interoperable with Java. The setting and configuration of the development and the system operation are fully explained with screenshots in this chapter. The implementation issues I faced in this project is the Android Studio development, Android class, and mobile application user experience.

In Chapter 6, the system was evaluated with the test, all the main functions test is success in the test result. After testing out the system, it had been confirmed that the system has no bug, and it is reliable and stable. Challenges faced of this project are the security concern, real time data collection, and performance optimization. After the evaluation of the objectives, this project has met the objectives well.

In the end, the motivation of this project is that people nowadays have poor knowledge about Wi-Fi technologies, it is because Wi-Fi is very easy to access by any device such as smartphones and laptops. It means that whenever they face a Wi-Fi network-related issue, they will have no idea on how to solve it. With the Wi-Fi analyzer, users can quickly spot the issue and find a solution to solve it.

7.2 Recommendation

The recommendation I would like to suggest for improving the system is to provide the signal strength mapping of the Wi-Fi. It is a feature that allows users to see how the signal strength of their Wi-Fi network changes over time and in different locations. If this project of the Wi-Fi analyzer application can include the signal strength mapping feature, it will become more versatile.

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FINAL YEAR PROJECT WEEKLY REPORT

(Project II)

Trimester, Year: Y3S3	Study week no.: 5
Student Name & ID: TAY BOON YAN 20ACB01273	
Supervisor: Encik Syed Muhammad Bin Syed Omar	
Project Title: Wi-Fi Analyzer for Users to Optimize Current Network	

1. WORK DONE

[Please write the details of the work done in the last fortnight.]

Confirm the remaining objectives and organize how to do it.

2. WORK TO BE DONE

Develop and implement the remaining functions.

3. PROBLEMS ENCOUNTERED

None

4. SELF EVALUATION OF THE PROGRESS

Need to accelerate the development of the project

SyMhd

Supervisor's signature

Tay

Student's signature

FINAL YEAR PROJECT WEEKLY REPORT

(Project II)

Trimester, Year: Y3S3	Study week no.: 12
Student Name & ID: TAY BOON YAN 20ACB01273	
Supervisor: Encik Syed Muhammad Bin Syed Omar	
Project Title: Wi-Fi Analyzer for Users to Optimize Current Network	

1. WORK DONE

[Please write the details of the work done in the last fortnight.]

The main functions of the whole project

2. WORK TO BE DONE

Design a user-friendly layout and interface and finalize the project.

3. PROBLEMS ENCOUNTERED

None

4. SELF EVALUATION OF THE PROGRESS

So far so good.

SyMhd

Supervisor's signature

Tay

Student's signature

FINAL YEAR PROJECT WEEKLY REPORT

(Project II)

Trimester, Year: Y3S3	Study week no.: 13
Student Name & ID: TAY BOON YAN 20ACB01273	
Supervisor: Encik Syed Muhammad Bin Syed Omar	
Project Title: Wi-Fi Analyzer for Users to Optimize Current Network	

1. WORK DONE

[Please write the details of the work done in the last fortnight.]

The design of the layout and interface

2. WORK TO BE DONE

System Testing

3. PROBLEMS ENCOUNTERED

None

4. SELF EVALUATION OF THE PROGRESS

So far so good.

SyMhd

Supervisor's signature

Tay

Student's signature

Wi-Fi Analyzer For Users To Optimize Current Network

Introduction

This Wi-Fi Analyzer is to provide the service to analyze the information of your access point around

Objective

Develop a convenient, user-friendly, and accurate Wi-Fi Analyzer, helping users to optimize their network

Method

- Android Studio
- Kotlin
- Android Class related to Wi-Fi Connectivity

Conclusion

It is a useful tool for users to troubleshoot the Wi-Fi related issues, plan network deployments and more

Project Developer: Tay Boon Yan

Project Supervisor: Encik Syed Muhammad Bin Syed Omar

PLAGIARISM CHECK RESULT

Wi-Fi Analyzer For Users To Optimize Current Network

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TECHNOLOGY**

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Form Title : Supervisor's Comments on Originality Report Generated by Turnitin for Submission of Final Year Project Report (for Undergraduate Programmes)			
Form Number: FM-IAD-005	Rev No.: 0	Effective Date: 01/10/2013	Page No.: 1 of 1
Full Name(s) of Candidate(s)	TAY BOON YAN		
ID Number(s)	20ACB01273		
Programme / Course	BACHELOR OF INFORMATION TECHNOLOGY (HONOURS) COMMUNICATIONS AND NETWORKING		
Title of Final Year Project	Wi-Fi Analyzer for Users to Optimize Current Network		

Similarity	Supervisor's Comments (Compulsory if parameters of originality exceeds the limits approved by UTAR)
Overall similarity index: <u>8</u> % Similarity by source Internet Sources: <u>7</u> % Publications: <u>2</u> % Student Papers: <u>-</u> %	Based on student's explanation, the similarity hits are a lot from eprints.utar.edu.my because the chapter titles and terms are similar to many other students.
Number of individual sources listed of more than 3% similarity: <u>1</u>	Other than eprints.utar.edu.my, the Internet sources that hits similarity are all not more than 1%
Parameters of originality required and limits approved by UTAR are as Follows: (i) Overall similarity index is 20% and below, and (ii) Matching of individual sources listed must be less than 3% each, and (iii) Matching texts in continuous block must not exceed 8 words <i>Note: Parameters (i) – (ii) shall exclude quotes, bibliography and text matches which are less than 8 words.</i>	

Note Supervisor/Candidate(s) is/are required to provide softcopy of full set of the originality report to Faculty/Institute

Based on the above results, I hereby declare that I am satisfied with the originality of the Final Year Project Report submitted by my student(s) as named above.

SyMhd

Signature of Supervisor

Signature of Co-Supervisor

Name: Syed Muhammad Syed Omar

Name: _____

Date: 28/4/2023

Date: _____



UNIVERSITI TUNKU ABDUL RAHMAN

**FACULTY OF INFORMATION & COMMUNICATION TECHNOLOGY
(KAMPAR CAMPUS)**

CHECKLIST FOR FYP2 THESIS SUBMISSION

Student Id	20ACB01273
Student Name	TAY BOON YAN
Supervisor Name	Encik Syed Muhammad Bin Syed Omar

TICK (√)	DOCUMENT ITEMS
	Your report must include all the items below. Put a tick on the left column after you have checked your report with respect to the corresponding item.
√	Front Plastic Cover (for hardcopy)
√	Title Page
√	Signed Report Status Declaration Form
√	Signed FYP Thesis Submission Form
√	Signed form of the Declaration of Originality
√	Acknowledgement
√	Abstract
√	Table of Contents
√	List of Figures (if applicable)
√	List of Tables (if applicable)
√	List of Symbols (if applicable)
√	List of Abbreviations (if applicable)
√	Chapters / Content
√	Bibliography (or References)
√	All references in bibliography are cited in the thesis, especially in the chapter of literature review
√	Appendices (if applicable)
√	Weekly Log
√	Poster
√	Signed Turnitin Report (Plagiarism Check Result - Form Number: FM-IAD-005)
√	I agree 5 marks will be deducted due to incorrect format, declare wrongly the ticked of these items, and/or any dispute happening for these items in this report.

*Include this form (checklist) in the thesis (Bind together as the last page)

I, the author, have checked and confirmed all the items listed in the table are included in my report.

Tay

(Signature of Student)

Date: 26 April 2023