Campus Map

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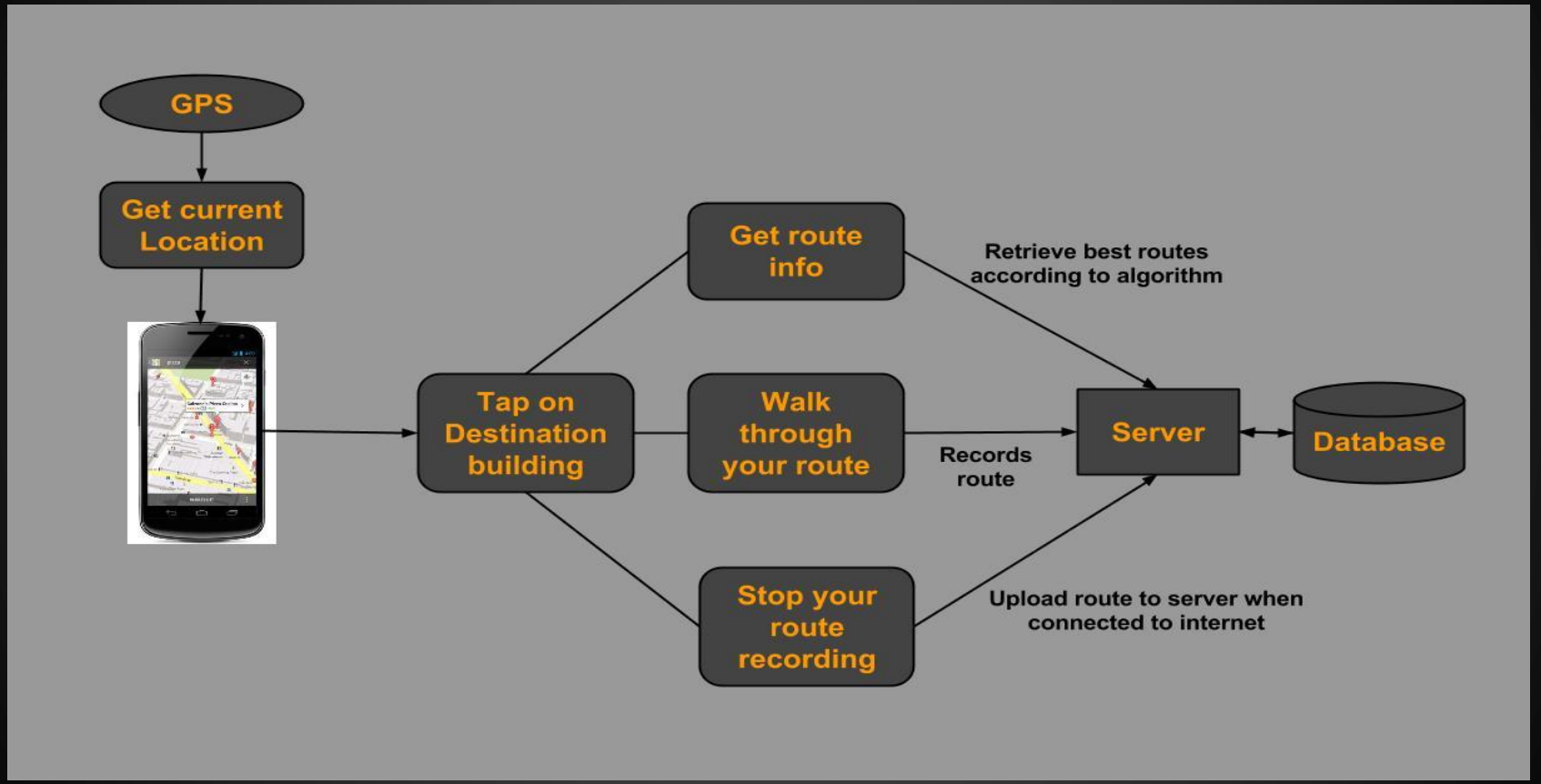
What has been done? - Problem & Approach

- The aim of CampusMap app is to provide a better navigation through the UI campus.
- The app gives a path to a building, as requested by the user by making comparisons among all the path it has got in the server.
- We are using a Client-Server model to implement the concept, since the workload given to the smartphone needs to reduced to optimize memory and battery consumption.

System Description - Diagram

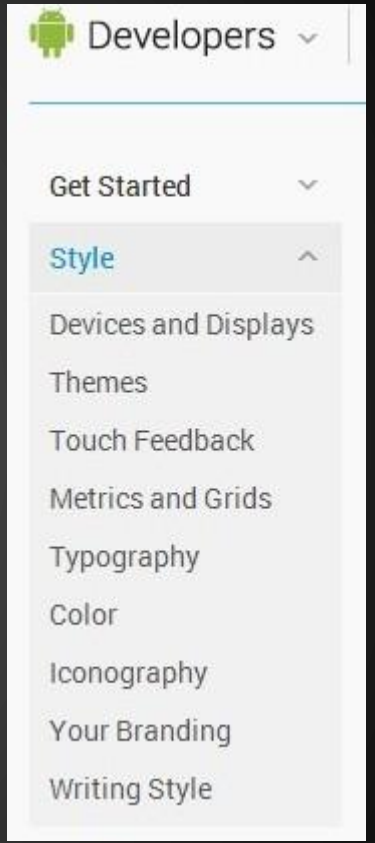


Problems and Solutions

#1 - User Interface

- The importance of UI
- Different UI style
- Our idea:

The Simpler The Better!

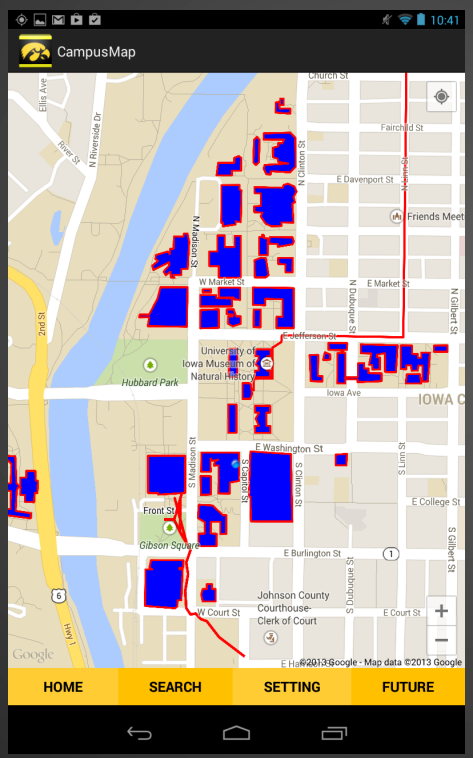


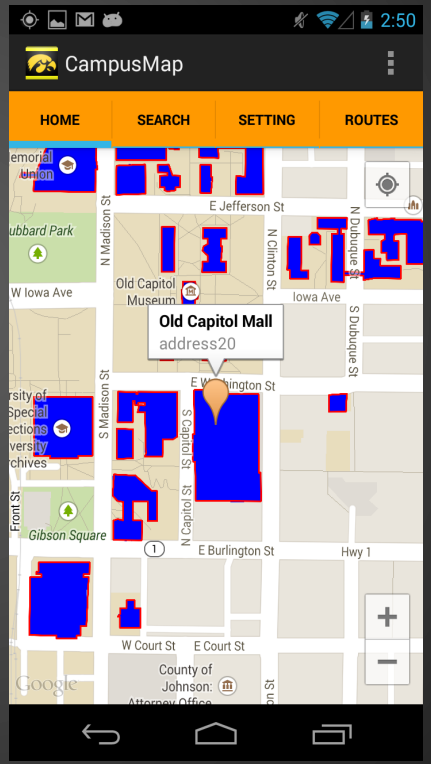
Simple to the eye!

- Layout

  Title bar

  Search bar
- Color





Simple to the mind!

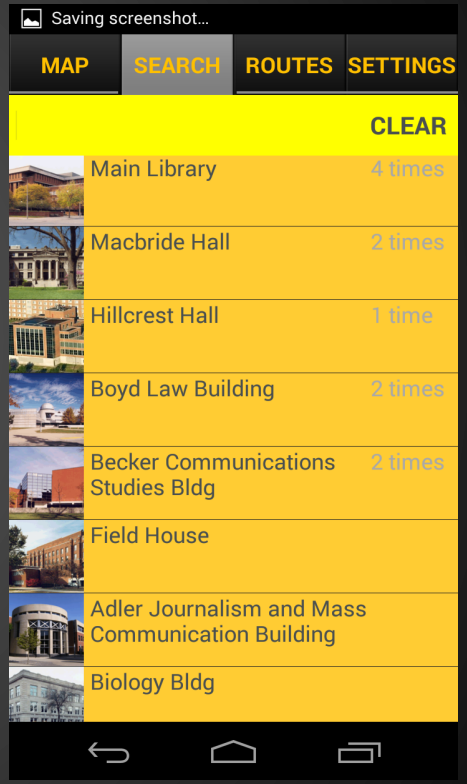
- Components

  Listeners

  Multi-level menu & dialog
  Customized message bar

  Listview with multi-item & hidden-item

User: just enjoy the click!



#2 - Route recording

Indoor estimate

Route indoor recording approach

- At first tried Wifi access point and sense fusion. (Both failed)

- Geometry location estimate
  - (Works only if GPS signal reliable)

*Geometry Location Estimate

In a building, GPS signal is terrible

Thus,

- Signal lost for 5s, assert entered a building
- Calculate which building is entered
- Add center point of corresponding building into the recorded route.

Entered which building?

- Calculating Euclidean distance to find the nearest building.
- Only works when signal is reliable

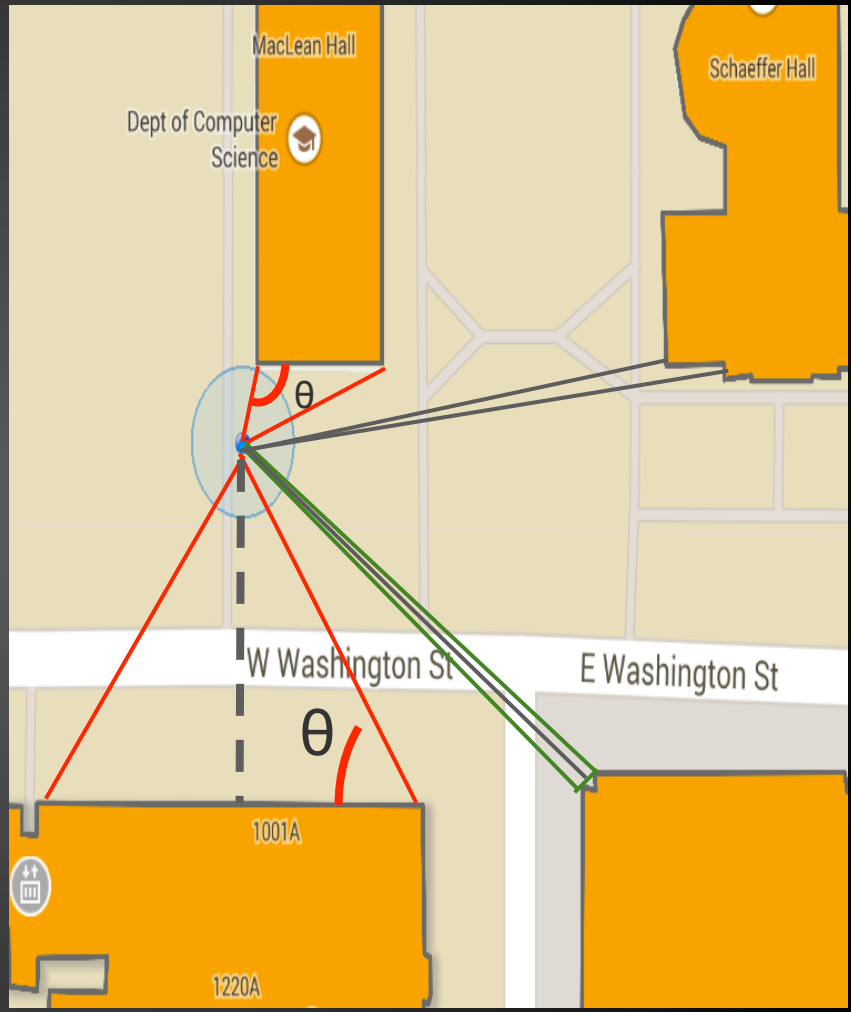
$$\cos A = \frac{b^2 + c^2 - a^2}{2bc}$$

$$\cos B = \frac{c^2 + a^2 - b^2}{2ca}$$

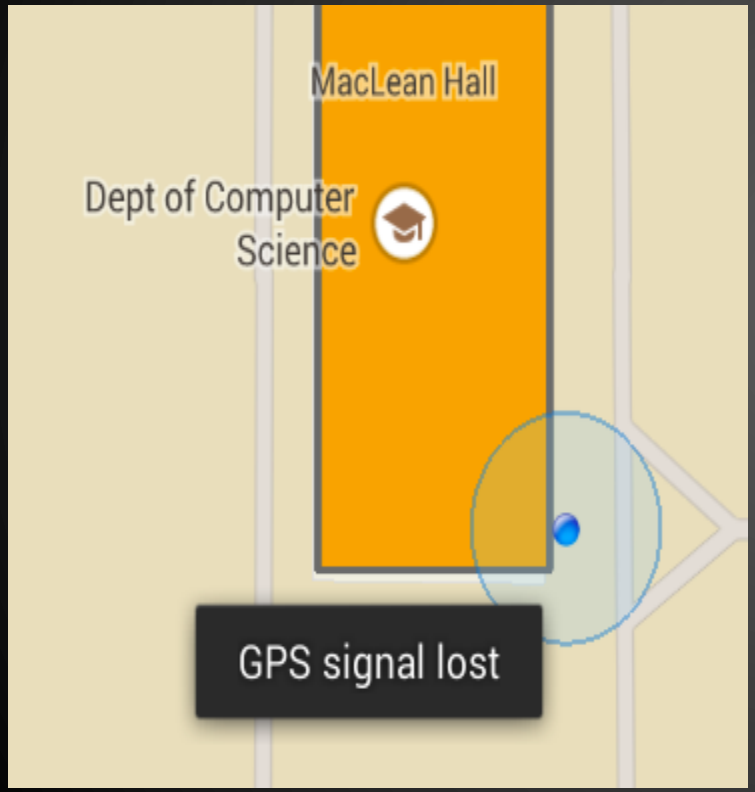
$$\cos C = \frac{a^2 + b^2 - c^2}{2ab}$$

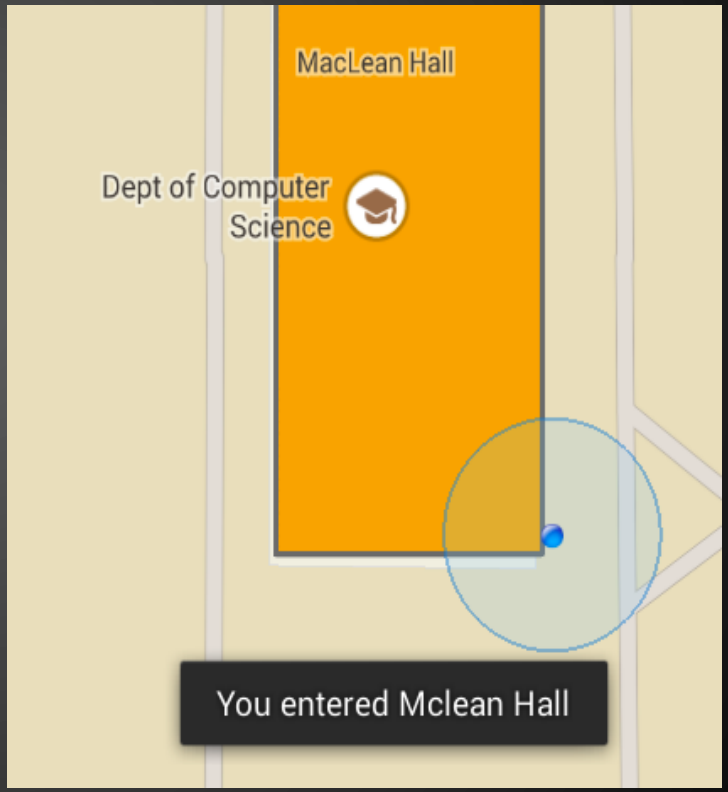
θ<90d
Point to line distance
θ>=90d
Euclidean D to closest one

$$\text{distance}(ax + by + c = 0, (x_0, y_0)) = \frac{|ax_0 + by_0 + c|}{\sqrt{a^2 + b^2}}.$$

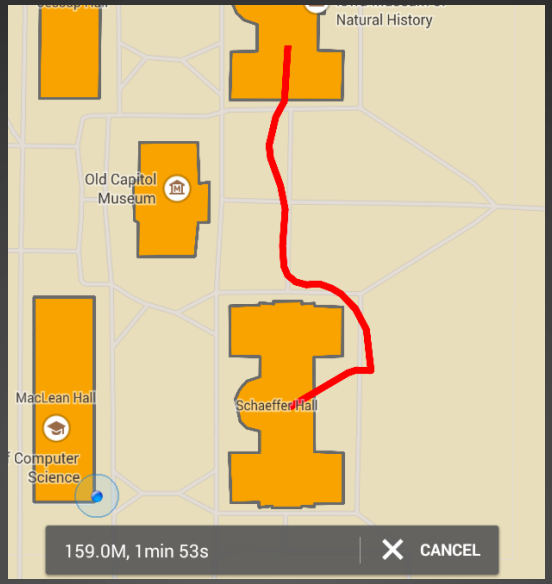


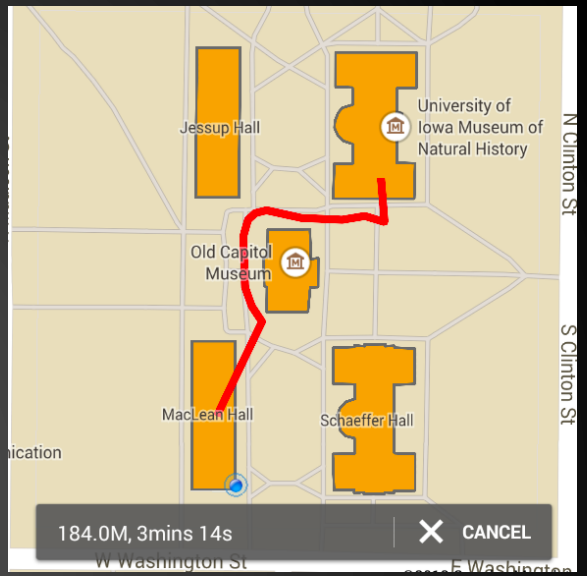
Screenshot - GPS signal lost for 5 seconds

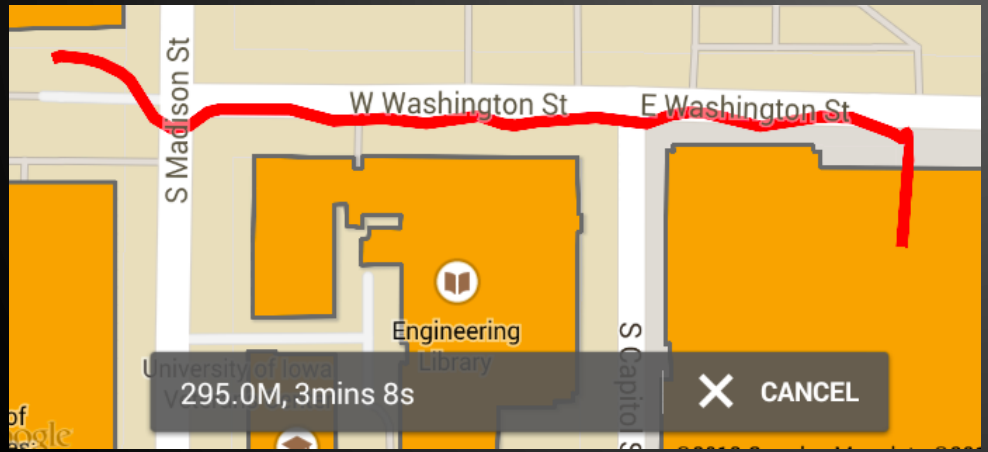


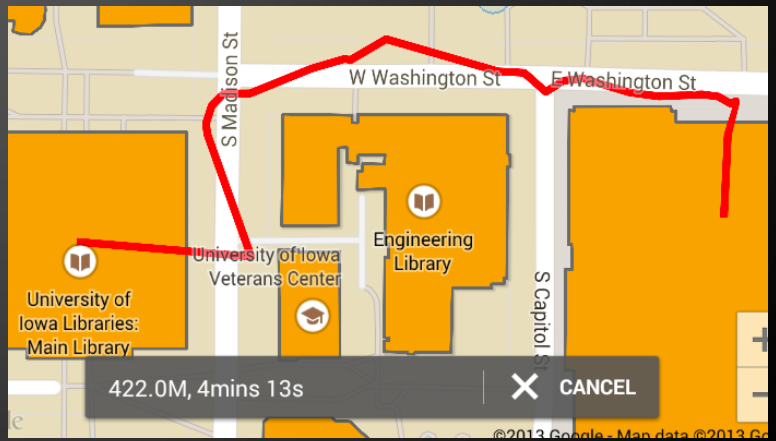


Recorded Routes Examples:









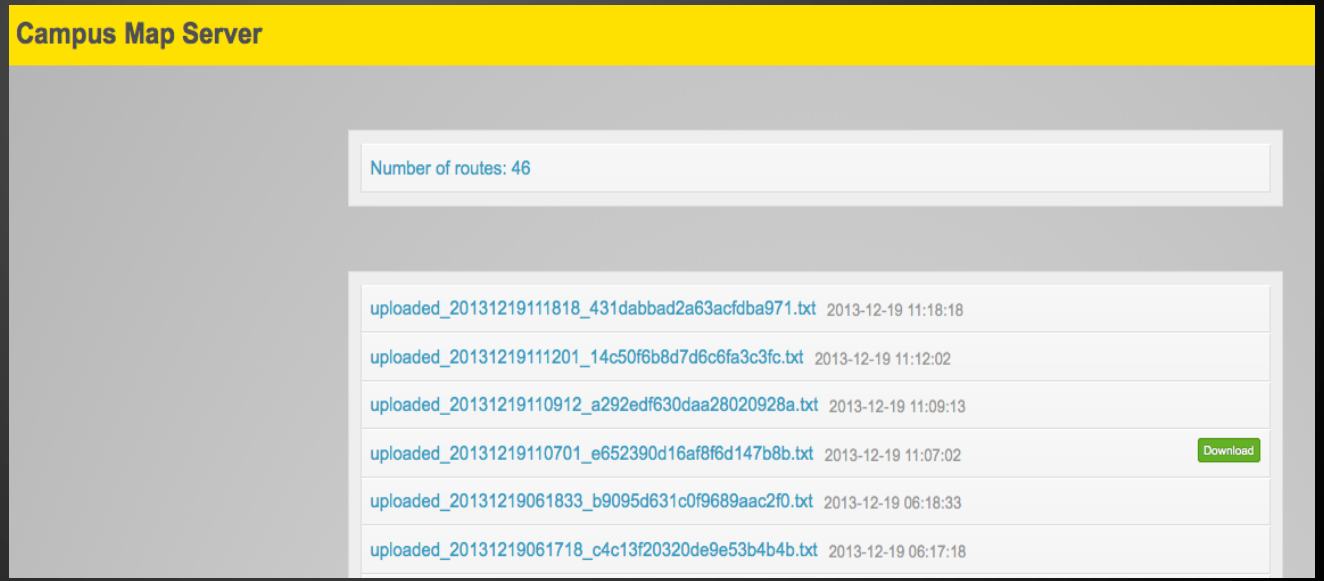
#3 - Requesting Routes

Request Routes Process

1. Send request to server (also to google)
2. Server calculates and returns 5 routes
3. Client optimizes 5 routes
4. Sort them based on distance
5. Render at most three routes

CampusGPS Server

http://1.campusgps.sinaapp.com/login.php



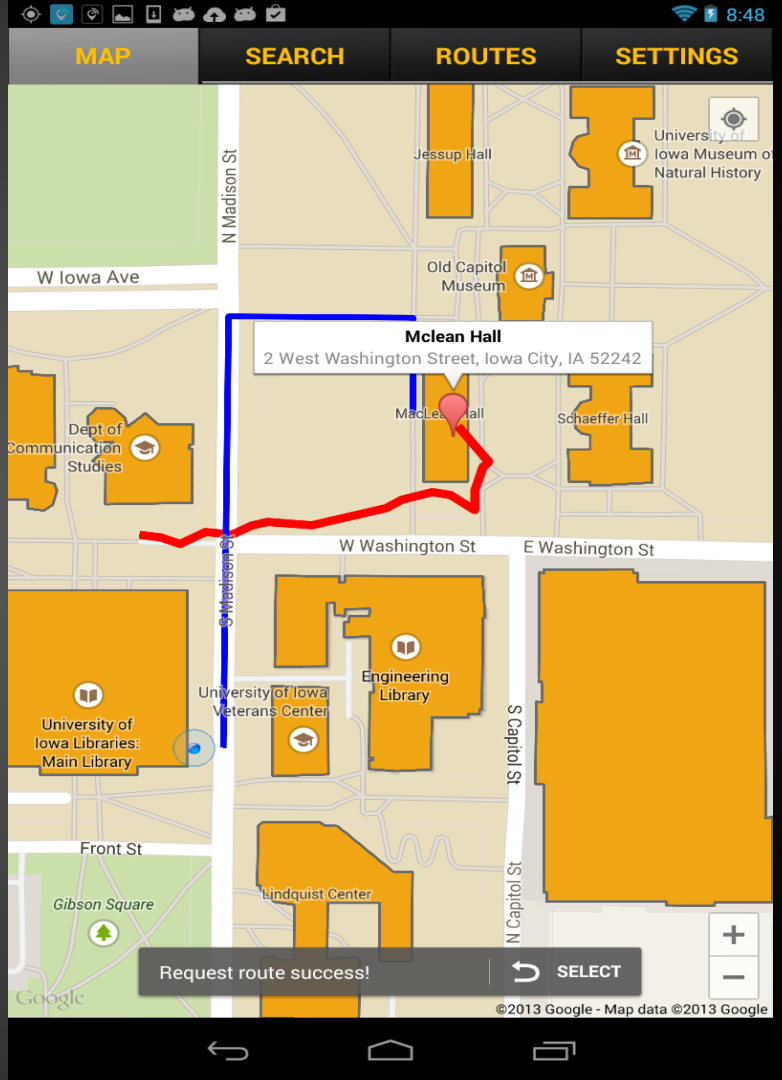
*Reusing nearby routes

1. Infinite Locations, but routes limited
2. If no routes nearby, **reuse** other further but relative closer routes

Associated with google direction

Before:

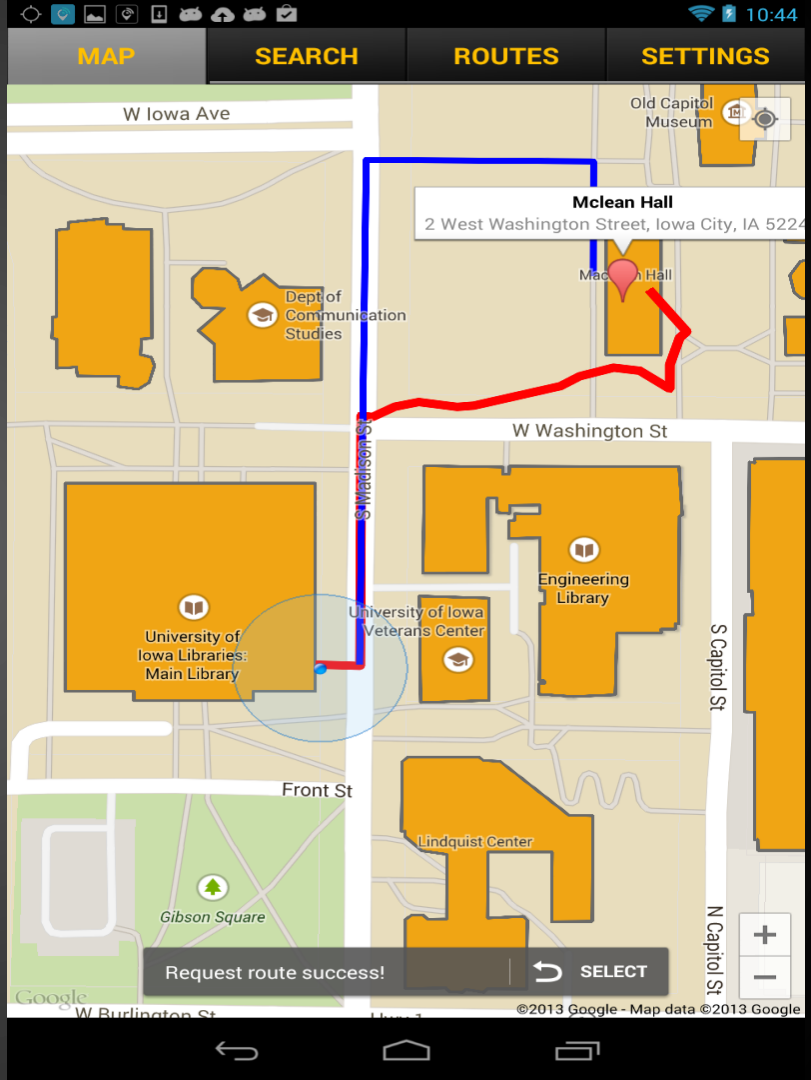
1. No routes 20m around me
2. One route 100m around
3. Crossed with google route



After:

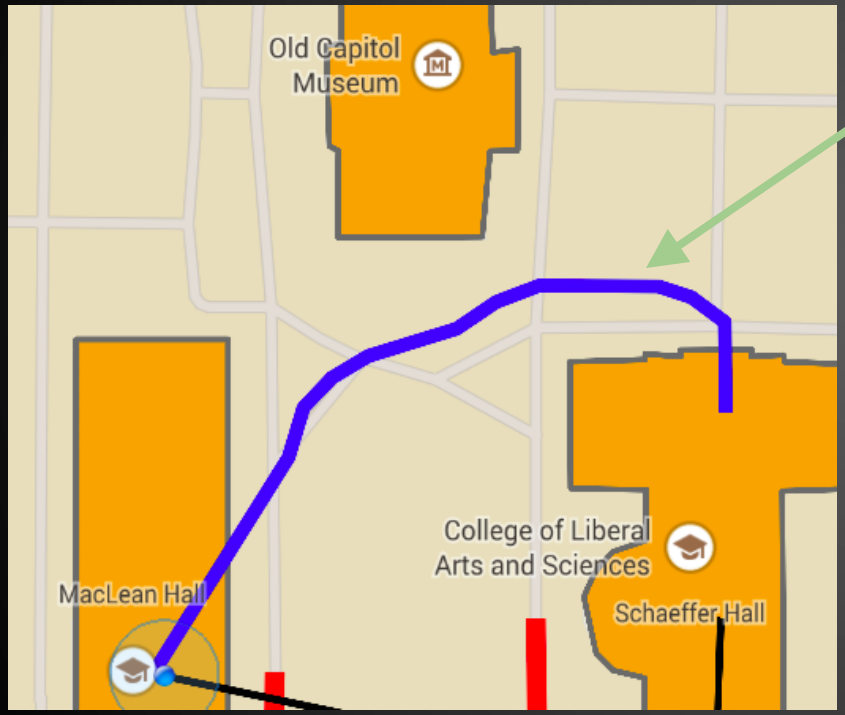
1. Generate a new route
2. Recalculate distance

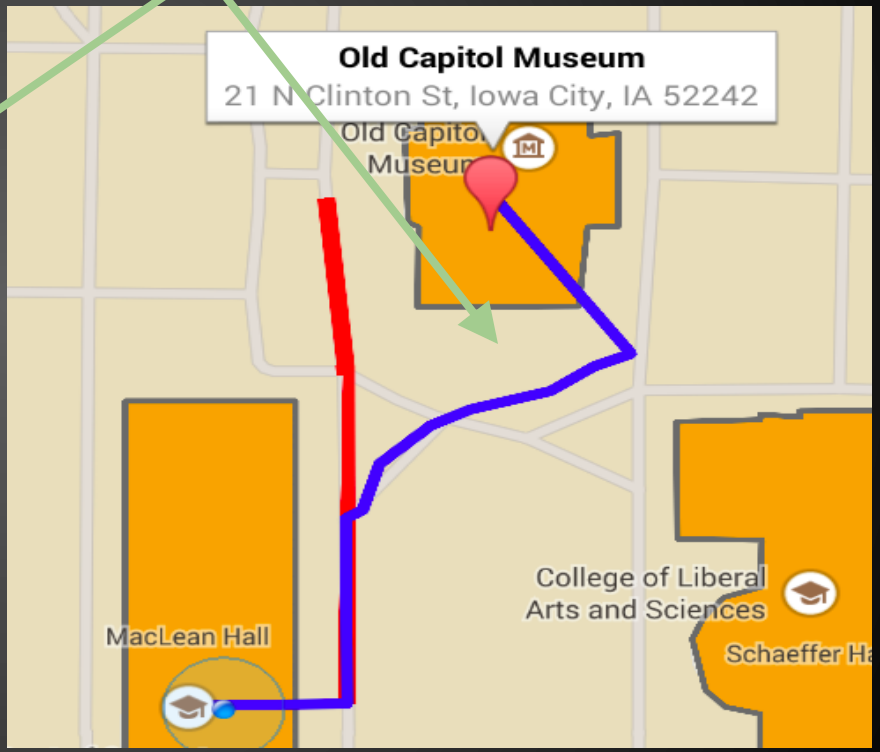
Demo in different buildings



Reusing routes

Same route,but optimized





Bottleneck

- Recording from building to outdoors.
- Signal loss while walking from building to building.

Evaluation

Performance measure

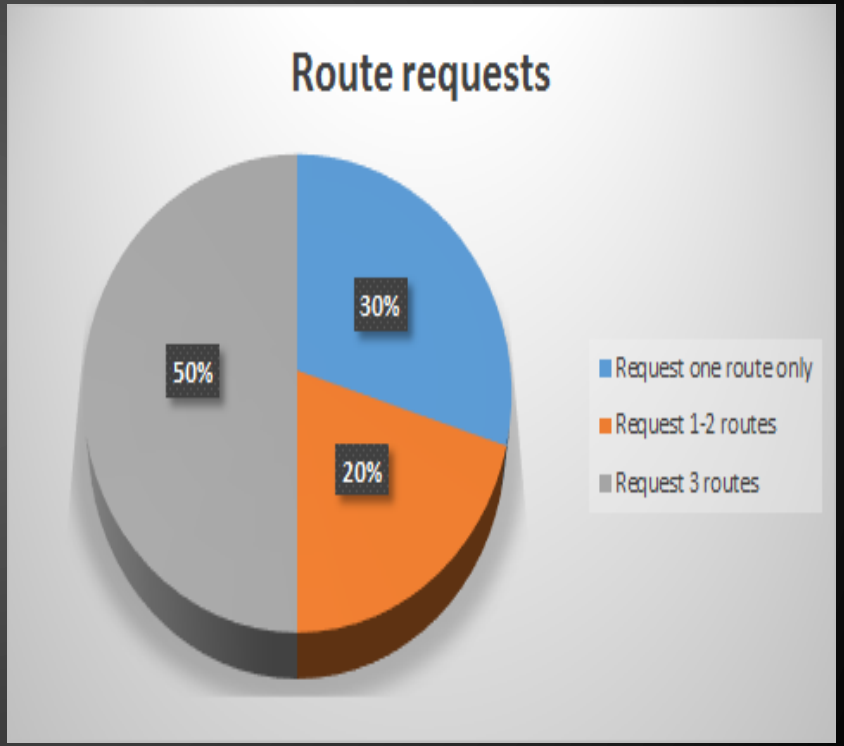
Recording routes

- We recorded 60 routes, out of which 46 routes turned out to be good.
- Therefore, the performance of the system will be approximately 77%.

Performance measure

Request routes

- For now, if we request routes from current location to a building, it will give 3 routes most of the time.
- As we get more routes from the user, the percentage of “Request 3 routes” will increase.



Performance measure

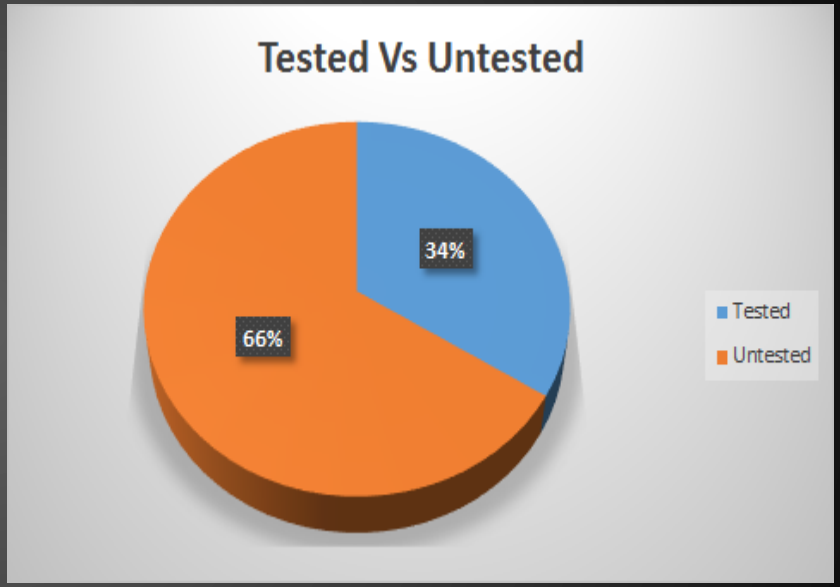
Good, Bad and Ugly

- Out of 60 routes that we recorded, 46 turned out to be very good.
- The rest routes did not yield a better result, due to poor GPS signal.

Performance measure

Tested Vs Untested

- It is important to know the location where our app works well.
- For that, we were able to test 34% (i.e 15 out of 45 buildings) and our app works fine within these buildings!



Experience

Advantages

- The routes we get is better than Google map’s routes.
- After optimizing, can generate shorter routes
- If the GPS signal is good, the route recording is perfect.
- Gives the user, an option to choose the route he/she wants to take along with the distance and time taken for each route by

Disadvantages

- Right now, the algorithm chooses the best route wrt time and distance factor.
- If the GPS signal is very bad, there are bounces in the routes, despite using a smoothing algorithm.

Enhancements

- Share the shortest path on Facebook/Twitter to help your friends.
- Sync Google calendar to get alerts if you are near a building.

Related Work & References

- http://www.cs.uic.edu/~jakob/papers/easytracker-sensys11.pdf
- http://www.eecs.harvard.edu/~konrad/projects/motetrack/
- http://en.wikipedia.org/wiki/Kalman%5Ffilter
- http://androidexample.com/Upload_File_To_Server_-_Android_Example/index.php?view=article_discription&aid=83&aaid=106
- http://www.ahristov.com/tutorial/geometry-games/point-line-distance.html
- http://www.vogella.com/articles/AndroidSensor/article.html
- http://www.thousand-thoughts.com/2012/03/android-sensor-fusion-tutorial/
- http://stackoverflow.com/questions/3145089/what-is-the-simplest-and-most-robust-way-to-get-the-users-current-location-in-a/3145655#3145655
- http://rvmiller.com/2013/05/part-1-wifi-based-trilateration-on-android/#comment-5922
- http://ddewaele.github.io/GoogleMapsV2WithActionBarSherlock/part5
- http://www.youtube.com/playlist?list=PL2F07DBCDCC01493A
- http://www.androidviews.net/2013/05/httpsimonvt-github-iomessagebar/

Thank you!