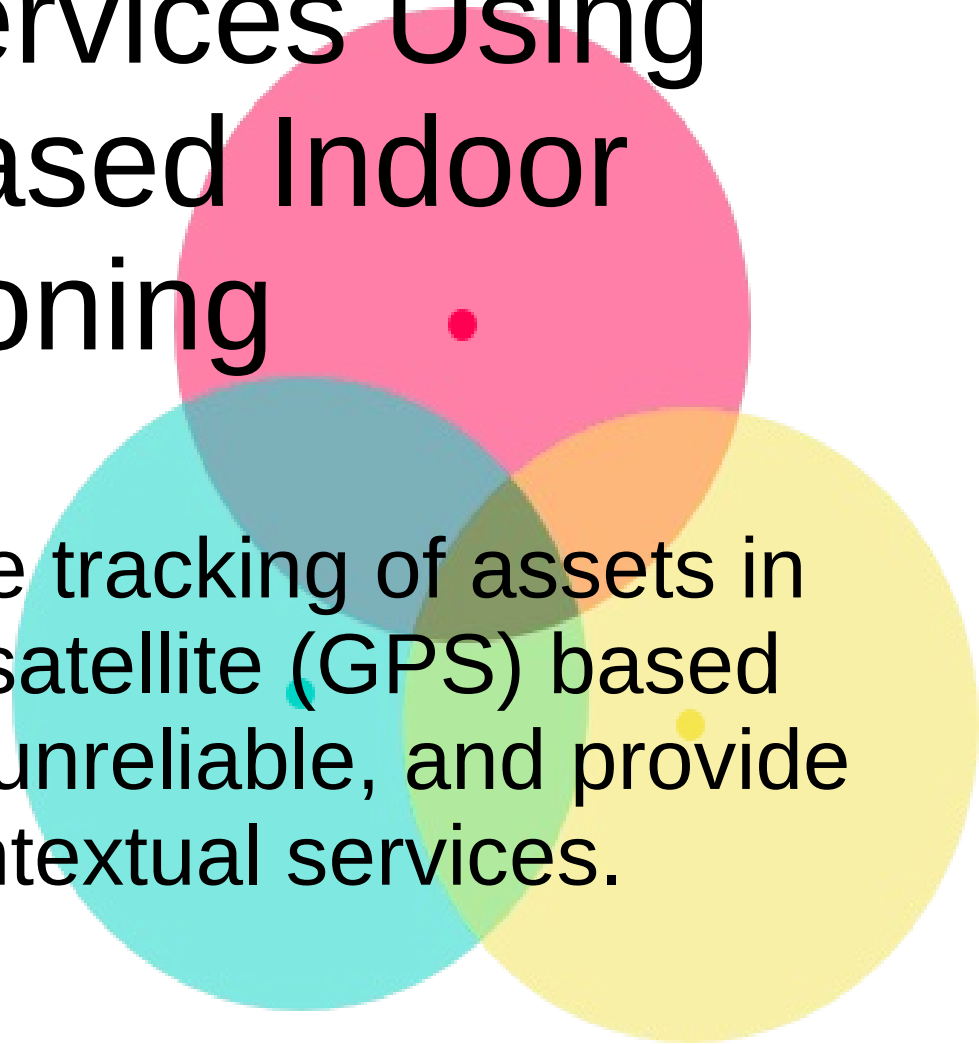
- BLIP -
Asset Tracking & Location Based Contextual Services Using Bluetooth Based Indoor Positioning



Solution for the effective tracking of assets in indoor spaces, where satellite (GPS) based positioning systems are unreliable, and provide location based contextual services.

Components

- User Wearable / Android Device
- Stationary Broadcasting Beacons
- Backend
- Realtime Database

Summary

- ***Objective***: To provide asset tracking and give location based contextual information to it similar to a scene in the movie "The Time Machine (2002)" (https://www.youtube.com/watch?v=CQbkhYg2DzM)
- ***Process***: We started with this idea and implemented a Minimum Viable Product app that acted as a Proof Of Concept for our idea during the *offline hackathon that took place at SAP Labs Gurgaon.* Further, we created a *Demo in our University Library's reception area by installing the beacons at specific locations and mapping the area and set certain images to pop up when* you are at a certain location.
- ***Outcome***: An app that relays RSSI values to a Realtime Database, queries the realtime database for it's calculated position and receives contextual information (currently an image) relating to its position inside the building where beacons have been setup.

How We Do It

- Bluetooth (IEEE 802.15.1) is a wireless technology standard for exchanging data over short distances (using short-wavelength UHF radio waves in the ISM band from 2.4 to 2.485 GHz) from fixed and mobile devices.

How We Do It

- Attenuation is the gradual loss in intensity of any kind of flux through a medium such as dark glasses attenuating sunlight, lead attenuating X-rays .
- Attenuation in electromagnetic waves is proportional to the square of the distance between the transmitter and receiver, and also proportional to the square of the frequency of the radio signal.

How We Do It

- To put it simply without the complicated math, Electromagnetic signals such as bluetooth and WiFi that lie in the 2.4 to 2.485 GHz band attenuate quiet rapidly over typical indoor infrastructure measures , allowing us to effectively use their attenuation b/w the transmitter and reciever (Transmitted power – Recieved Power) as an effective measure of the lenght of the path between them.

A Bit Of Mathematics.

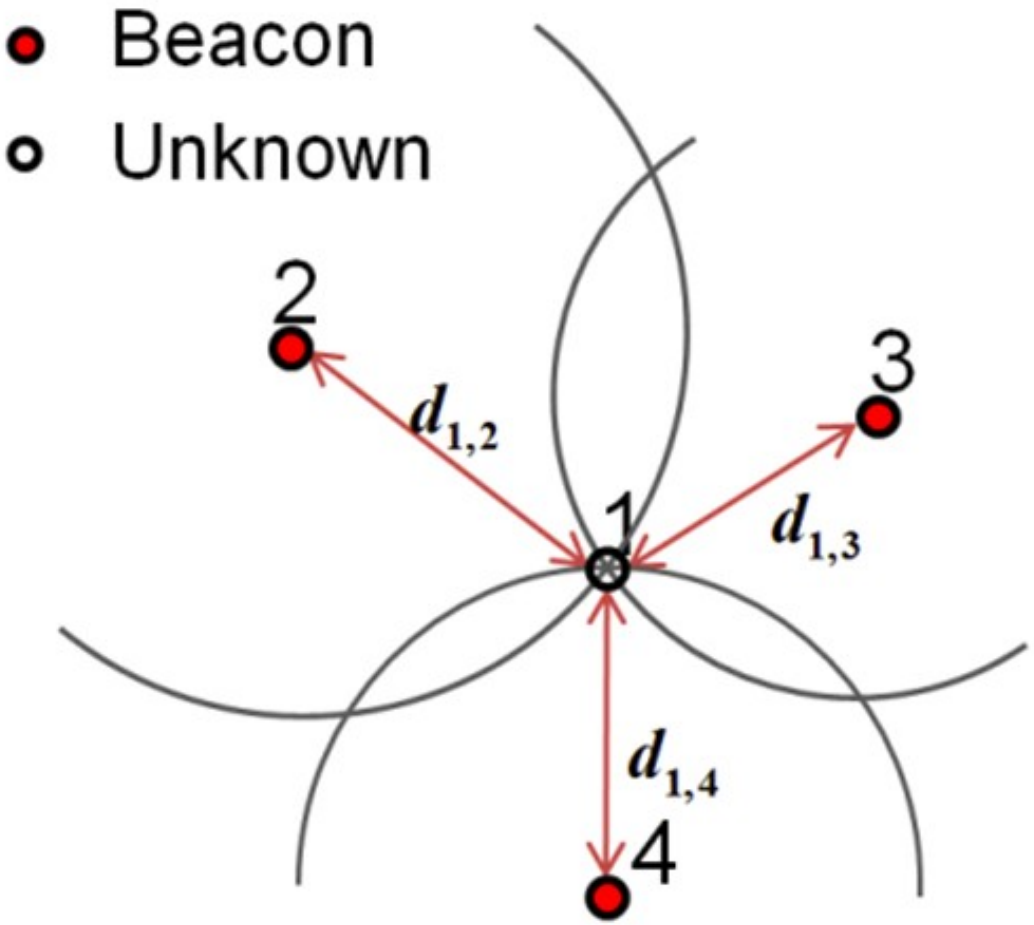
- The Free-Space (LOS) Path Loss between a transmitter and reciever is mathematically given by :-

$$\mathrm{FSPL(dB)} = 10 \log_{10} \left(\left(\frac{4\pi}{c} df \right)^2 \right)$$

- Where, d is the distance
- f is the frequency of the transmitted signal
- c is the speed of light

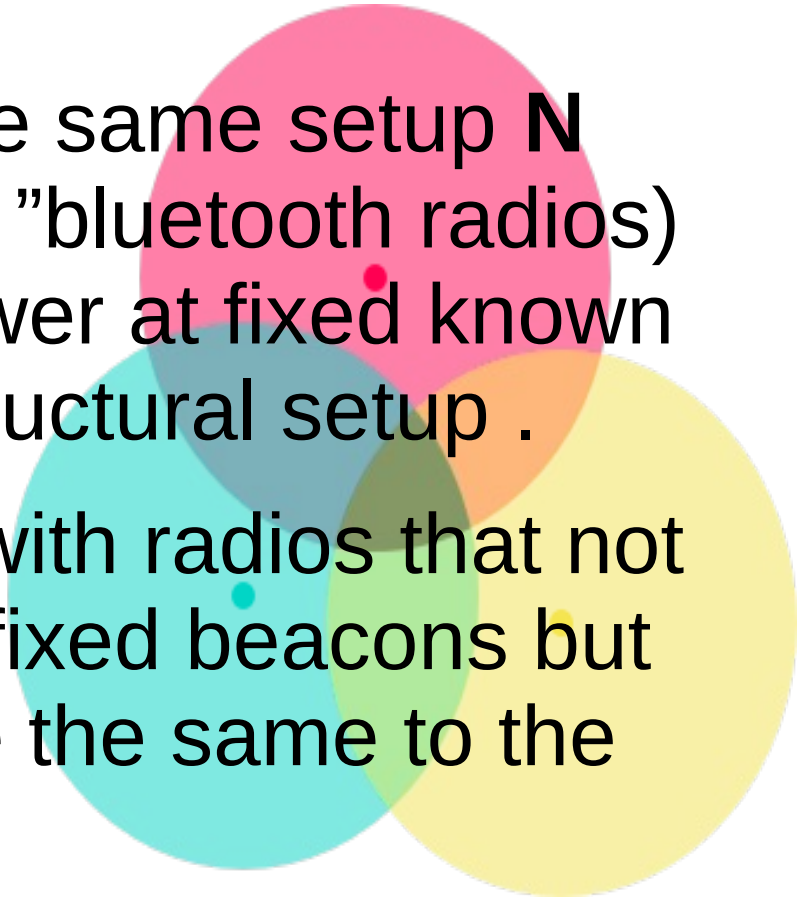
How We Do It

- In order to estimate the asset's position in a given plane, it is geometrically trivial that one needs atleast 3 known points and 3 associated distances.



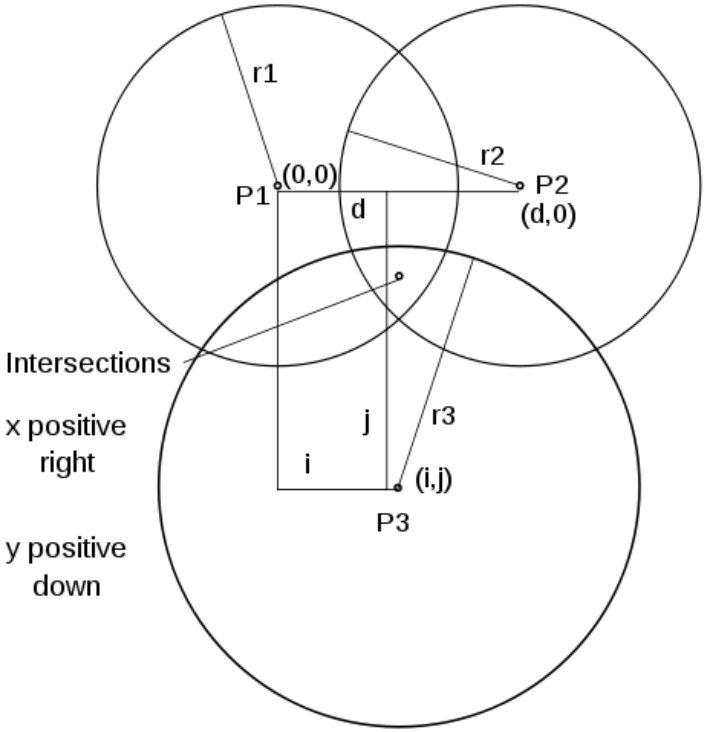
How We Do It

- We in order to implement the same setup **N bluetooth beacons**(“visible ”bluetooth radios) that transmit at constant power at fixed known loacations inside our infrastructural setup .
- Our asset will be equipped with radios that not only allow it to sense these fixed beacons but also allow it to communicate the same to the cloud.



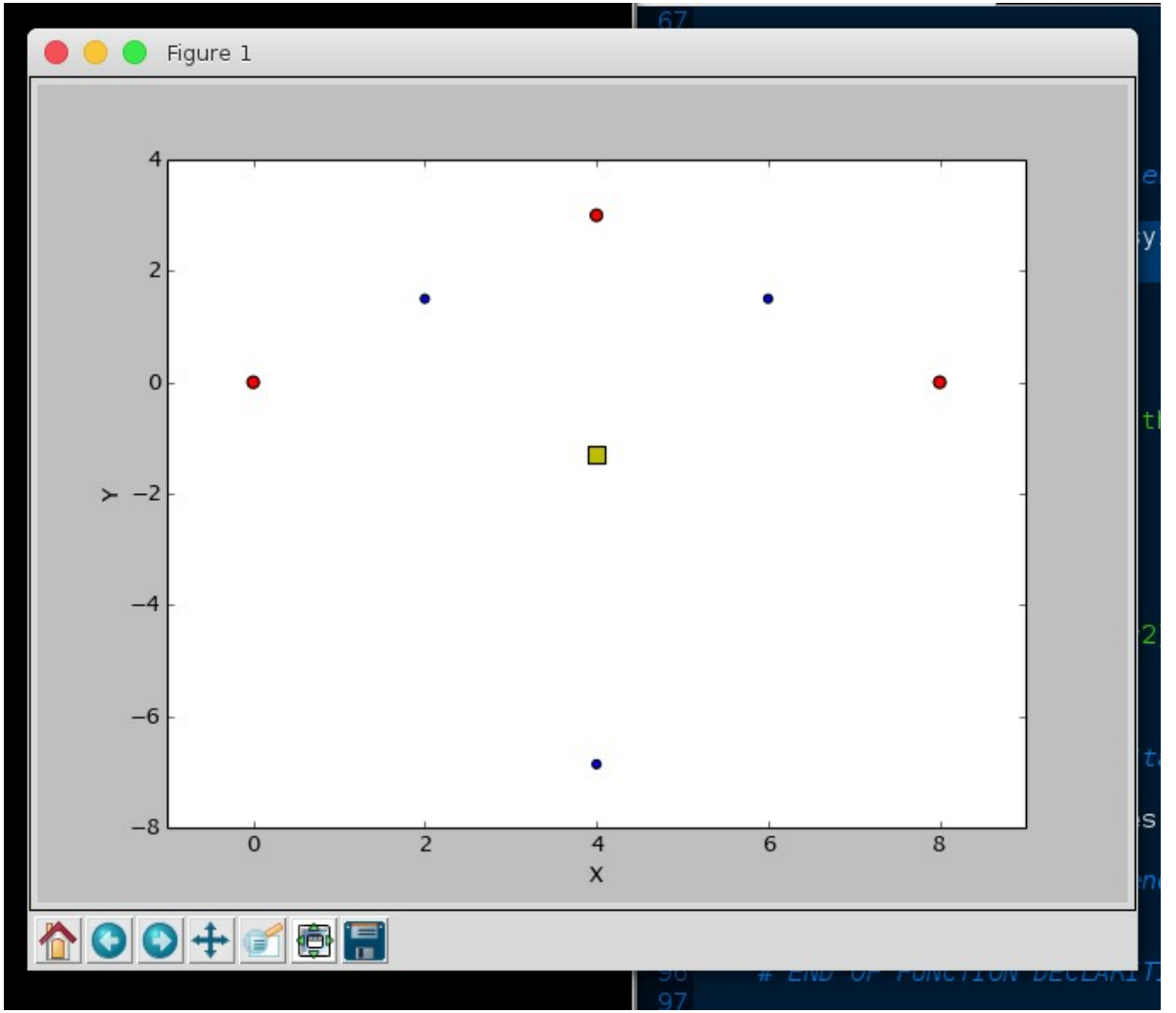
How We Do It

- The distances measured from the fixed beacons are much like finding the points of intersections of circles, used to find potential positions of the asset using all **N** beacons in a revised implementation of the traditional trilateration algorithm made suitable for the current situation.



How We Do It

- The collection of potential points of the asset generated using the above method are fed into a specalised clustering algorithm that returns the most probable location relative to the fixed beacons.



Other Applications

- Tracking assets like cars in parking lots and providing them context based info.
- Customer tracking inside shopping complexes.
- Realtime personal walkthrougs/tours of large buildings/complexes.

Thanks