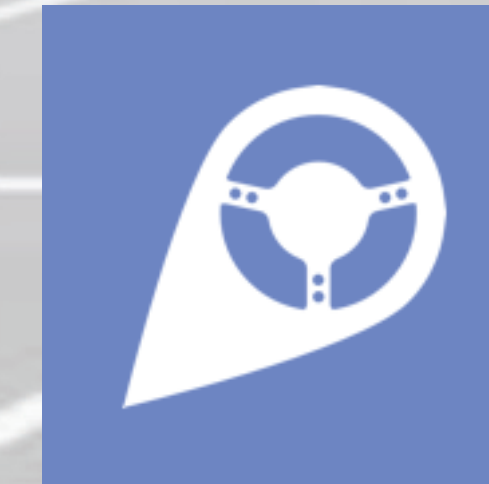


Indoor localization: technologies and apps

Lo Sui Kong, Chan Chun Hang, Chow Ka Ho

Advised by Prof. Gary Chan



Project Overview

This project aims at building an application called "Parkner" which can be used to locate the car of a user inside car park using iBeacon technology.



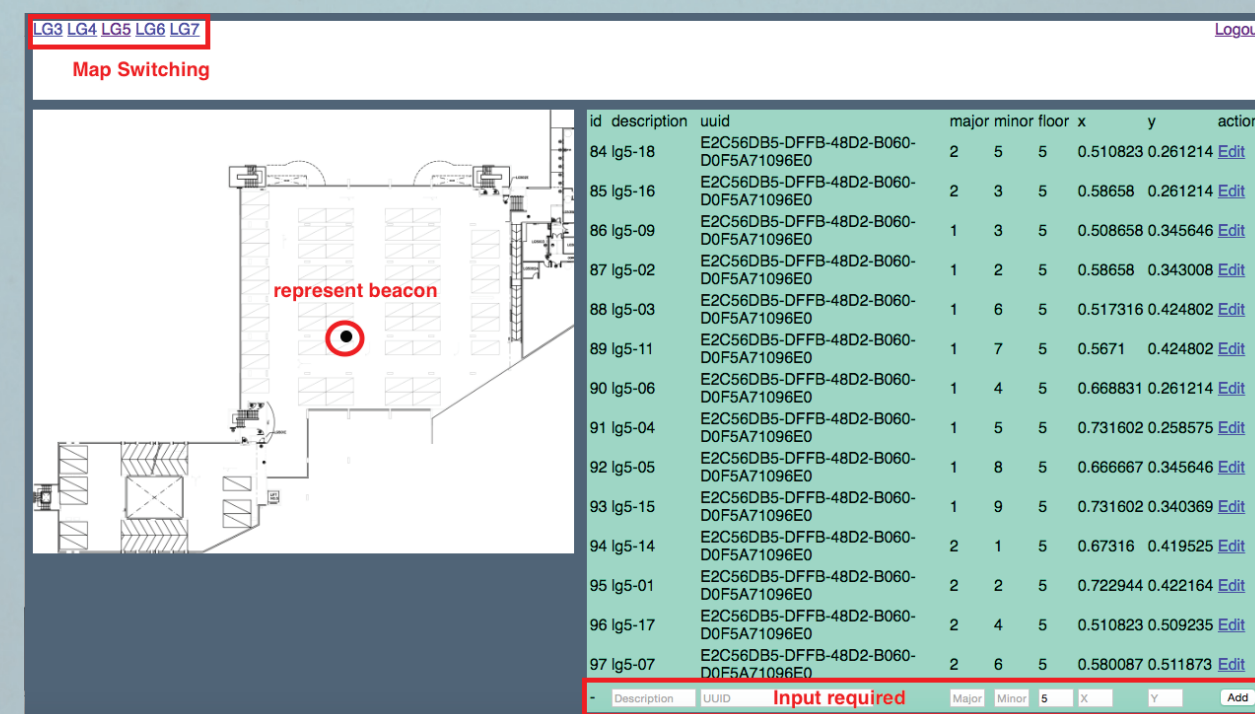
iBeacon



Client side user interface

Client side: A mobile application supporting both Android and iOS devices.

Server side: A web-based backend for managing iBeacons' configurations

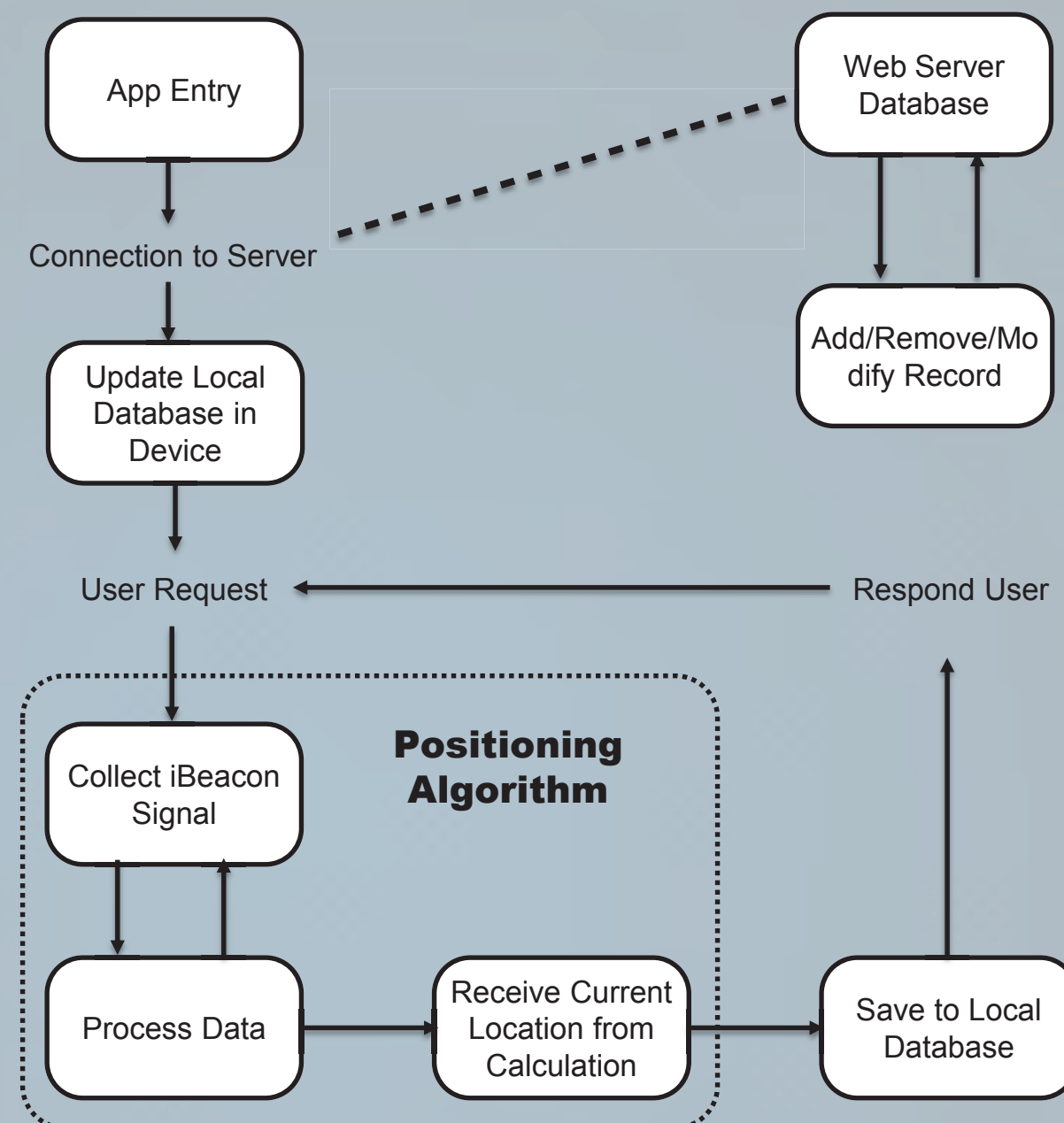


id	description	uid	major	minor	floor	x	y	action
84	lg5-18	E2C56DB5-DFB3-48D2-8060-D0F5A71096E0	2	5	5	0.510823	0.261214	Edit
85	lg5-16	E2C56DB5-DFB3-48D2-8060-D0F5A71096E0	2	3	5	0.58658	0.261214	Edit
88	lg5-09	E2C56DB5-DFB3-48D2-8060-D0F5A71096E0	1	3	5	0.508658	0.345648	Edit
87	lg5-02	E2C56DB5-DFB3-48D2-8060-D0F5A71096E0	1	2	5	0.58658	0.343008	Edit
88	lg5-03	E2C56DB5-DFB3-48D2-8060-D0F5A71096E0	1	6	5	0.517316	0.424802	Edit
89	lg5-11	E2C56DB5-DFB3-48D2-8060-D0F5A71096E0	1	7	5	0.5671	0.424802	Edit
90	lg5-06	E2C56DB5-DFB3-48D2-8060-D0F5A71096E0	1	4	5	0.688831	0.261214	Edit
91	lg5-04	E2C56DB5-DFB3-48D2-8060-D0F5A71096E0	1	5	5	0.731602	0.258575	Edit
92	lg5-05	E2C56DB5-DFB3-48D2-8060-D0F5A71096E0	1	8	5	0.686667	0.345648	Edit
83	lg5-15	E2C56DB5-DFB3-48D2-8060-D0F5A71096E0	1	9	5	0.731602	0.340389	Edit
94	lg5-14	E2C56DB5-DFB3-48D2-8060-D0F5A71096E0	2	1	5	0.67316	0.419525	Edit
95	lg5-01	E2C56DB5-DFB3-48D2-8060-D0F5A71096E0	2	2	5	0.722944	0.422184	Edit
96	lg5-17	E2C56DB5-DFB3-48D2-8060-D0F5A71096E0	2	4	5	0.510823	0.508235	Edit
97	lg5-07	E2C56DB5-DFB3-48D2-8060-D0F5A71096E0	2	6	5	0.580087	0.511673	Edit

Server side user interface

To achieve this goal, our group has conducted some studies on the behaviour of iBeacons to decide the essential factors in this project such as placement of iBeacon, optimised height to set the iBeacon and the distribution of the reference points used for fingerprint database of cosine similarity algorithm.

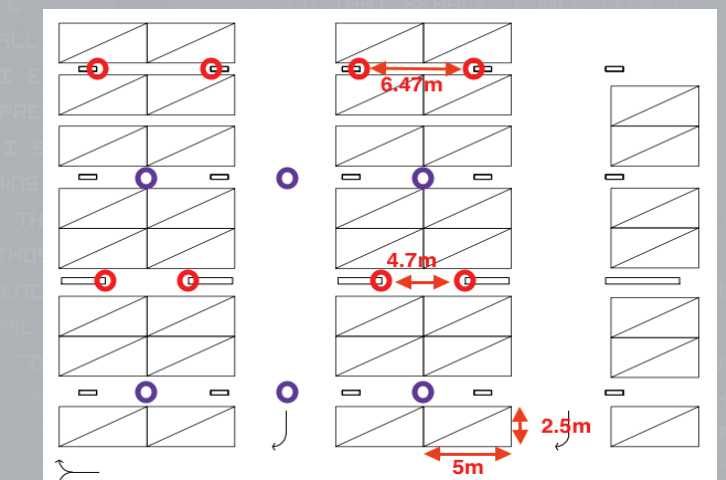
Methodology



1. Support both Android and iOS gadgets
2. Available for all indoor car parks in HKUST
3. Web backend with authentication for secured iBeacon management
4. Use self-adjusted cosine similarity algorithm to improve the accuracy
5. Design of iBeacon placement grid to minimise the cost with reliable result

Result

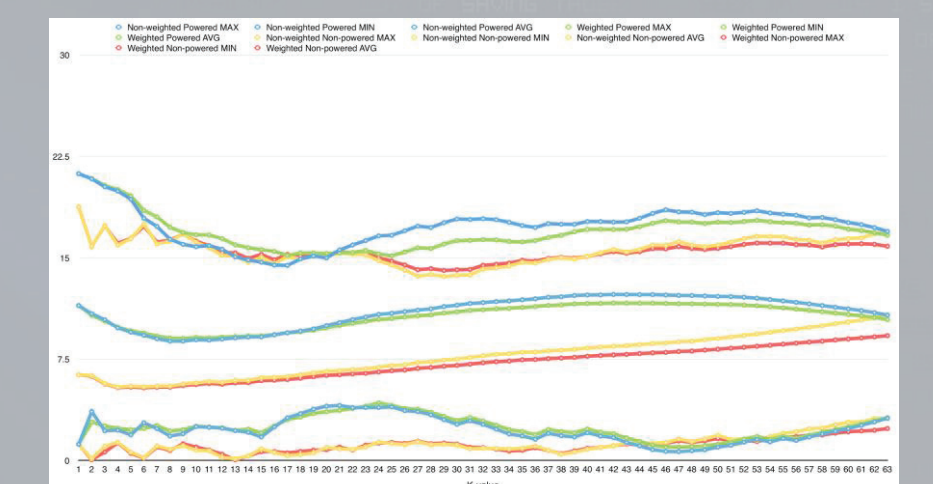
We have successfully implemented the iOS and Android versions of Parkner and the iBeacon management system for carpark manager to manage the iBeacons. Also, we designed a pattern of iBeacon placement to reduce the cost with higher quality.



Placement of iBeacon

For the main algorithm we used in calculation, we tried different combinations of settings to test the equation. We finally figured out the optimised settings

to get the best result in the carpark in HKUST.



Test result of algorithm

On average, the latency of locating the position will be no more than 6 seconds and the error of the calculated result compared with actual position is 6 meters.

Future Enhancement

1. Collect more bluetooth fingerprints in different levels of carpark loading to reduce the error due to unstable signal
2. Implement the routing feature for users to create a path to find their cars