WIRELESS AND MOBILE NETWORKING (CSE 570)

INDOOR FINGERPRINT APP- TERM PROJECT

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Objective:

This project is an implementation of Indoor localization methodology to determine and calculate different indoor locations using cellular and Wi-Fi Signal information.

Problem Statement:

Current GPS system does not provide information regarding the position of indoor building system like mall, hospital, university etc.

Our Solution:

We have developed a full-fledged android mobile application which can be used by a researcher to determine the different cellular and Wi-Fi signal information at a place and map that location with its latitude and longitude coordinate values. This data would be saved in the database which is a file system which keeps important signal attributes for different X-Y locations. Later, this data can be used to localize any indoor place using its signal values.

Key Highlights:

1. App has flexibility to load a map from internal/external storage drive at run time. There is a menu option which browses the phone/external storage drive using which any map (image file) can be loaded.

2. For better accuracy and consistency, there is a setting page to configure the number of scanning occurrences on every long press of a location.

3. In addition to support the above feature accurately, it also provides time interval gap feature in between two scanning operations. These values are getting saved in phone shared preferences for easy and better access.

4. ZoomableImageView container has been used to support Zoom In/Out and scrolling feature which is more flexible and smooth as compared to the traditional static style. Pinch zoom is also supported for better look and feel of the application.

5. Wi-Fi Service and Phone state Listener has been used to access the signal information. Scanner will save the corresponding data to the file (Wi-Fi and Cellular) in the key value format where key is the coordinates of the point on the map and values correspond to the Cellular/Wi-Fi signal information. Database file would be saved to the base file manager location.

6. All required UI validation and error scenarios are handled. In case of any on-going scan, researcher is not allowed to push the second scan. Proper toast will be shown as operation is in progress, on completion finished message will be displayed.

7. Around 2000 lines of code have been written to make the app robust and fulfil all the required needs.

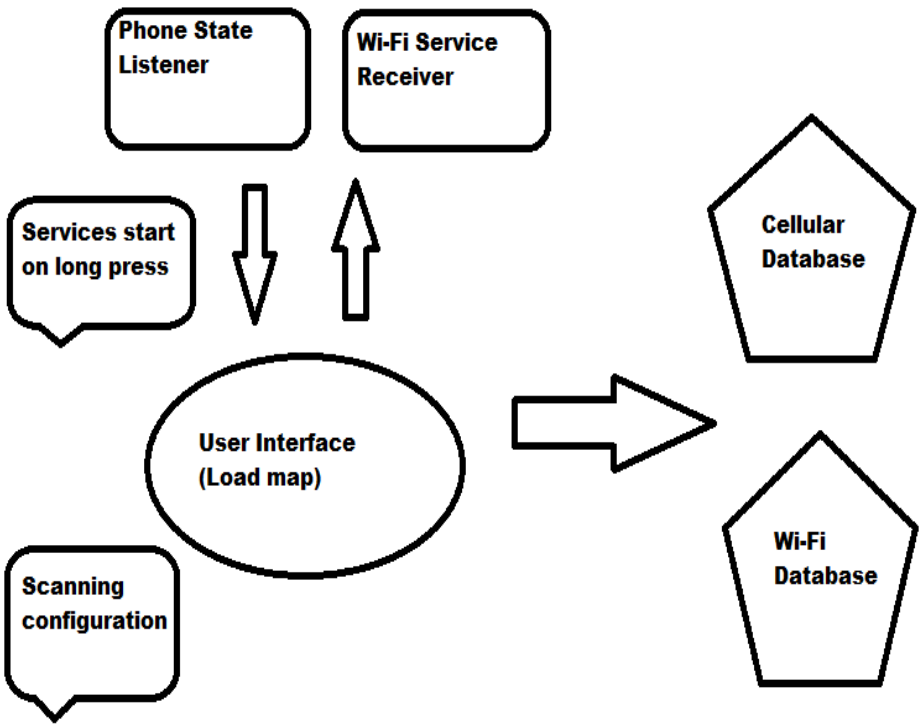
Technical Challenges and Solutions:

1. The biggest challenge was to get location co-ordinates correctly irrespective of zoom level and relative position of marked location on screen. We solved this problem by using a custom ImageView and transforming the relative co-ordinates into absolute one using scale factor into account.

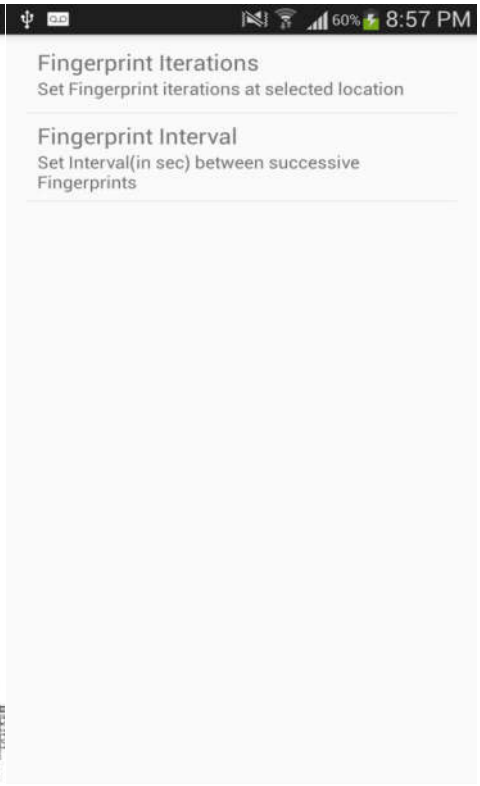
2. Another important challenge we faced was to implement the scanning in loop after fixed interval. As Wifi and Cellular scan API callbacks are asynchronous, it was difficult to implement the loop part. We implemented a solution that invokes next scan when current scan result comes and it blocks other fingerprint tasks till the current fingerprint task completes.

3. Implementing the zoom and scale functionality was also a tough task as it involved zoom and scroll operation on a simple image. We implemented a custom image view to handle zoom and scroll in all directions.

Application Design



Screenshots:



Cellular Database Snippet:

```
X=380, Y=675:-->:| 1450141853799 [CellInfoLte: mRegistered=YES mTimeStampType=unknown mTimeStamp=922337203685477580 7ns, LteCellI
X=380, Y=675:-->:| 1450141853805 [CellInfoLte: mRegistered=YES mTimeStampType=unknown mTimeStamp=922337203685477580 7ns, LteCellI
X=617, Y=933:-->:| 1450141860401 [CellInfoLte: mRegistered=YES mTimeStampType=unknown mTimeStamp=922337203685477580 7ns, LteCellI
X=617, Y=933:-->:| 1450141860452 [CellInfoLte: mRegistered=YES mTimeStampType=unknown mTimeStamp=922337203685477580 7ns, LteCellI
X=617, Y=933:-->:| 1450141866978 [CellInfoLte: mRegistered=YES mTimeStampType=unknown mTimeStamp=922337203685477580 7ns, LteCellI
X=617, Y=933:-->:| 1450141867011 [CellInfoLte: mRegistered=YES mTimeStampType=unknown mTimeStamp=922337203685477580 7ns, LteCellI
X=617, Y=933:-->:| 1450141873602 [CellInfoLte: mRegistered=YES mTimeStampType=unknown mTimeStamp=922337203685477580 7ns, LteCellI
X=366, Y=705:-->:| 1450142058796 [CellInfoLte: mRegistered=YES mTimeStampType=unknown mTimeStamp=922337203685477580 7ns, LteCellI
X=411, Y=704:-->:| 1450142065274 [CellInfoLte: mRegistered=YES mTimeStampType=unknown mTimeStamp=922337203685477580 7ns, LteCellI
X=411, Y=704:-->:| 1450142065298 [CellInfoLte: mRegistered=YES mTimeStampType=unknown mTimeStamp=922337203685477580 7ns, LteCellI
X=492, Y=934:-->:| 1450142071883 [CellInfoLte: mRegistered=YES mTimeStampType=unknown mTimeStamp=922337203685477580 7ns, LteCellI
X=492, Y=934:-->:| 1450142071898 [CellInfoLte: mRegistered=YES mTimeStampType=unknown mTimeStamp=922337203685477580 7ns, LteCellI
X=492, Y=934:-->:| 1450142078470 [CellInfoLte: mRegistered=YES mTimeStampType=unknown mTimeStamp=922337203685477580 7ns, LteCellI
X=380, Y=709:-->:| 1450142082636 [CellInfoLte: mRegistered=YES mTimeStampType=unknown mTimeStamp=922337203685477580 7ns, LteCellI
X=380, Y=709:-->:| 1450142085065 [CellInfoLte: mRegistered=YES mTimeStampType=unknown mTimeStamp=922337203685477580 7ns, LteCellI
X=380, Y=709:-->:| 1450142085107 [CellInfoLte: mRegistered=YES mTimeStampType=unknown mTimeStamp=922337203685477580 7ns, LteCellI
```

Wi-Fi Database Snippet:

```
X=296, Y=1238:-->:| 6c:f3:7f:96:08:18,WolfieNet-Secure,-72,5805| 00:24:6c:72:e0:f2,eduroam,-67,5220| 6c:f3:7f:96:08:1a,eduroam,
X=756, Y=1321:-->:| 6c:f3:7f:96:08:18,WolfieNet-Secure,-74,5805| 00:24:6c:72:e0:f2,eduroam,-71,5220| 6c:f3:7f:96:08:1a,eduroam,
X=756, Y=1321:-->:| 6c:f3:7f:96:08:18,WolfieNet-Secure,-74,5805| 00:24:6c:72:e0:f2,eduroam,-71,5220| 6c:f3:7f:96:08:1a,eduroam,
X=756, Y=1321:-->:| 6c:f3:7f:96:08:18,WolfieNet-Secure,-74,5805| 00:24:6c:72:e0:f2,eduroam,-71,5220| 6c:f3:7f:96:08:1a,eduroam,
X=565, Y=903:-->:| 6c:f3:7f:96:08:18,WolfieNet-Secure,-74,5805| 00:24:6c:72:e0:f2,eduroam,-72,5220| 6c:f3:7f:96:08:1a,eduroam,-
X=565, Y=903:-->:| 6c:f3:7f:96:08:18,WolfieNet-Secure,-74,5805| 00:24:6c:72:e0:f2,eduroam,-72,5220| 6c:f3:7f:96:08:1a,eduroam,-
X=565, Y=903:-->:| 6c:f3:7f:96:08:18,WolfieNet-Secure,-74,5805| 00:24:6c:72:e0:f2,eduroam,-72,5220| 6c:f3:7f:96:08:1a,eduroam,-
X=230, Y=460:-->:| 6c:f3:7f:96:08:18,WolfieNet-Secure,-73,5805| 00:24:6c:72:e0:f2,eduroam,-75,5220| 6c:f3:7f:96:08:1a,eduroam,-
X=230, Y=460:-->:| 6c:f3:7f:96:08:18,WolfieNet-Secure,-73,5805| 00:24:6c:72:e0:f2,eduroam,-75,5220| 6c:f3:7f:96:08:1a,eduroam,-
X=230, Y=460:-->:| 6c:f3:7f:96:08:18,WolfieNet-Secure,-73,5805| 00:24:6c:72:e0:f2,eduroam,-75,5220| 6c:f3:7f:96:08:1a,eduroam,-
X=310, Y=982:-->:| 6c:f3:7f:96:08:18,WolfieNet-Secure,-73,5805| 00:24:6c:72:e0:f2,eduroam,-73,5220| 6c:f3:7f:96:08:1a,eduroam,-
X=310, Y=982:-->:| 6c:f3:7f:96:08:18,WolfieNet-Secure,-73,5805| 00:24:6c:72:e0:f2,eduroam,-73,5220| 6c:f3:7f:96:08:1a,eduroam,-
X=310, Y=982:-->:| 6c:f3:7f:96:08:18,WolfieNet-Secure,-73,5805| 00:24:6c:72:e0:f2,eduroam,-73,5220| 6c:f3:7f:96:08:1a,eduroam,-
X=310, Y=982:-->:| 6c:f3:7f:96:08:18,WolfieNet-Secure,-81,5805| 00:24:6c:72:e0:f2,eduroam,-73,5220| 6c:f3:7f:96:08:1a,eduroam,-
X=310, Y=982:-->:| 6c:f3:7f:96:08:18,WolfieNet-Secure,-81,5805| 00:24:6c:72:e0:f2,eduroam,-73,5220| 6c:f3:7f:96:08:1a,eduroam,-
X=310, Y=982:-->:| 6c:f3:7f:96:08:18,WolfieNet-Secure,-81,5805| 00:24:6c:72:e0:f2,eduroam,-73,5220| 6c:f3:7f:96:08:1a,eduroam,-
```

Conclusion:

This project has been developed to provide a robust and flexible tool to researcher which will help in creating indoor fingerprinting database.

Application has been tested in different indoor locations and prepared database successfully.

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