PA3 README

Collaborators, group 15:

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Task 1

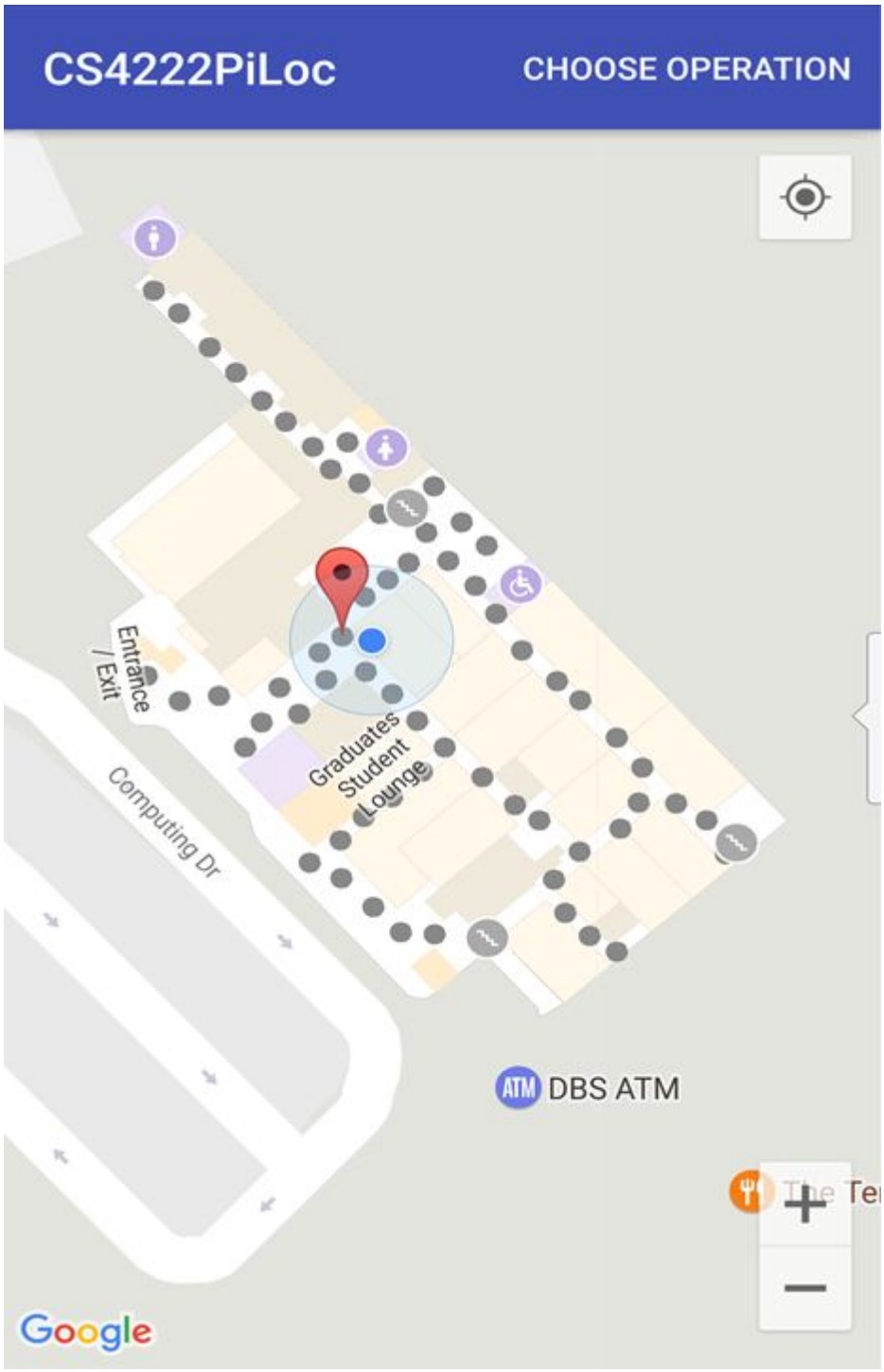
The attached files contain the wifi fingerprints read at 3 different times during the day. “fingerprintsMorning.txt” was recorded at 9:45am on a Monday, “fingerprintsAfternoon.txt” was recorded at 12:45pm on the same Monday, and “fingerprintsEvening.txt” was recorded at 6:30pm on a Wednesday. They are organized into 4 sections each, delimited by a series of dashed lines. The first section contains readings from location A, the second section for location B, and so on. Each section contains the entire wifi fingerprint, with the first set of characters indicating the MAC address of the detected device, and the number following it indicating the signal strength (smaller is better).

We can immediately see that the program picks up many fingerprints, however the fewest are found during the morning. The points vary in accuracy throughout the day, with no correlation between the time of day and signal strength. This can be the result of a variety of reasons, but the most likely is that all measurements were taken in an uncontrolled environment. As an example, it is possible that someone was standing in the signal path during an afternoon measurement but not in the morning.

When averaging the signal strength across all measured networks, we can see that the evening has the best average signal strength, followed by the morning and afternoon. An interesting feature found in the fingerprints is that some MAC addresses appear in both position B and C. One example is a8:9d:21:74:0b:2f, which is has a strength of roughly 55 from both measurements, implying it is a device situated between points B and C with a reasonable line of sight (few obstructions).

Task 2

Our group has been tasked to determine the location (within COM1 level 1) containing the given set of WIFI fingerprints using the WIFI fingerprints collected. The screenshot below shows where our localisation method determined the given set of fingerprints corresponds to based on the greatest similarity of signals.

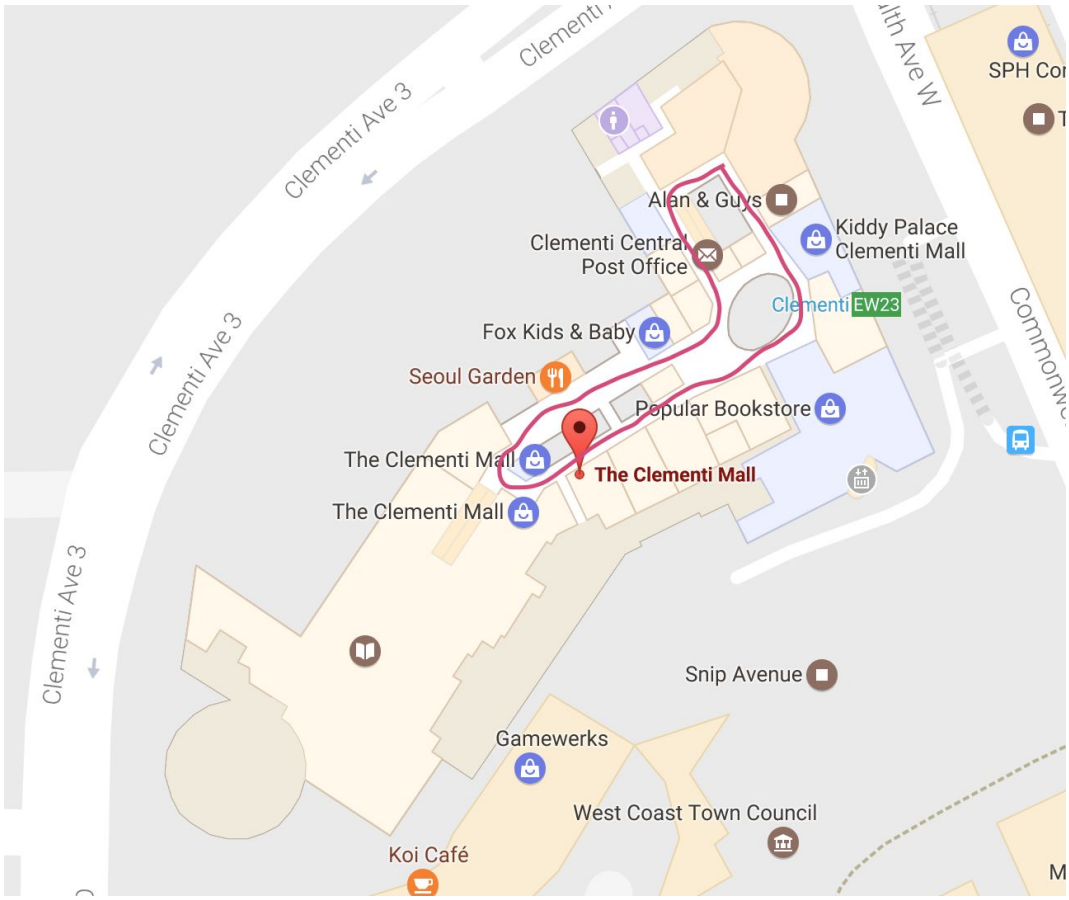


A total of 3 walks were taken throughout the day (morning, afternoon and evening) in order to determine the location and minimize the effects of negative factors such as the interference from other portable wireless devices that may have appeared on the fingerprints collected during the walk. Our localization

method first computes the Euclidian distance (using RSSI values) between matching MAC addresses contained within the given fingerprints and the fingerprints retrieved from the database for each location located on the radio map for COM1 level 1. After computing the Euclidian distance for each location, there will be a check to verify if the Euclidian distance is calculated from at least more than half of the MAC addresses contained within the given fingerprints (this is to prevent small Euclidian distances due to low number of matching MAC addresses from dominating). After that verification, our localization method would regard that computed Euclidian distance as the minimum Euclidian distance only if it has more matching MAC addresses than the current minimum (the distance is more accurate with a greater number of matching MAC addresses) or if it has the same number of matching MAC addresses as the current minimum and the computed Euclidian distance is less than the current minimum Euclidian distance. If it passes all checks, the current minimum Euclidian distance is replaced with the computed Euclidian distance and its location and number of matching MAC addresses stored for later iterations. At termination, our localization method will return the location with the minimum Euclidian distance if it has found one, otherwise no location will be returned.

Task 3

Our group has been assigned to construct the radio map for The Clementi Mall and we have chosen to do so on **level 5**. It was verified that no radio map exists for that particular floor. The layout for the floor is shown in the screenshot below:



The planned path to map for the floor is drawn in red. This route covers most of the ‘public’ areas on the floor.

A total of 4 walks were attempted and uploaded to the server. After each walk, we attempt to download the radiomap to perform the localisation.

(1) After the first walk, the estimated localisation error is approximately 5-8m. The 2nd walk is a repeat of the first walk and does not seem to improve the accuracy much.
However, the third walk is done in the opposite direction. The localisation seem to show a small improvement in accuracy to 3-5m. It is hard to tell whether the error accuracy is consistent throughout the floor as the error ranges are quite large. Further complicating matters, the red marker can jump around quite a bit, however, the estimated error min/max seems to be fairly consistent across the floor.

(2)

a. The localisation algorithm. Not all devices in the vicinity are useful for wifi fingerprinting. It would be more optimal to use only predetermined addresses in our algorithm.
b. The number of wifi base stations in the area. An optimal number of base stations can help improve the accuracy of the 'triangulation'. Having too many can cause difficulties in assessing the exact location, but too few will limit the algorithm.
c. The 'cluttered-ness' of the environment. A more cluttered environment enables the signal to bounce, resulting in higher variance in signal strength and lower accuracy in fingerprinting.

(3)

a. We can attempt to identify the mac addresses of the fixed wifi base stations and give those addresses a higher weight in the algorithm. The intuition is that the RSSI map of these stations is likely to be more static and thus can give higher accuracy. One way to identify these wifi base stations is to take traces across the day, especially when the mall is just opening or closing as the wifi channels would be less congested. The mac addresses across the readings can then be intersected to identify those which are likely to be from the base stations.
b. Have more varied path of travel. The radio map generated from a varied travel path would intuitively be more robust as data is collected.