Monitoring Soccer Players Using a Smartphone

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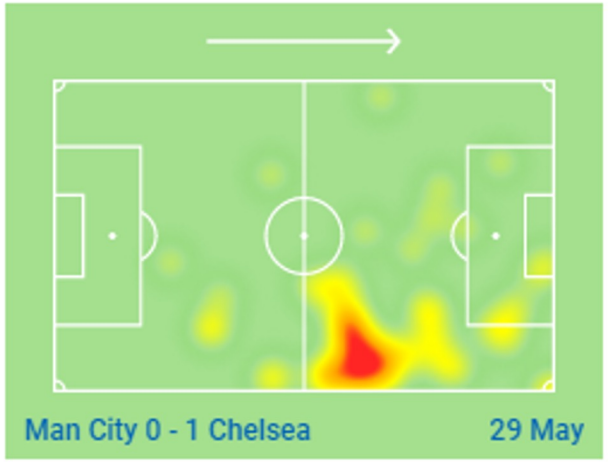
Performance tracking in soccer

Riyad Mahrez



SofaScore Statistical rating	6.5

Minutes played	90'
Goals	0
Assists	0
Shots on target	0
Shots off target	1
Shots blocked	0
Dribble attempts (succ.)	3 (0)
Touches	48
Acc. passes	23/32 (72%)
Key passes	1
Crosses (acc.)	4 (0)
Long balls (acc.)	1 (0)

Ground duels (won)	7 (3)
Aerial duels (won)	2 (1)
Possession lost	17
Fouls	1
Was fouled	3
Clearances	0
Blocked shots	0
Interceptions	0
Tackles	0
Dribbled past	0

SofaScore

Technologies used

The technologies used can be divided in two groups:

- Wearable technologies:
  1. GPS
  2. Accelerometer
  3. Gyroscope

  ...
- In-field technologies

  Usually multi camera systems

In-field systems: pros and cons

- Pros:
  1. No need for players setup
  2. Generally preferred by players as opposed to wearable sensors
- Cons:
  1. Expensive
  2. Installation required
  3. Not easy to relocate
  4. Specialized crew required

Wearable sensors systems: pros and cons

- Pros:
  1. More precise statistics
  2. Some data can only be collected with sensors on the athlete’s body
- Cons:
  1. Harder to setup players
  2. More invasive

Wrapping up

- In-field technologies mainly used in official matches
- Wearable sensors mainly used in unofficial matches and training sessions

Why did we develop TrainingStat?

TrainingStat: platform and infrastucture

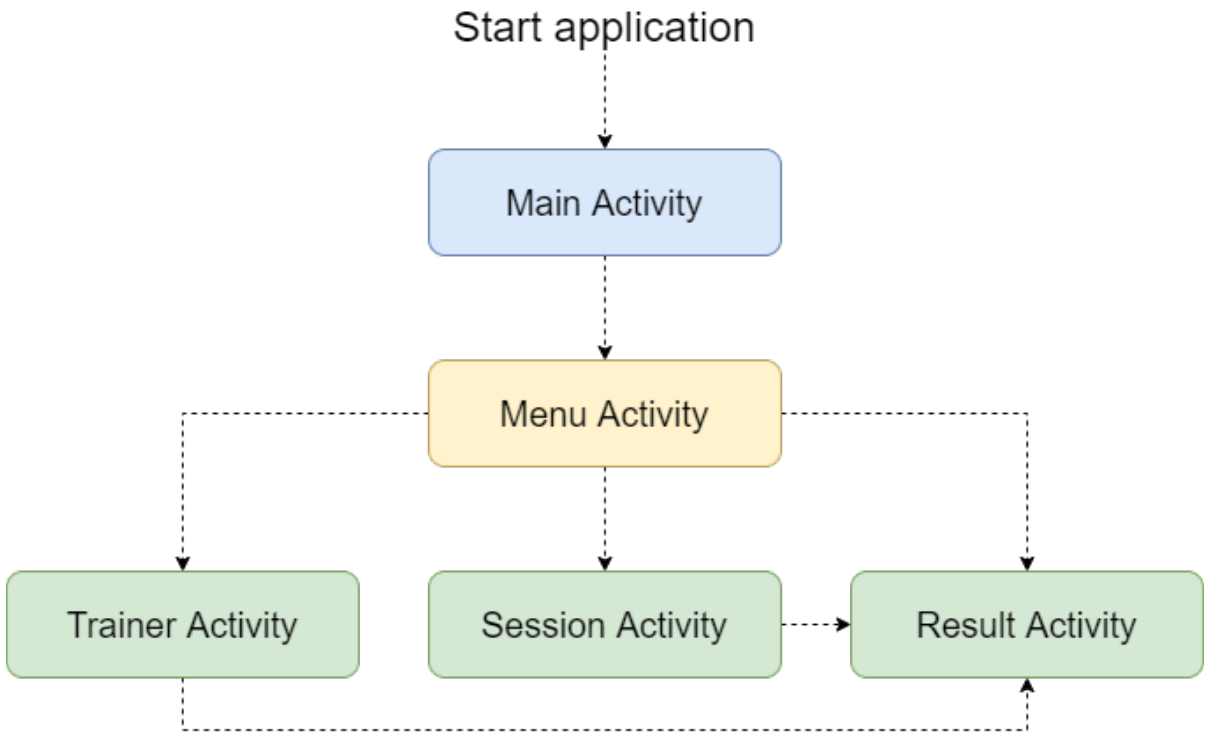
- Android is the most popular OS
- Android devices are packed with useful sensors
- Kontakt.io BLE beacons to estimate the position of the player

Functionalities and setup

- Functionalities:
  1. Players can track their individual training sessions;
  2. Coaches can monitor collective training sessions;

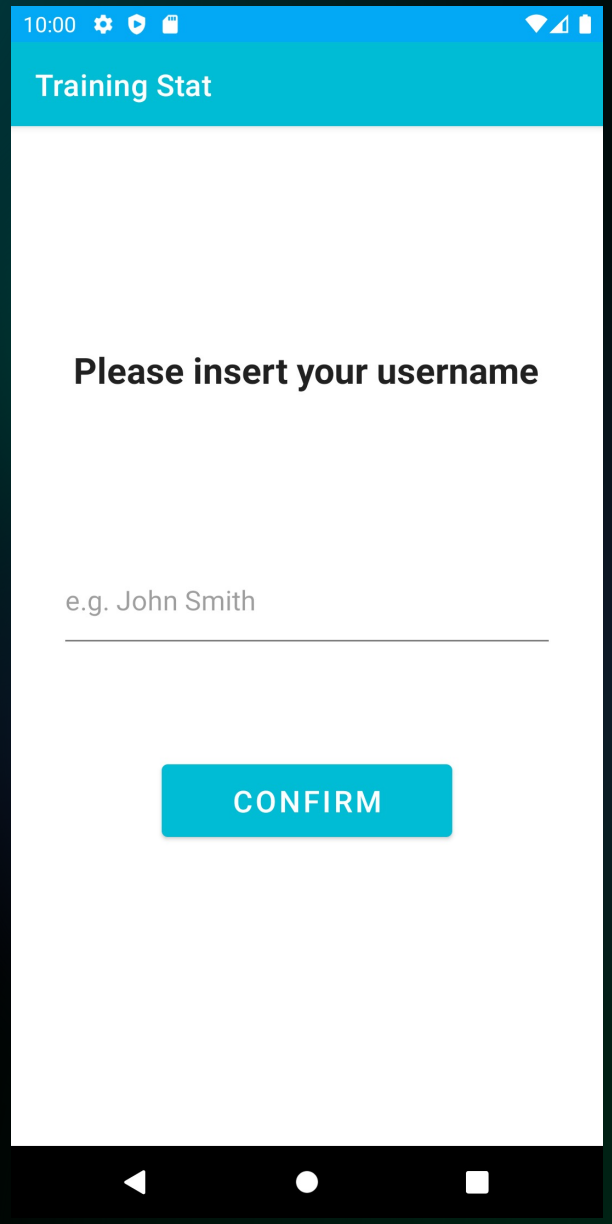
- Setup:
  1. Download the app, and strap the smartphone on the arm;
  2. Place 4 or more beacons in the field;

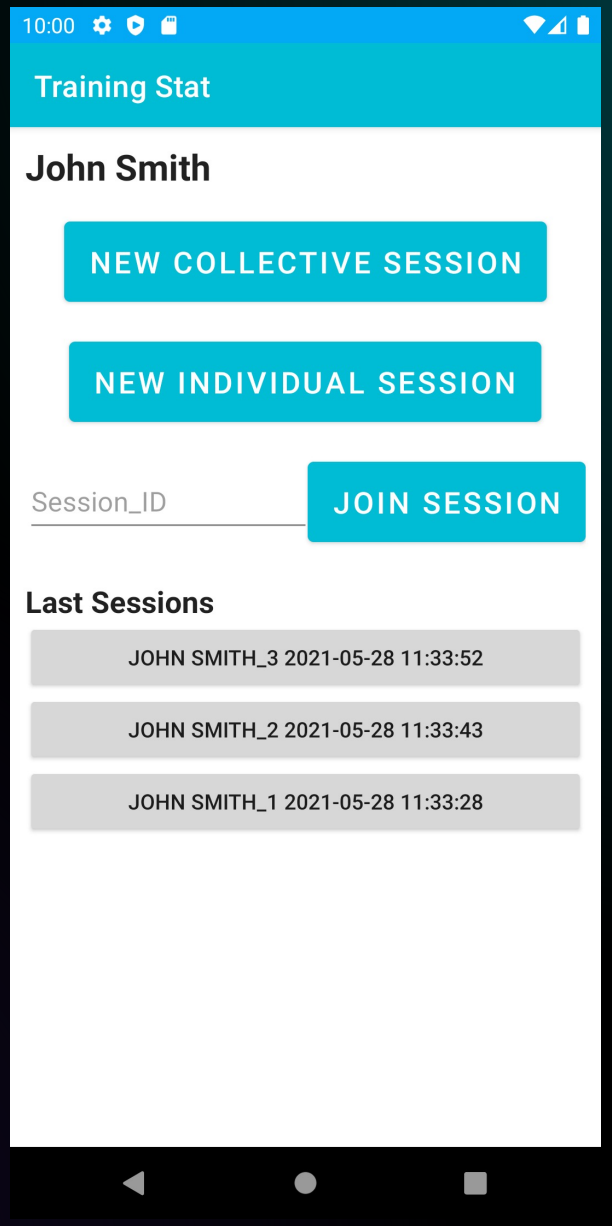
Application structure



Main Activity

LOGIN FUNCTIONALITIES (ALMOST)



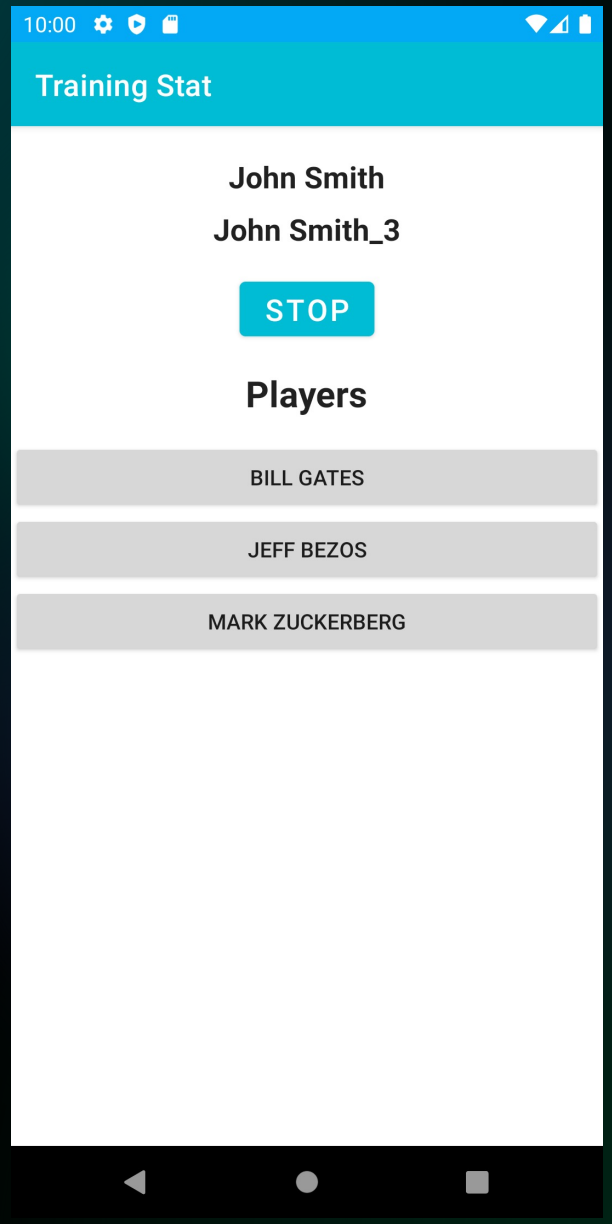


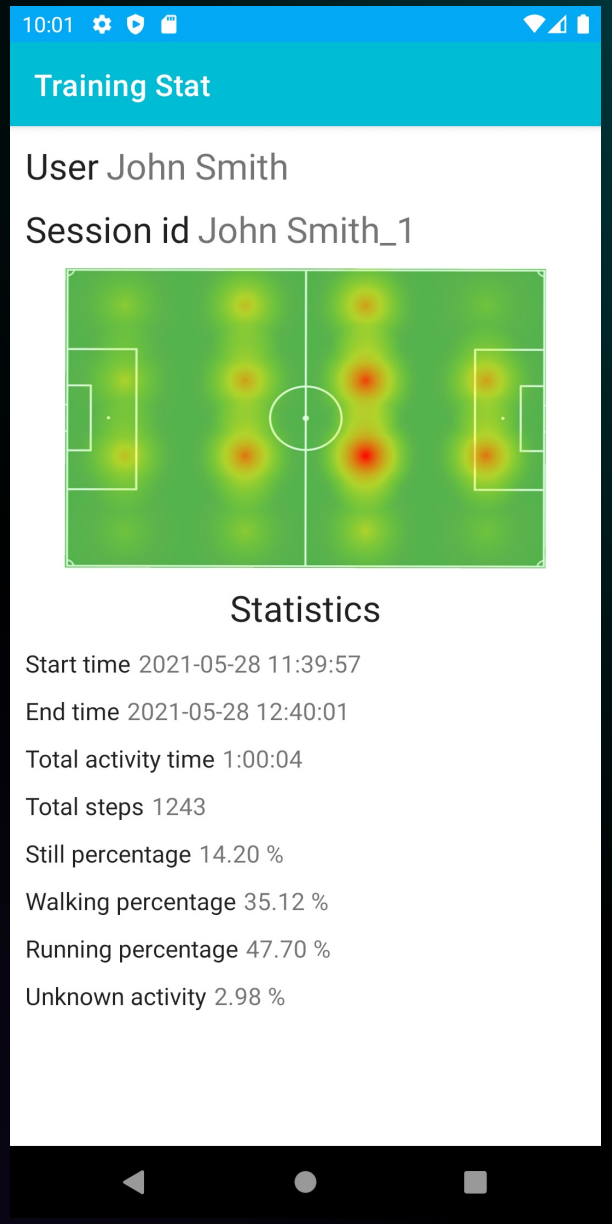
Menu

- Start an individual session
- Start a collective session as trainer
- Join a collective session as a player
- Check last sessions (started or terminated)

- Stop the session
- Check player list
- Check player result
- Check aggregate results

Trainer session

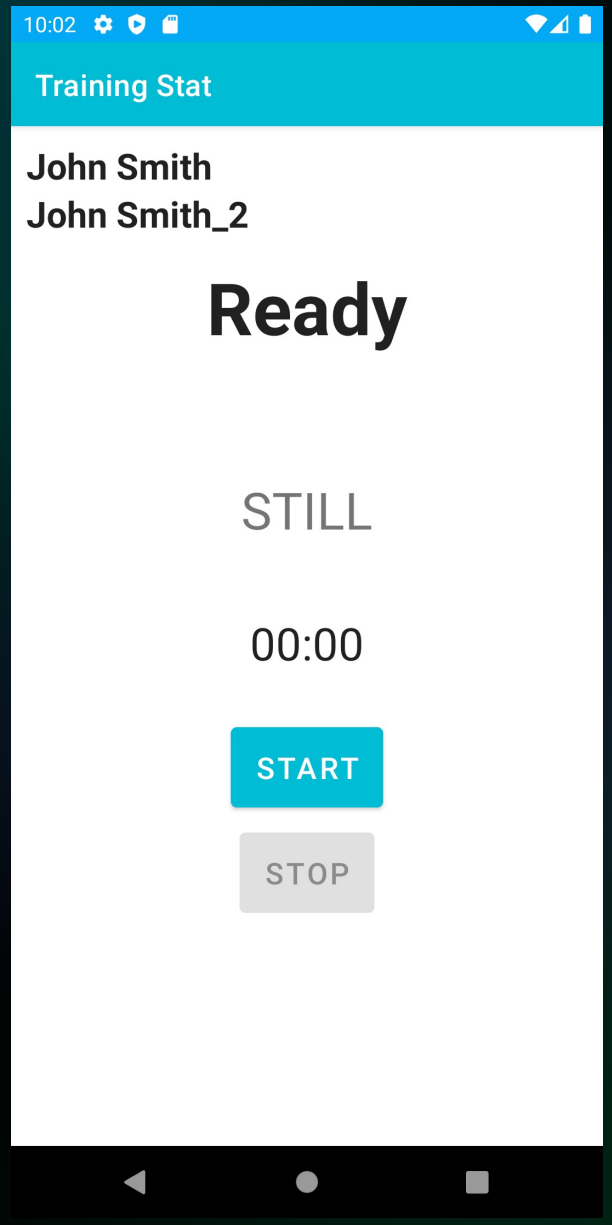




Results

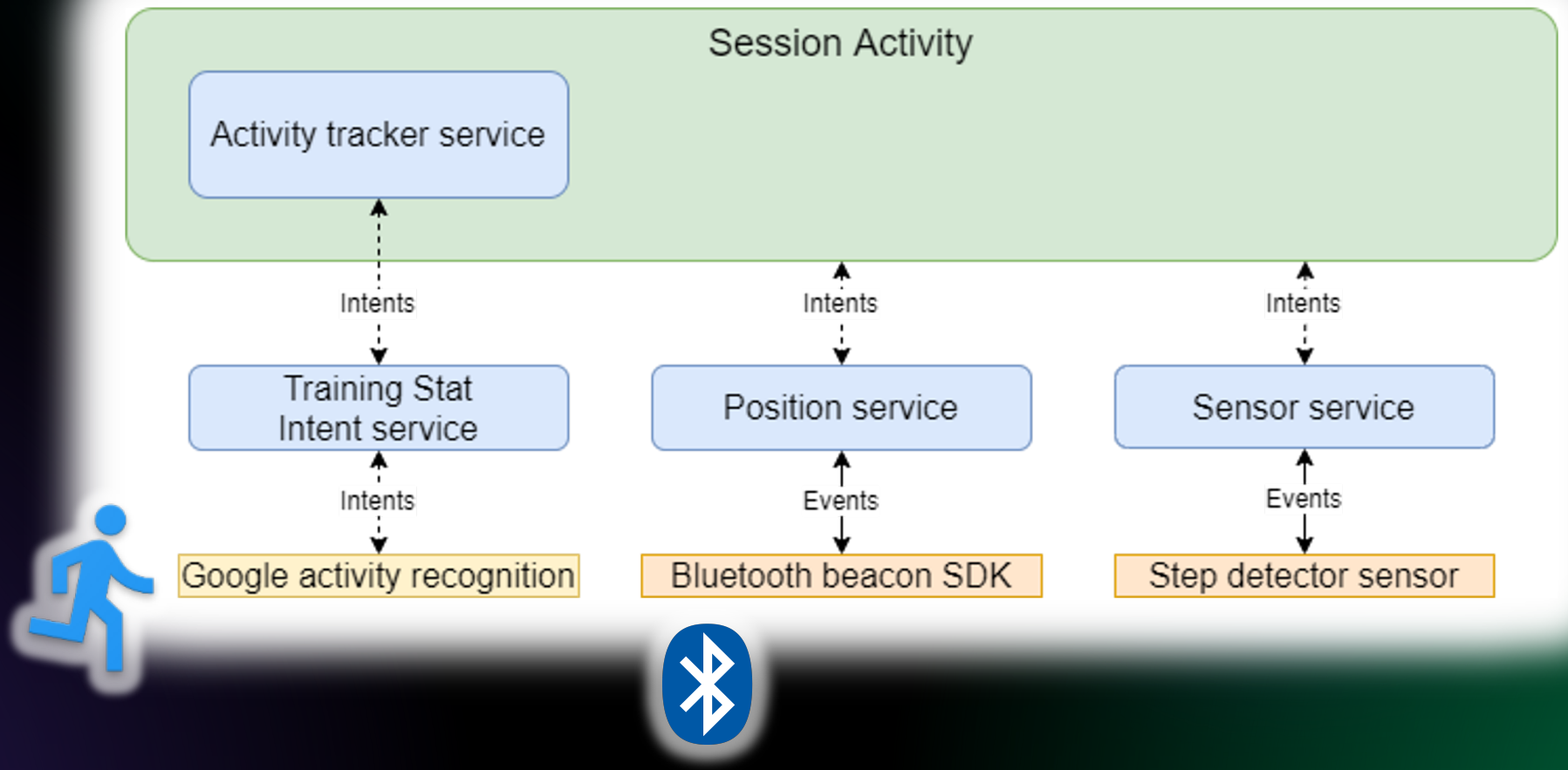
CHECK STATISTICS OF THE SESSION

Session Activity



How are data collected?

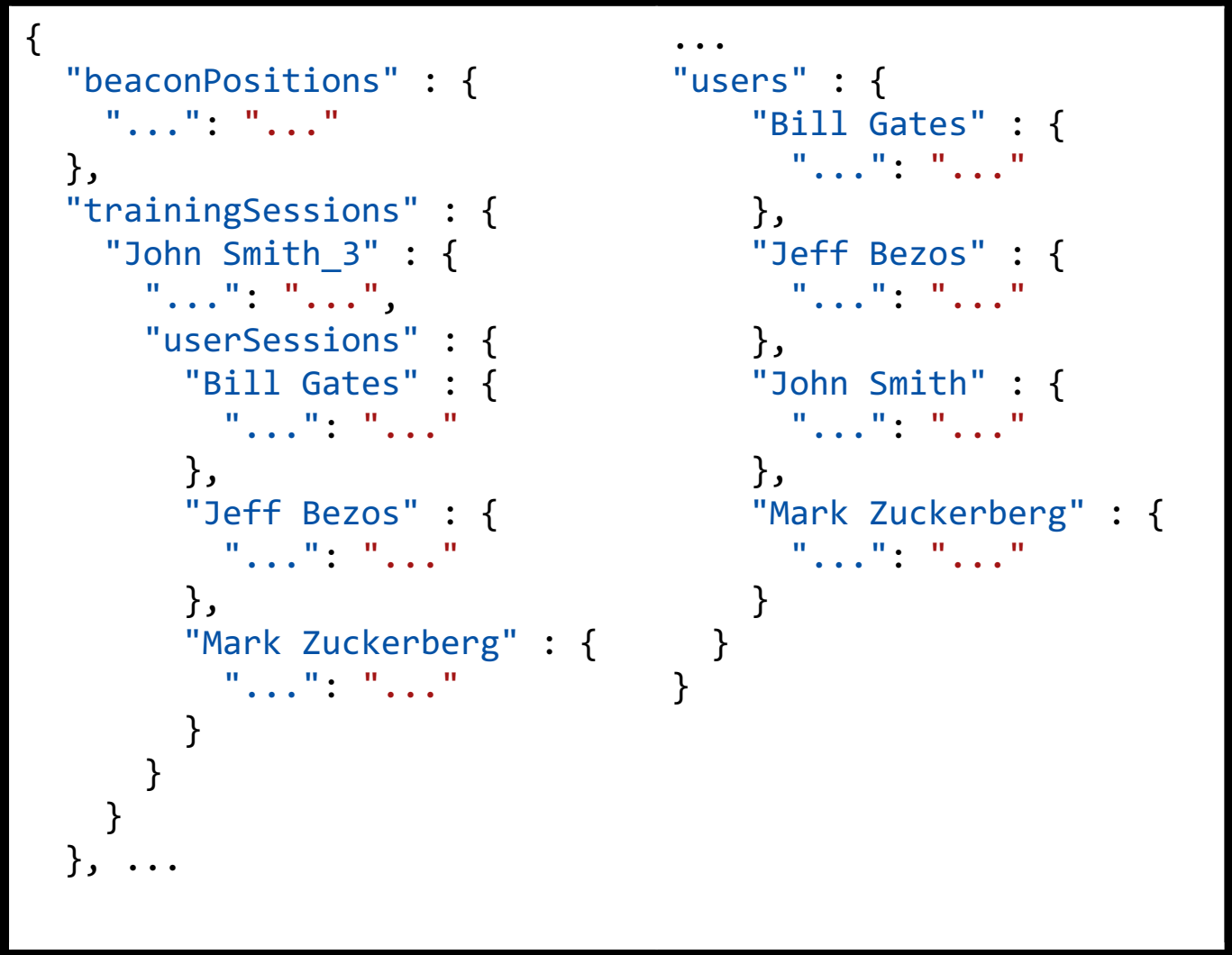
Session Activity Structure



Storing data

Firebase Realtime Database

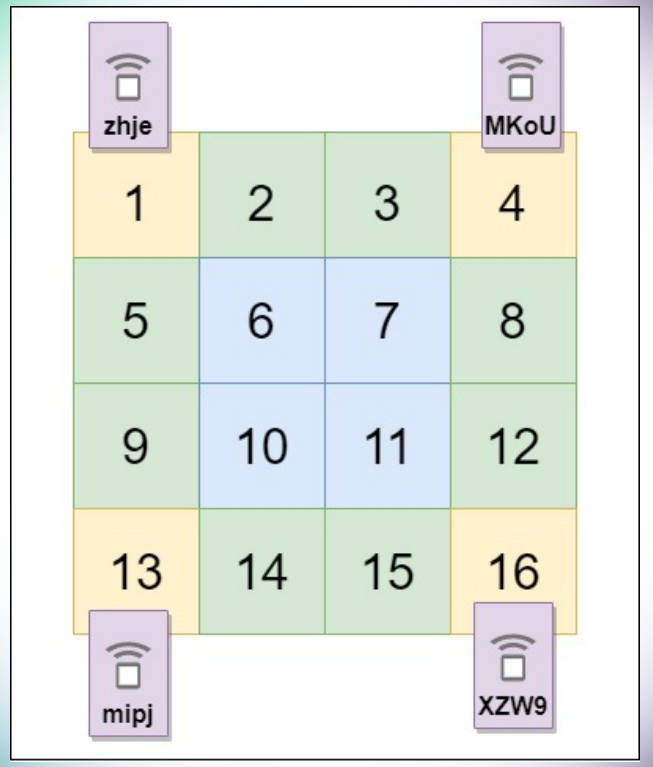
- NoSQL JSON object Database
- Realtime by Object Events



JSON structure of our database

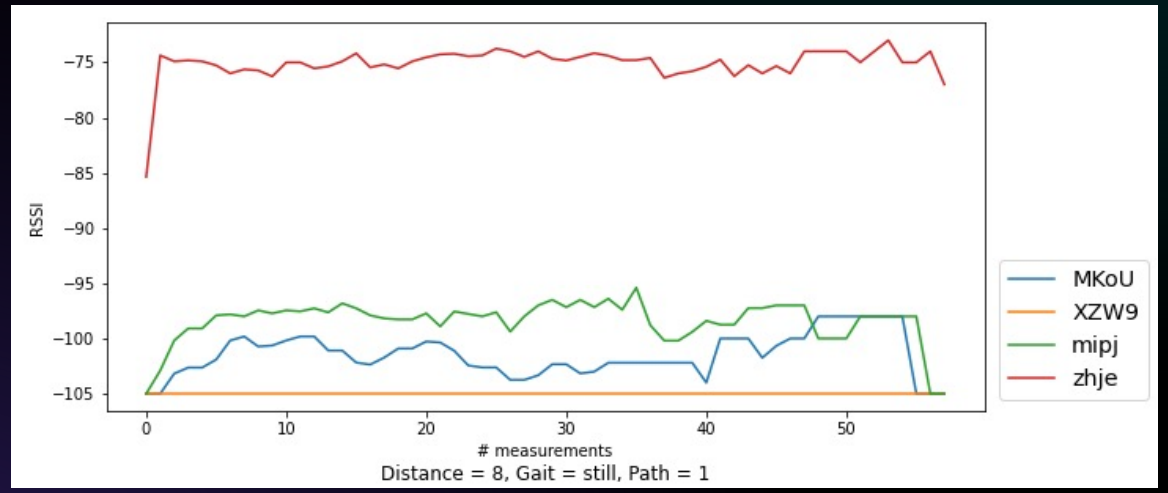
Experimental Testbed

- Distance between beacons: 8 meters
- Size of a single cell: 2m x 2m
- Type of Cells:
  - Angular (Yellow)
  - Perimetral (Green)
  - Central (Blue)

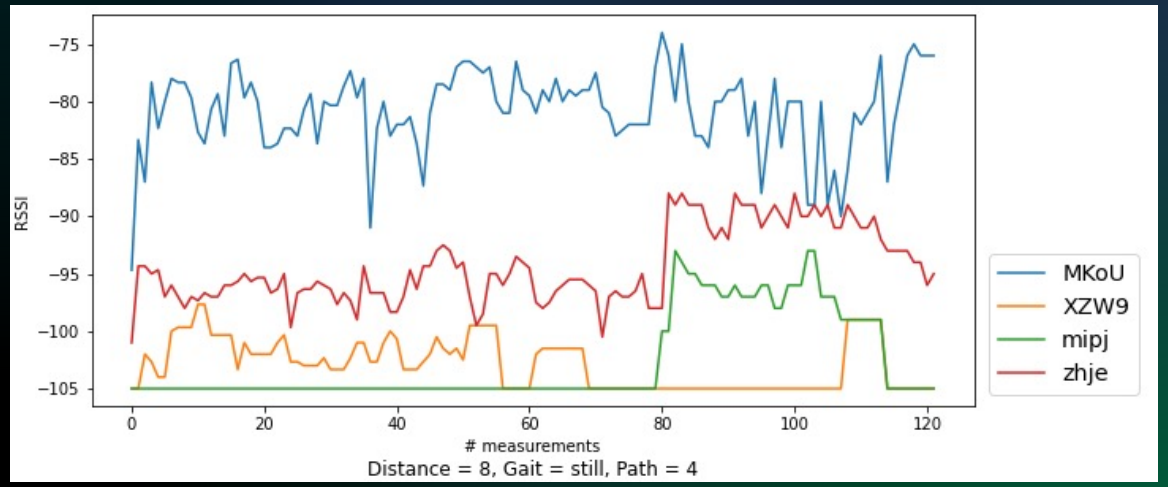


Angular Cells

- Angular Cell 1

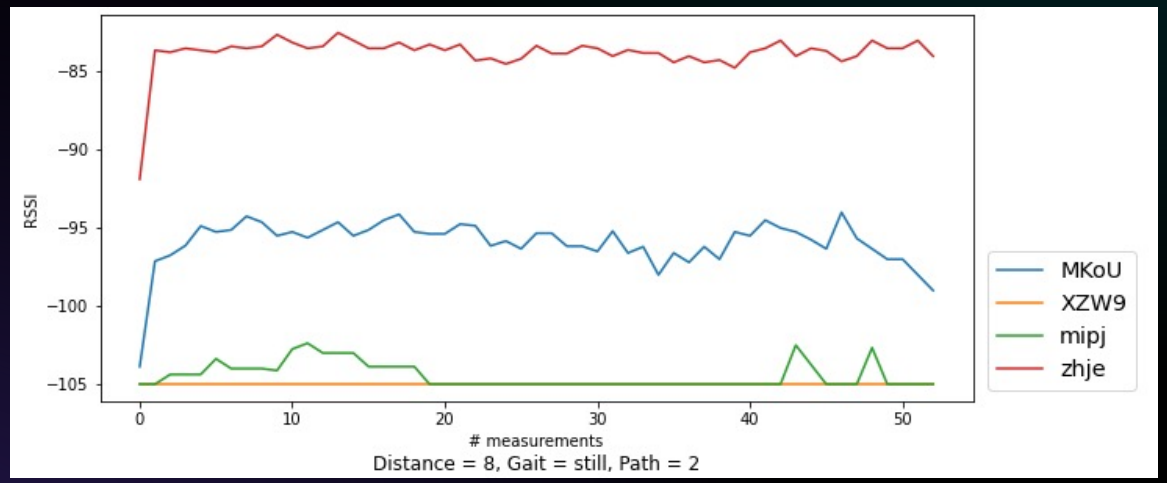


- Angular Cell 4

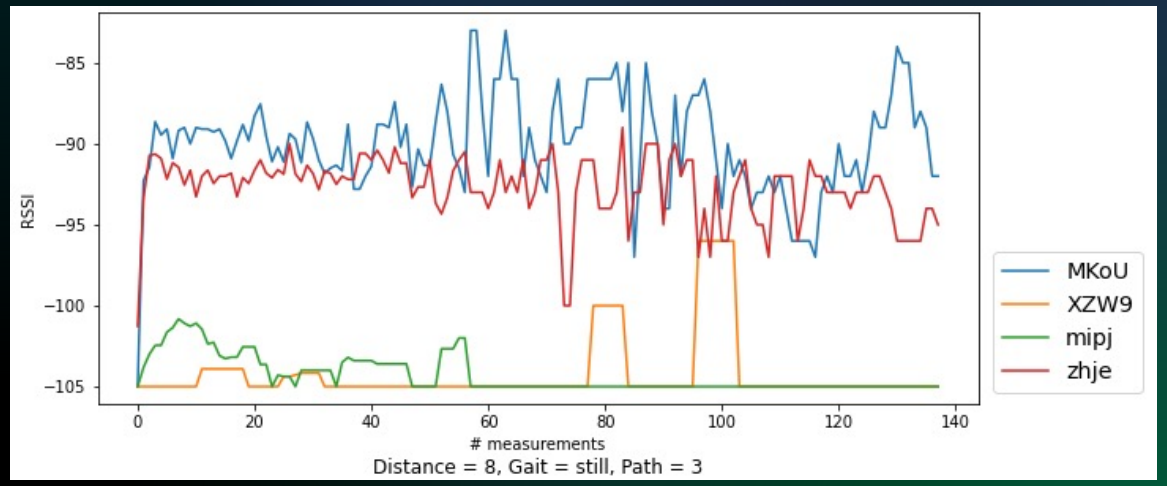


Perimetral Cells

- Perimetral Cell 2

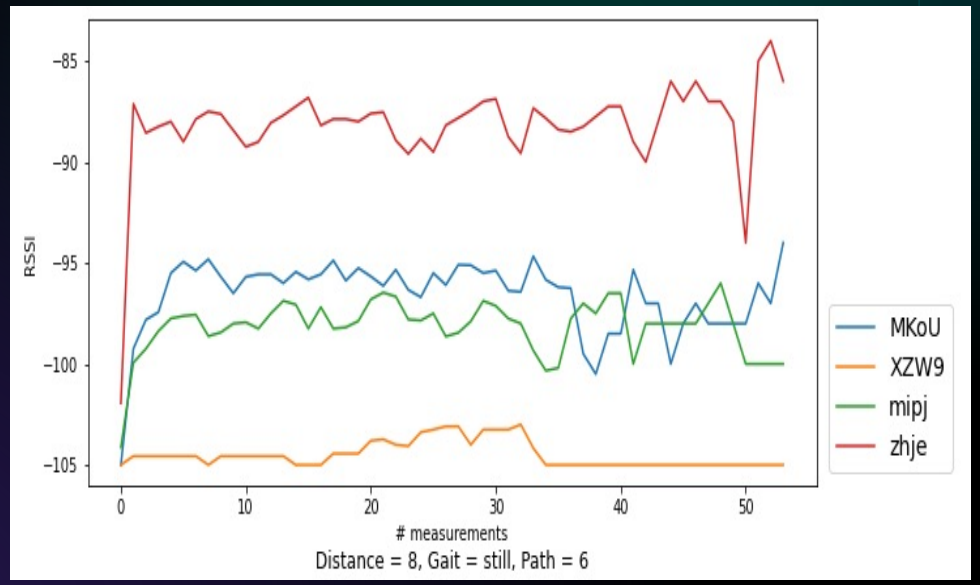


- Perimetral Cell 3

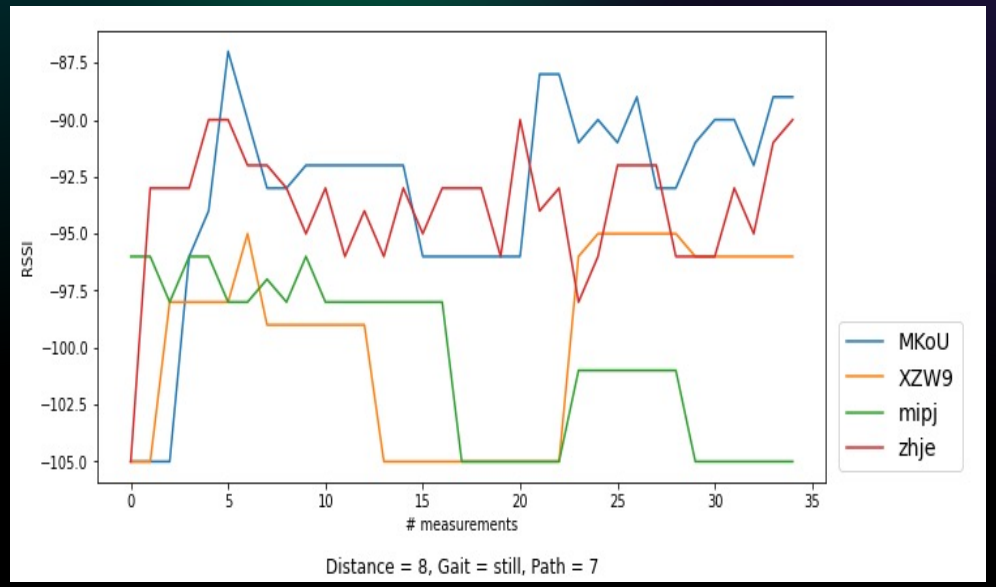


Central Cells

- Central Cell 6

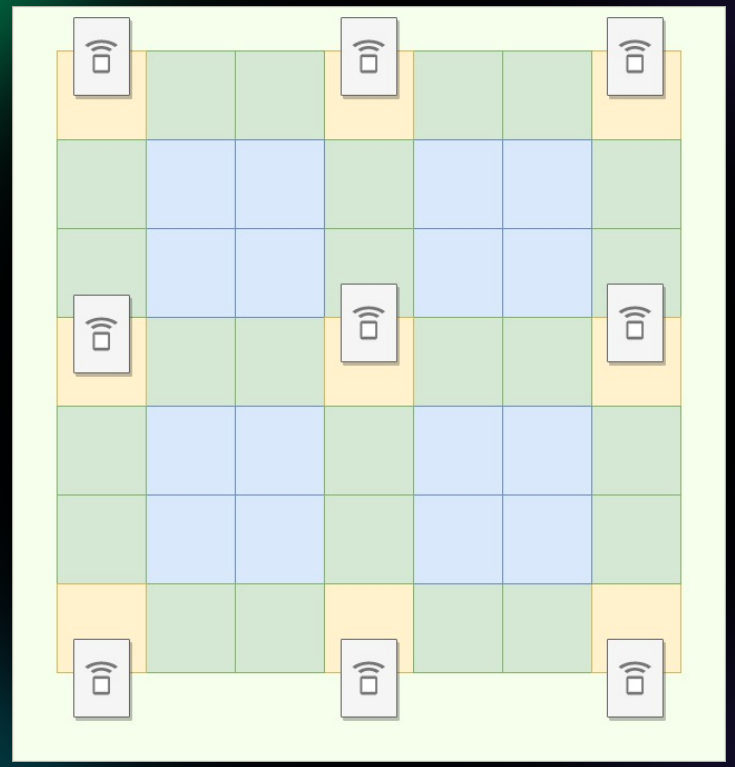


- Central Cell 7



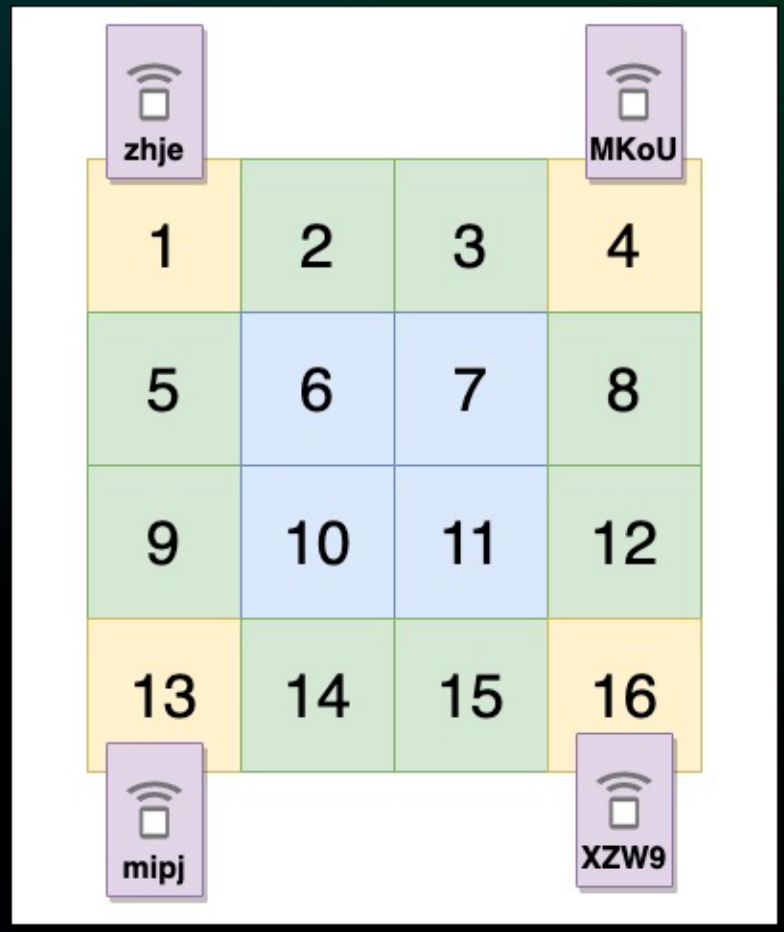
Positioning Algorithm

- The logical grid can be replicated to cover the whole field
- Beacon's positions are saved as coordinates in the DB



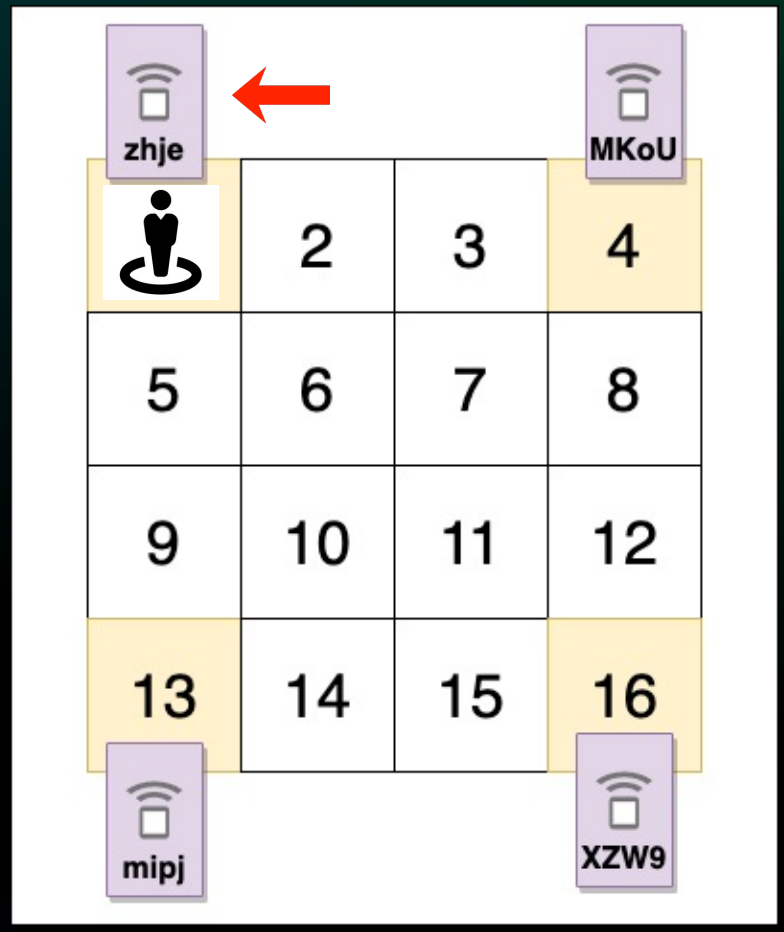
Position algorithm

- The position algorithm can be described looking to the positioning on the different types of cells:
  - Angular (Yellow)
  - Perimetral (Green)
  - Central (Blue)



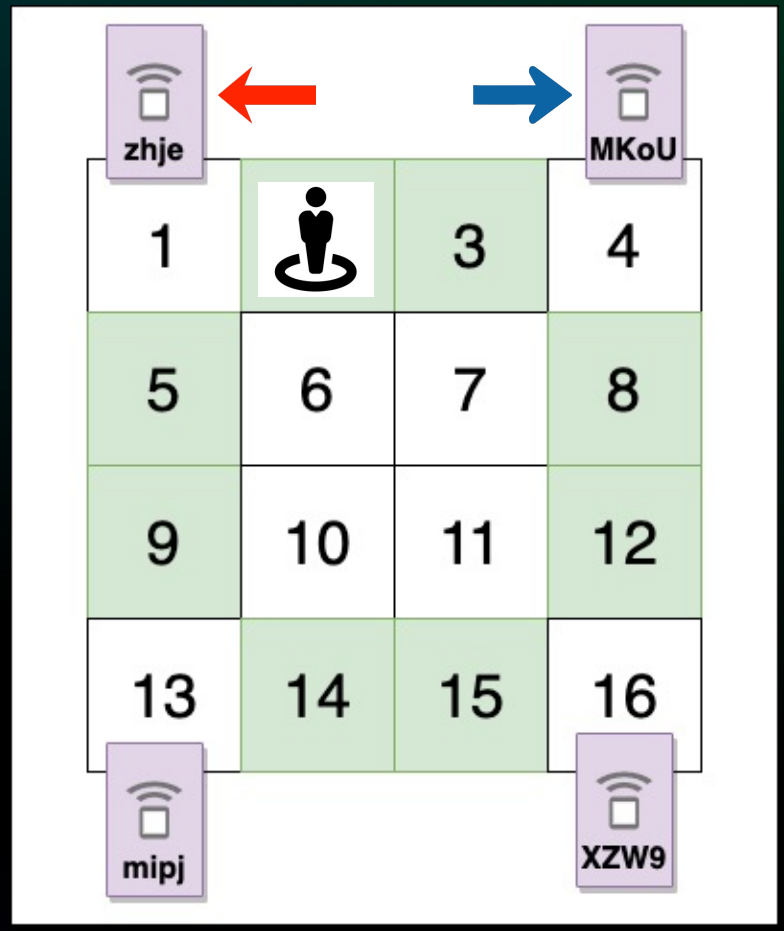
Positioning on angular cells

- Conditions:
  - number of beacons received is 1 or
  - the strongest RSSI is much stronger than the other ones
- Reason:
  - the user is very close to the beacon with highest RSSI and very far from the other ones
- Estimated coordinates:
  - the ones of the cell nearest to that beacon



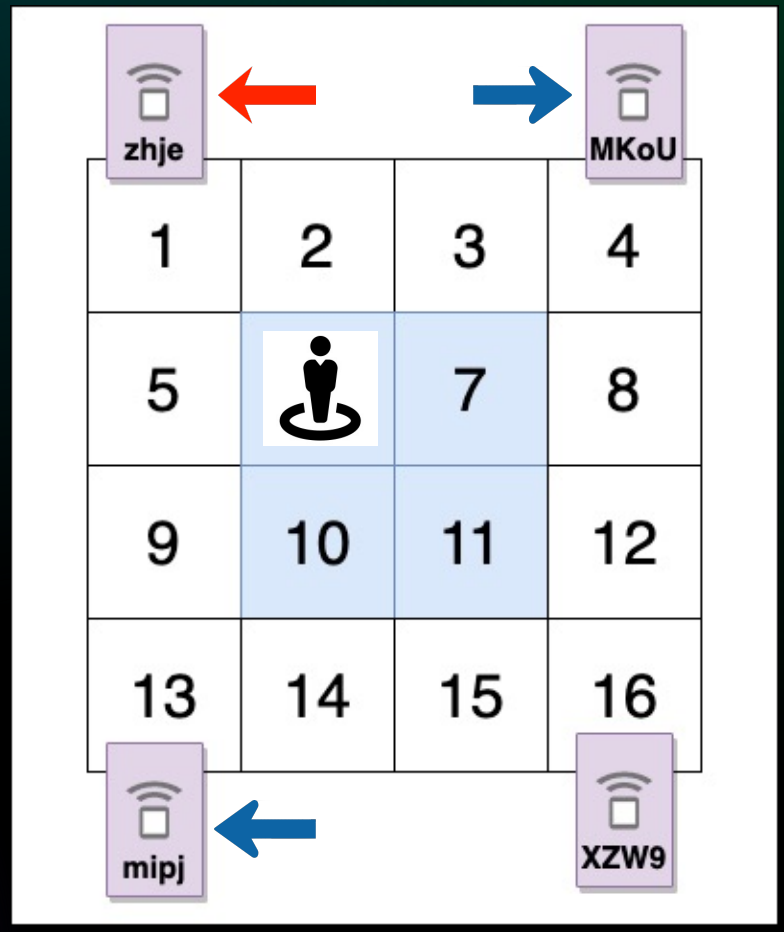
Positioning on perimetral cells

- Conditions:
  - number of beacons received is 2 or
  - the two strongest RSSI are much stronger than the other ones
- Reason:
  - the user is between the two beacons with highest RSSI and far from the other ones
- Estimated coordinates:
  - the ones of the perimetral cell in the middle of the angular cells where there are the two beacons and nearest to the cell of the beacon with strongest RSSI



Positioning on central cells

- Conditions:
  - number of beacons received is more than 2 and
  - the three strongest RSSI are similar
- Reason:
  - the user is at the center of the grid
- Estimated coordinates:
  - the ones of the central cell nearest to the cell of the beacon with strongest RSSI



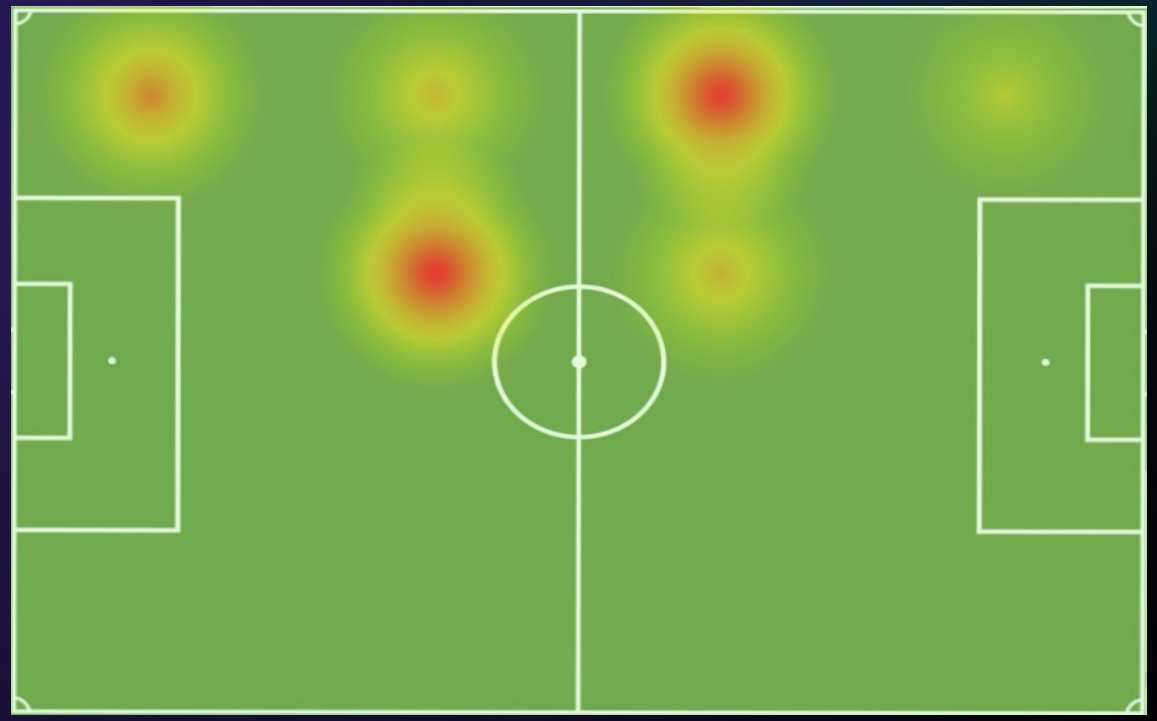
Results

Cell type	Accuracy	Error distance	Error
Angular	78,87624615	1,277979458	2,555958917
Perimetral	64,05286231	1,036176179	2,072352358
Central	66,15277062	1,063404895	2,126809789

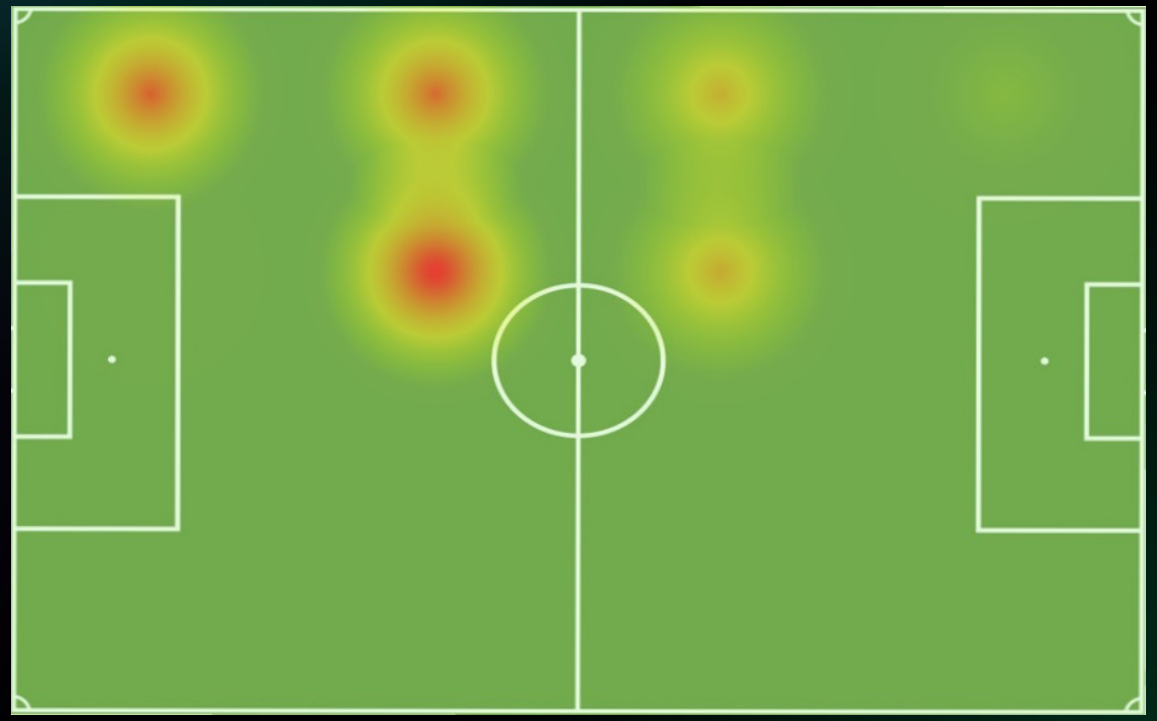
- 4 beacons at the angles of a 8m x 8m square
- Accuracy is not high
- On wrong estimations the estimated cell is adjacent to the correct one
- For high precision measurements the system is not good, but for Training Stat application we need position only to build an heatmap

Results

REAL HEATMAP



ESTIMATED HEATMAP



Conclusion

- The accuracy of the position estimation algorithm is not great compared to professional solutions but considering the overall price range we believe it to be a valuable low-cost tool in many circumstances in which strict precision is not required
- The main issue limiting the effectiveness of our solution is the unreliability of BLE (Bluetooth Low Energy) signal with respect to obstacles: e.g., other players between the line of sight, the orientation of the player with respect to each beacon
- A possible extension on this work may be looking into different signaling technologies in order to guarantee a clearer distinction between different cells, and possibly obtain a greater precision
- A more extensive set of statistics should also be considered


The End