EE447 Lab2 Report

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1   Requirements

Get used to the WiFi system and accomplish the sampling and measuring of WiFi signal strength through programming in Android on smartphone. Basically, we need to know what the workflow is in Android phone to measure WiFi strength. Moreover, try to think about possible ways to use WiFi to locate user's position in indoor situations.

2   Android Programming

2.1   workflow of scanning

1) Mainactivity calls scanning(user clicks SCAN button)

2) SuperWifi get the SSID groups

3) threads run for every router, the total scanning will run for several times

4) record measured results and compute average results, set scanning flag as false to stop

5) Mainactivity get results and write text to the Interface.

2.2   Migrate to Androidx

In this lab I installed the latest version of android studio and find many projects uses androidx support libraries in layout files. To migrate to AndroidX, I searched on the internet and change the support libraries and add dependencies in gradle files. Please see External Links part there are some websites I used to migrate my project to AndroidX.

In brief, it is better to look into the documentation android provides. It will told you what dependencies you need to claim for an element. And after you changed in the gradle file, make sure you synchronize the project and all will be done.

2.3 Some screenshots of the scanning results
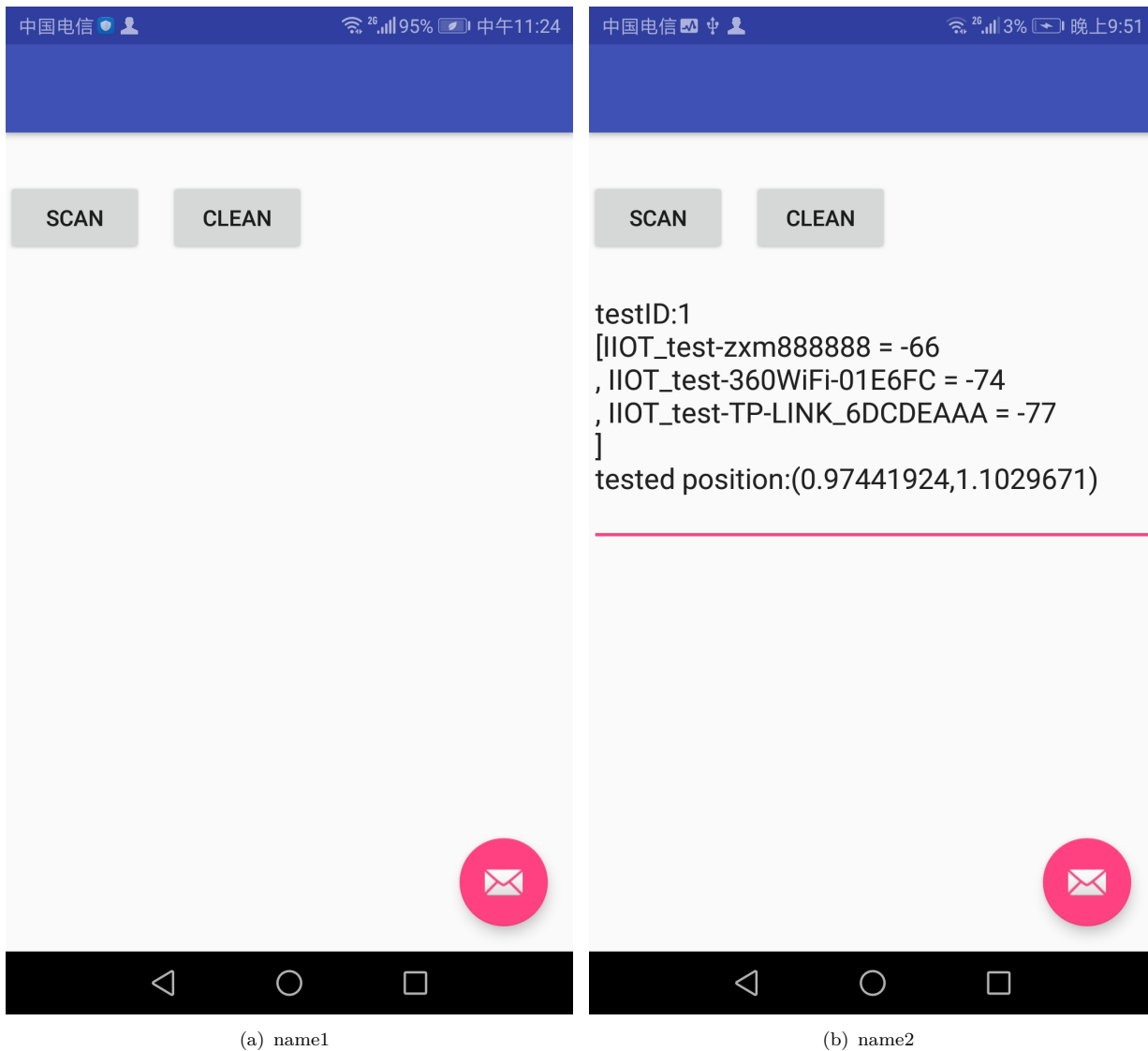

(a) name1
(b) name2

图 1: screen shots and scanning results

3 Questions

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

   A:It is noticed that during scanning the WiFi strength is unstable. For example, sometimes the strength will be very small but other data shows the signal is actually strong. Recording all the measured value helps to find those outliers. For this experiment, I think it is also very important for WiFi localization. We take advantage of the relationship between WiFi strength and distance so outliers will effect the accuracy. By checking the recorded measured value we can find such bugs, but we cannot get this information through the average value.

2) **Q:**Besides the WiFi strength, what other information of the Routers can be got in the test?

   A: Here I think we can get such information from android *WifiManager package*. Also, Android developer website writes documentation about *ScanResult*. I will put the reference in the reference part. Some of the information we can get from the scanning about the router:
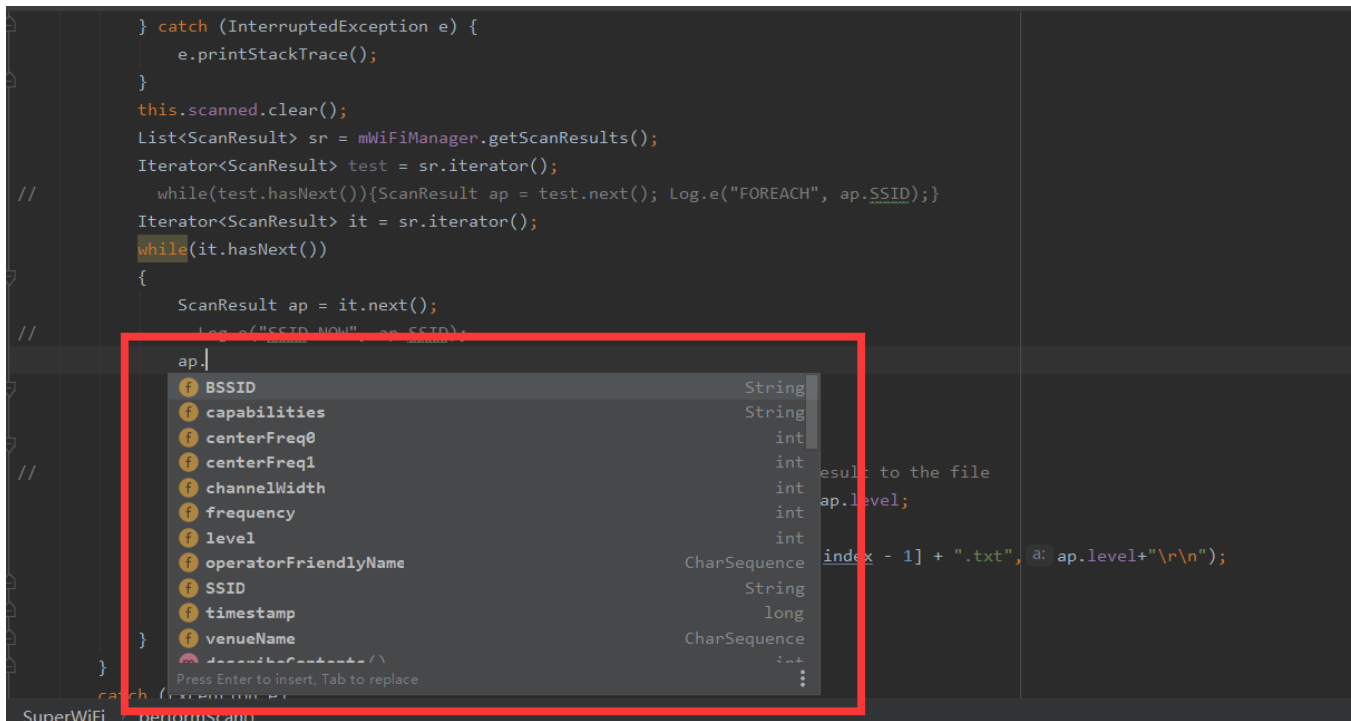
   - BSSID: the address of the access point

图 2: Some of the scanresult are shown in ScanResult class.

- SSID: the network name
- centerFreq(0 or 1): center frequency
- channelWidth: AP channel bandwidth

3) **Q:**Why does scanning need to be operated in thread "scanThread"?

A: Here I give my own thinkings.

- to improve the efficiency when scanning. make sure other routers can be scanned at the same time and don't have to wait.
- When there are many routers, using multiple threads can reduce the total scanning time.

4 Positioning Algorithms

There are several algorithms using WiFi to do localization. Below are some of the algorithms I leanrt from internet:

Some are not based on RSSI, like TOA(time of arrival), TDOA(time difference of arrival), AOA(angel of arrival), etc; Some are based on RSSI(this is similar to our lab), they get informtion about AP's strength and Ap's address to locate user. Of them, the simplest algorithm is Triangulation, which uses 3 known points to locate items.

In this lab, I simplify the idea.(I don't consider the earth'shape as a ball) The relationship between Wifi Strength and distance is:

$$\text{RSSI(dBm)} = -10\text{n}\log(\text{d}) + \text{A}$$

where n is propagation constant, A is received signal strength in dBm at 1 meter, we need adjust ourselves.

Now, we denote the three access points' location as (x_1, y_1), (x_2, y_2), (x_3, y_3), and we compute the distance to these three points as d_1 , d_2, d_3. Suppose we are at (x, y), then we have:

$$(x - x_1)^2 + (y - y_1)^2 = d_1$$
$$(x - x_2)^2 + (y - y_2)^2 = d_2$$
$$(x - x_3)^2 + (y - y_3)^2 = d_3$$

To solve this problem, I first solve the first two equations(Here in my family, the two routers location are set as $(0,0)$ and $(3,0)$) and we can already get the x, then we can move on to solving y. Here I try to find a y so that the distance we calculated is close to measured value. Thus, I have got a simple solution.
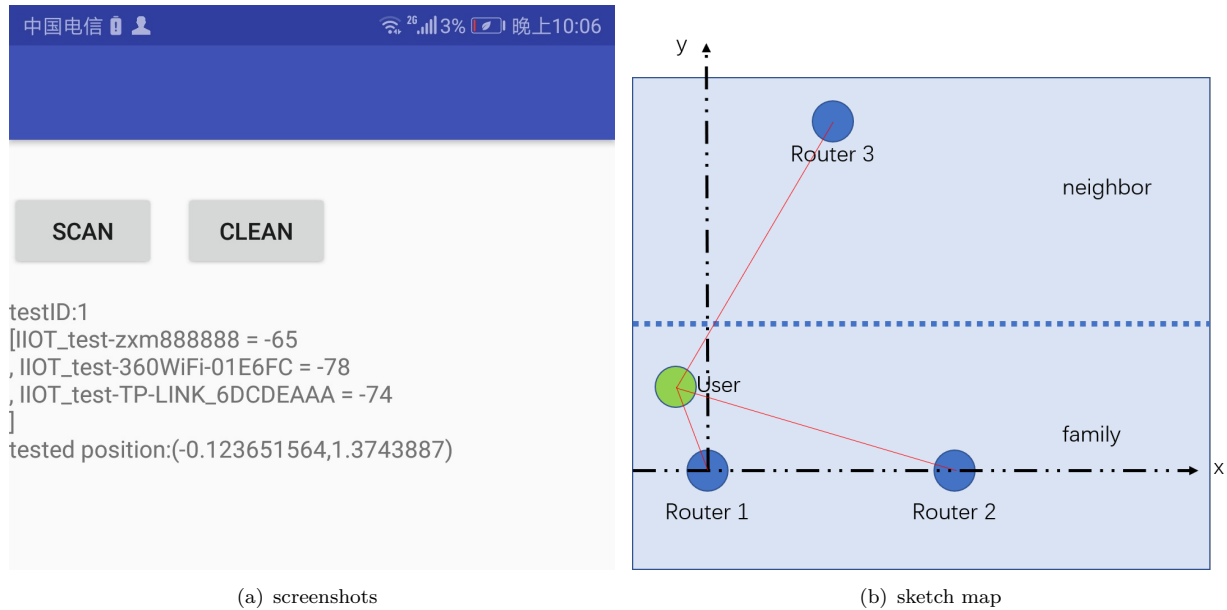
Below are some results of the test:

(a) screenshots

(b) sketch map

图 3: screen shots and scanning results

5 External Links

My github repository for this Lab

- https://github.com/koalazf99/EE447Lab/tree/master/Lab2

The relationship between WiFi strength and the distance:

- https://electronics.stackexchange.com/questions/83354/calculate-distance-from-rssi
- https://cloud.tencent.com/developer/ask/123184

Questions about the deprecated function startScan:

- https://stackoverflow.com/questions/49178307/startscan-in-wifimanager-deprecated-in-android-p

Adding dependencies for AndroidX

- https://developer.android.com/jetpack/androidx/releases/coordinatorlayout

Android ScanResult class documentation

- https://developer.android.com/reference/android/net/wifi/ScanResult