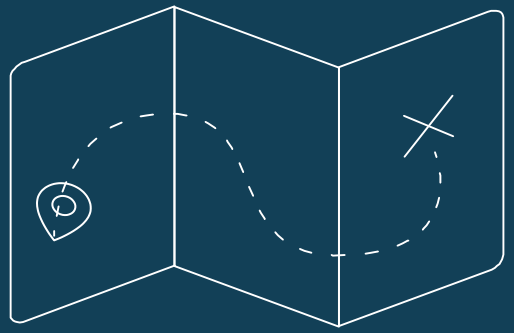
National Institute of Technology Warangal | Department of Computer Science and Engineering



Scalable Indoor Positioning System Driven By User Feedback

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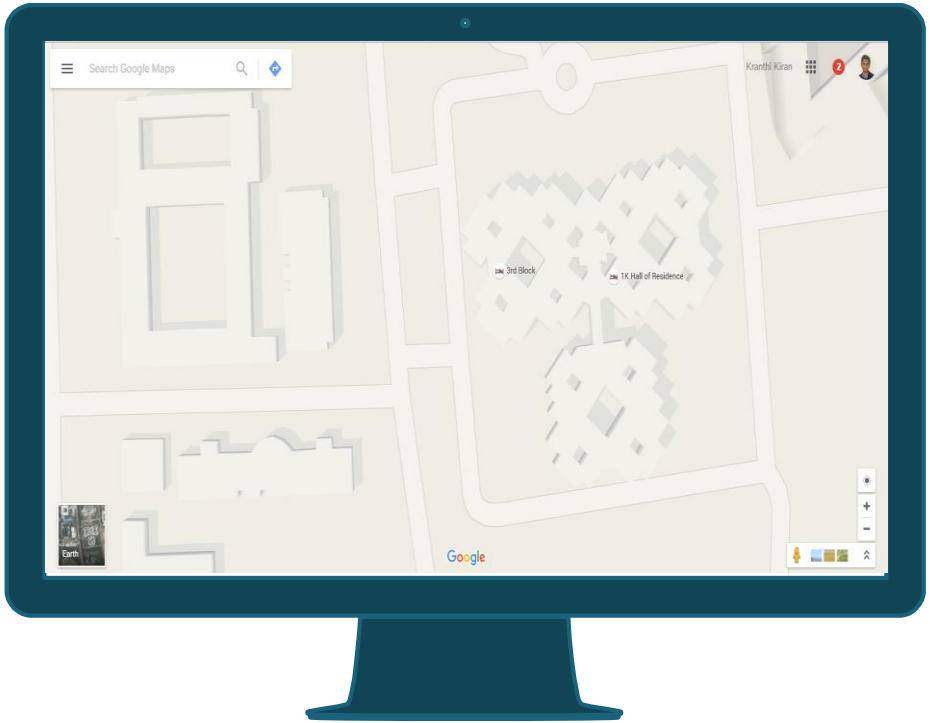
Problem Statement

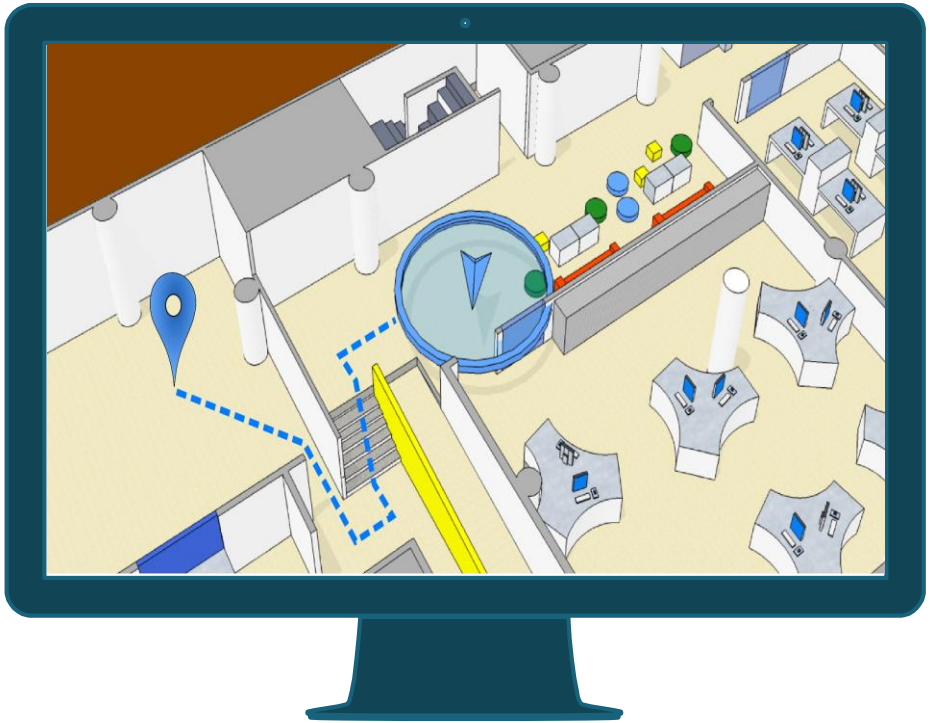
What are we solving?

What are we missing here?



What are we missing here?

Indoor Positioning and Navigation system



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Background Research

An overview of Research Papers we referred

Background Research

Analysis of 3 indoor localization techniques

Has given a comparison of WLAN (Wireless Local Area Network), RFID (Radio Frequency Identification tags) and IMU (Inertial Measurements Units) based approaches

Indoor WiFi Positioning System for Android Phone

Has given a flow – chart for the algorithm they have devised for android application.

Background Research

Enhancing WiFi fingerprinting for indoor positioning using feedback

Presented about the usage of Gaussian function in position determination and integration of the model with User Feedback

Location determination using WiFi fingerprinting versus WiFi trilateration

Presented an overview of Euclidean distance usage in fingerprinting

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Modelling

Solutions that we have modelled

Wi – Fi fingerprinting

- Training phase
- Captures RSSI tuples from all AP's at a chosen index point
- Schema for training data (Index Id, MAC, RSSI, Scan Id)

Wi – Fi fingerprinting

- Positioning phase
- kNN algorithm (k=1) is used
- Eucildean, Manhattan distances are used for distance calculation

$$Eucildean\ Distance = \sqrt{\sum_{i=1}^{n}(x_i - m_i)^2}$$

$$Manhattan\ Distance = \sum_{i=1}^{n}(x_i - m_i)$$

$$Weighted\ Eucildean\ Distance = \sqrt{\sum_{i=1}^{n} c_i(x_i - m_i)^2\ /C}$$

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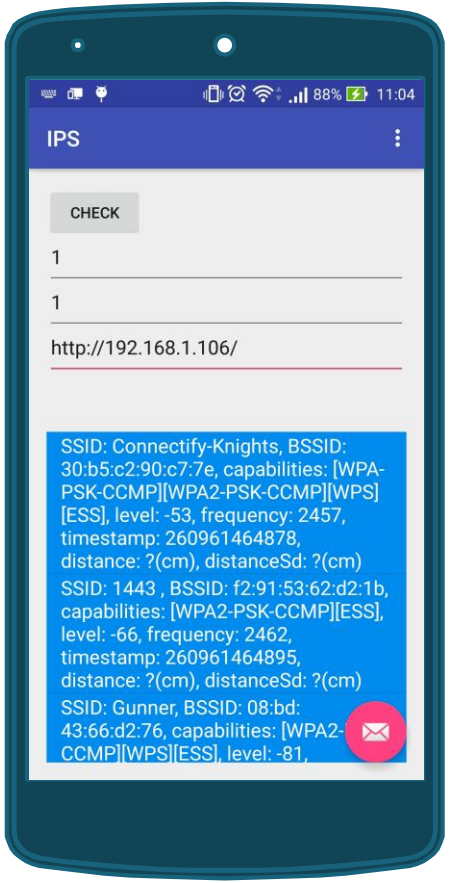
Implementation

Let's get started with implementation

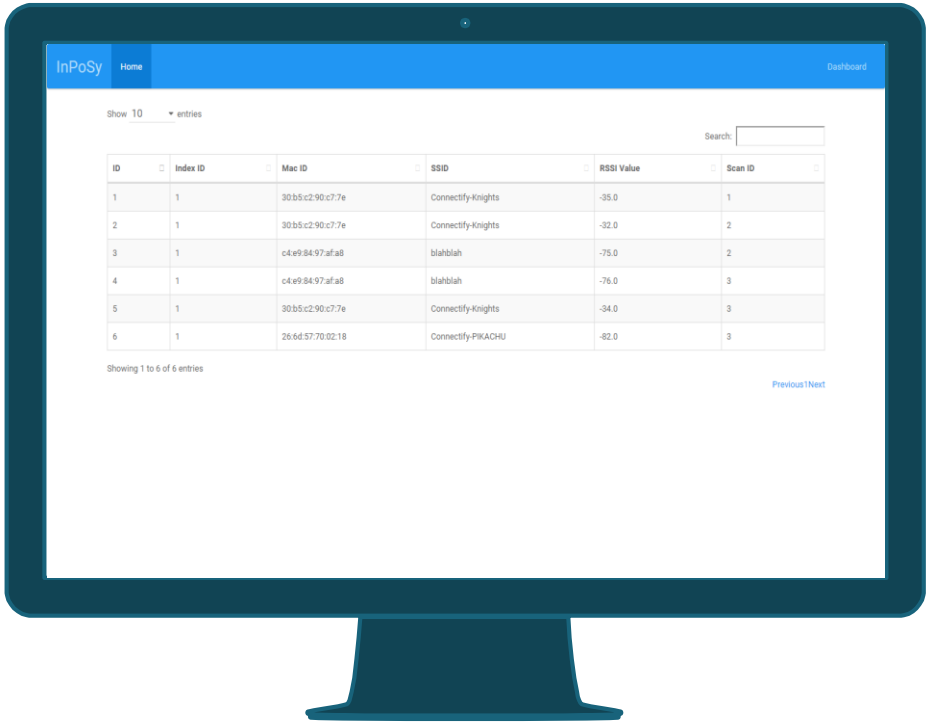
Trainer Application for android

Capture RSSI tuple at an index point which is sent to an RMA which stores the tuple in a training dataset



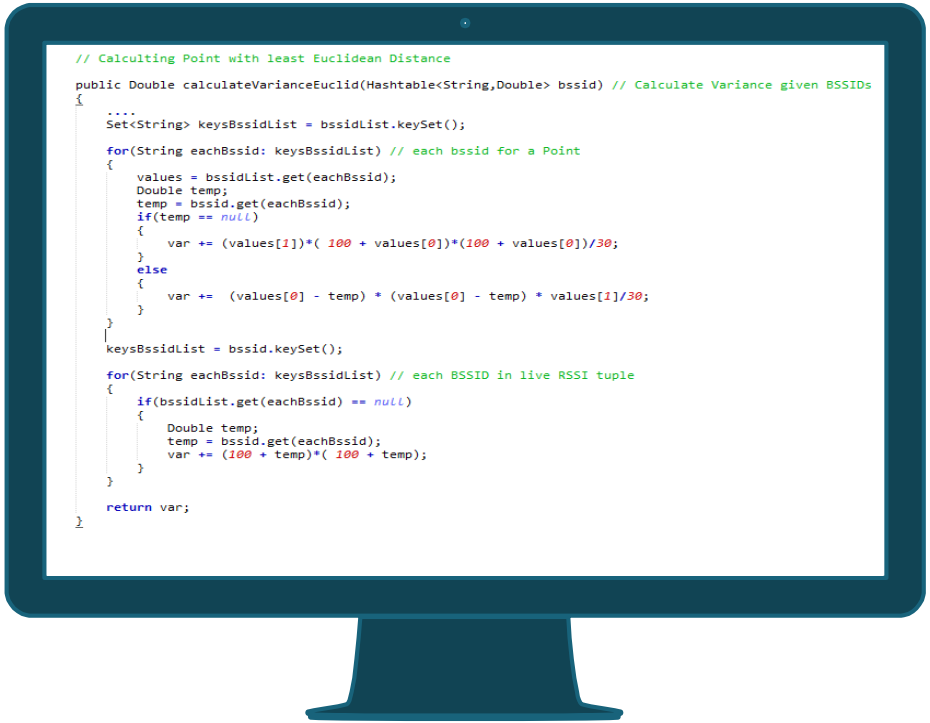
Remote Monitoring Application

Receives tuple from Trainer Application which is stored and displayed using a Django web server



Core Algorithm implementation

Java code snippet that we have modelled for weighted Euclidean distance approach



```
// Calculting Point with least Euclidean Distance

public Double calculateVarianceEuclid(Hashtable<String,Double> bssid) // Calculate Variance given BSSIDs
{
    ....
    Set<String> keysBssidList = bssidList.keySet();

    for(String eachBssid: keysBssidList) // each bssid for a Point
    {
        values = bssidList.get(eachBssid);
        Double temp;
        temp = bssid.get(eachBssid);
        if(temp == null)
        {
            var += (values[1])*( 100 + values[0])*(100 + values[0])/30;
        }
        else
        {
            var +=  (values[0] - temp) * (values[0] - temp) * values[1]/30;
        }
    }
    keysBssidList = bssid.keySet();

    for(String eachBssid: keysBssidList) // each BSSID in live RSSI tuple
    {
        if(bssidList.get(eachBssid) == null)
        {
            Double temp;
            temp = bssid.get(eachBssid);
            var += (100 + temp)*( 100 + temp);
        }
    }

    return var;
}
```

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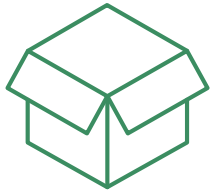
Lines of Java code



10+

Opensource tools and packages

42%

Accuracy for the system!

Technologies involved

Eclipse is an IDE for Java developers for developing Java applications using Core Java. We have implemented InPoSy Core algorithms using this

Android Studio v1.5 is an IDE for developing android mobile application. We have implemented InPoSy Trainer App using this

Technologies involved

Django is an ORM based python web framework, used to implement InPoSy Remote Monitoring Server

MySQL is a database management system used to cater database storage needs for InPoSy in coordination with InPoSy RMA and Trainer App

Technologies involved

Bootstrap

Bootstrap is a CSS framework used to cater frontend user interface(UI) design needs for InPoSy RMA

ANGULARJS by Google

AngularJS is a Javascript library used to cater frontend user interaction (UI/UX) needs for InPoSy RMA and mobile application

Technologies involved

Git is a widely used VCS for software development. It is a distributed VCS with an emphasis on support for distributed, non-linear workflows

GitLab is a web-based Git repository manager with wiki and issue tracking features

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Conclusion

So, what we found out is?

Comparison of results obtained

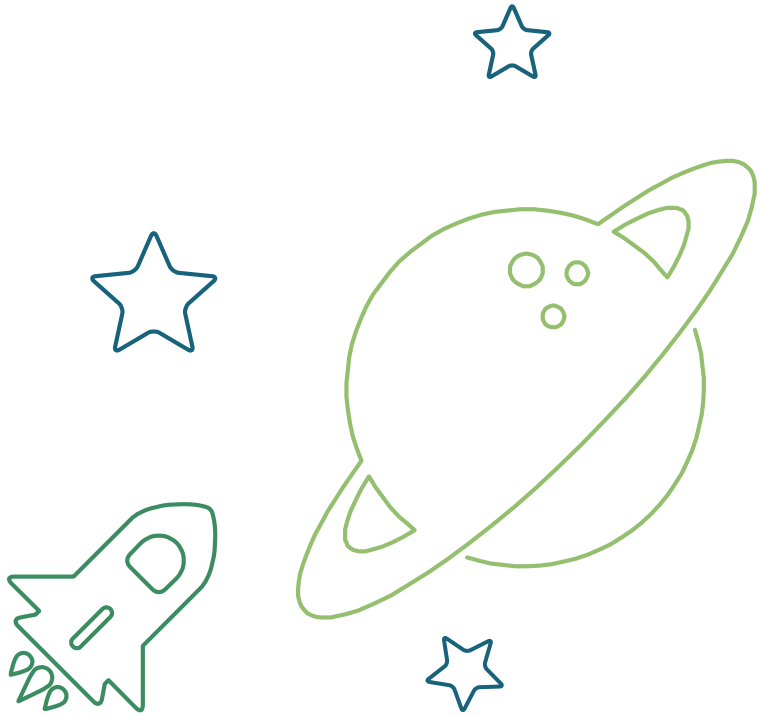
Distance Used	Points Matched	Percentage of Accuracy
Weighted Manhattan	3028	6%
Euclidean	16025	32%
Weighted Euclidean*	20718	42%

Comparison of results obtained

Our algorithm has achieved 10% higher accuracy compared to normal Euclidean approach

Future Work

What we will do next?



Future work

Optimize algorithms

Improve the accuracy of existing system

User Feedback

Integrate user feedback to the client application to improve the performance of system over time

Client Application

Android client application which will have a Graphical user interface of real time position display obtained from RMA

THANK YOU!

Any questions?