
WIRELESS COMMUNICATIONS AND MOBILE NETWORKS

LAB PROJECT MEASUREMENT OF WIFI SIGNAL STRENGTH

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1 Introduction

1.1 The purpose

Lab 8 aims to let us get used to the WiFi system and accomplish the sampling and measuring of WiFi signal strength through programming in Android on smartphone.

1.2 The Main Content

Researchers are generally required to complete mobile terminal scanning to indoor WiFi Routers, especially in indoor positioning, WiFi access point selection and other popular fields. As the result of the dynamic characteristics of the wireless channel, the wireless signal received by mobile terminals is always unstable. As shown in Figure.1, the signal measured at a settled position from a certain router is distributed in a specific distribution(not a fixed value). Therefore, the signal should be measured repeatedly, though the position is fixed. Then, the result needs to be analyzed as random data in a certain distribution.

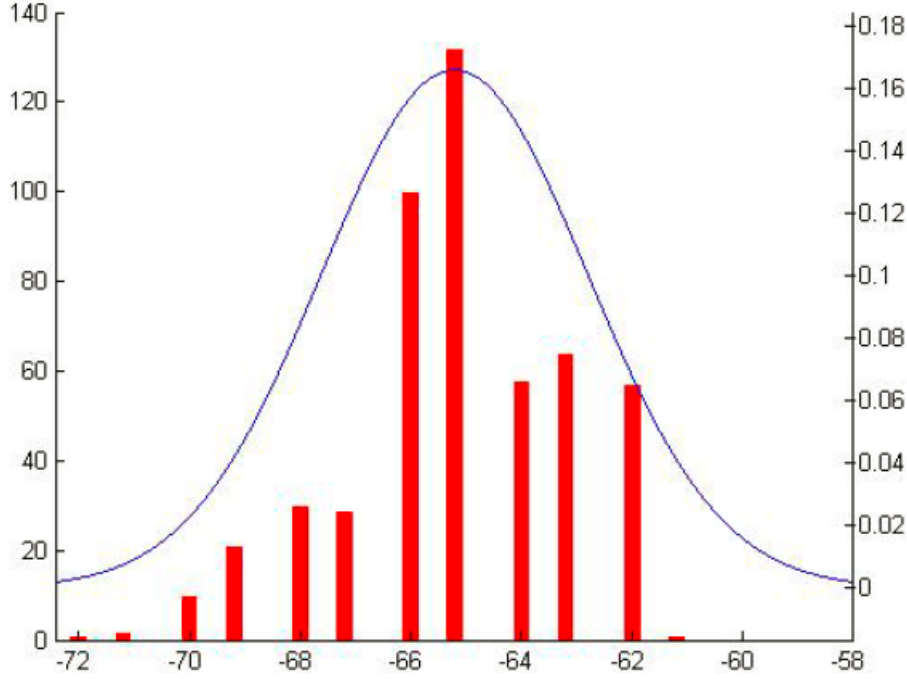


Figure 1: Wifi Signal Strength Distribution

We can use several compilers in the experiment to write the Android program. It will scan the WiFi Routers settled around the mobile phone continuously, record the signal strength, display the result on the mobile phone screen and write it to the SD card of the phone by the WiFi system of the Android.

2 Programming Details

Android Studio has already taken the place of Eclipse for Android these days and Eclipse is no longer supported by the Google. In this project, we use Android Studio as our compiler. With the complete code provided by TA, we do not have to write the codes from scratch. All we did was to modified the code a little bit.

2.1 collect RSS value

1. First, we changed to IWCTAP part to any available WiFi AP names, so that this code can be used in any environment and record the RSS records from the nearby accessible WiFi APs.
2. SSID is the name of the WLAN network when you login to access an access point but BSSID is the MAC address of access point. One access point can have many SSID profiles. So SSID is not the best identification for different WiFi devices, for there may be ten WiFi devices with the same name 'SJTU' in one place. So using the BSSID as the identification is a better way for different devices with a same SSID name.

3. And finally, the code did not provide necessary permissions for our smart phone to get the WiFi info, write the file. So we add all needed permissions into the code and we now have a WiFi signal Strength measuring Android App.
4. We did not modify MainActivity.java, the whole modified program is provided.

2.2 Localization with classification

1. First read the location and the RSS value in the offline phase.
2. We can use K-nearest-neighbor algorithm, choose the best k with the highest scores and calculate the accuracy. Other classification algorithms such as logistic regression, support vector machines and so on can be used as well.

3 Experiment Result

Some examples are shown in the file folder Experiment Code & Example. Including the algorithm and the collected RSS results.

4 Questions and Answers

Question 1

Why is necessary to record all the measured value rather than only the average value? Please give your own explanation.

Answer 1

As mentioned in the introduction, the signal received by mobile terminals is always unstable, so the result needs to be analyzed as random data in a certain distribution. This may be caused by several factors. First, the environment is changing all the time, making the signals vacillate. Besides, the transmitting and receiving process cannot be persistent all the time, which causes the value changing all the time.

Question 2

Besides the WiFi signal strength, what other information of the Routers can be got in the test?

Answer 2

According to Android Developers ([http://developer.android.com/reference/android/net/wifi/ScanResult.h](http://developer.android.com/reference/android/net/wifi/ScanResult.html)), we have the following information:

1. **BSSID:** The address of the access point.

2. **SSID:** The network name.
3. **capabilities:** Describes the authentication, key management, and encryption schemes supported by the access point.
4. **centerFreq0:** Not used if the AP bandwidth is 20 MHz. If the AP use 40, 80 or 160 MHz, this is the center frequency (in MHz) if the AP use 80 + 80 MHz, this is the center frequency of the first segment (in MHz)
5. **centerFreq1:** Only used if the AP bandwidth is 80 + 80 MHz if the AP use 80 + 80 MHz, this is the center frequency of the second segment (in MHz)
6. **channelWidth:** AP Channel bandwidth
7. **frequency:** The primary 20 MHz frequency (in MHz) of the channel over which the client is communicating with the access point.
8. **level:** The detected signal level in dBm, also known as the RSSI.
9. **operatorFriendlyName:** Indicates Passpoint operator name published by access point.
10. **timestamp:** timestamp in microseconds (since boot) when this result was last seen.
11. **venueName:** Indicates venue name (such as 'San Francisco Airport') published by access point; only available on Passpoint network and if published by access point.

We can use `ap.toString()` to check these property values.

Question 3

Why does the scanning need to be operated in thread 'scanThread'?

Answer 3

If we directly manipulate WiFi functions in the UI thread, due to its high overhead, it will clog the UI thread and incur poor user experience. Thus, we create another thread and put the scanning process into that thread.

5 Additional Questions

Design an indoor positioning system based on WiFi signal strength by using the signal strength measuring function of Android mobile phone. Any positioning algorithm is available.

We can use K-nearest-neighbor algorithm, choose the best k with the highest scores and calculate the accuracy. Other classification algorithms such as logistic regression, support vector machines and so on can be used as well. Details algorithms and experiments are attached.

6 Conclusion

In this lab, we write an Android App to measure the strength of WiFi signal. We implement the App and do some experiment. Then we answer all the questions and then do this report.

For additional question, many more advanced approaches are available and we have presented some of them in the report. For simplicity, here we utilize the basic one.

Through this lab, we learn the skills of using Android programming to measure the WiFi signal strength and seizure the basic ideas of indoor localization.