



Presentation by >>

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Smart Guide: A smart campus guide using BLE based indoor localization

INTRODUCTION

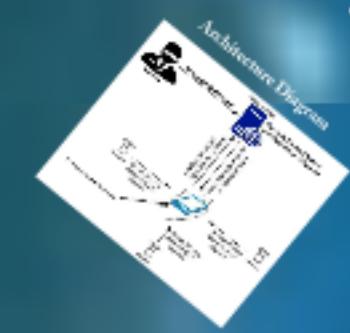
Overview

Predict room level location using BLE beacons.

RSSI fingerprinting technique.

Information of current and its nearby locations on user's mobile app.

To provide guided tour of the indoor building (CSE Dept of UET).



Problem Statement



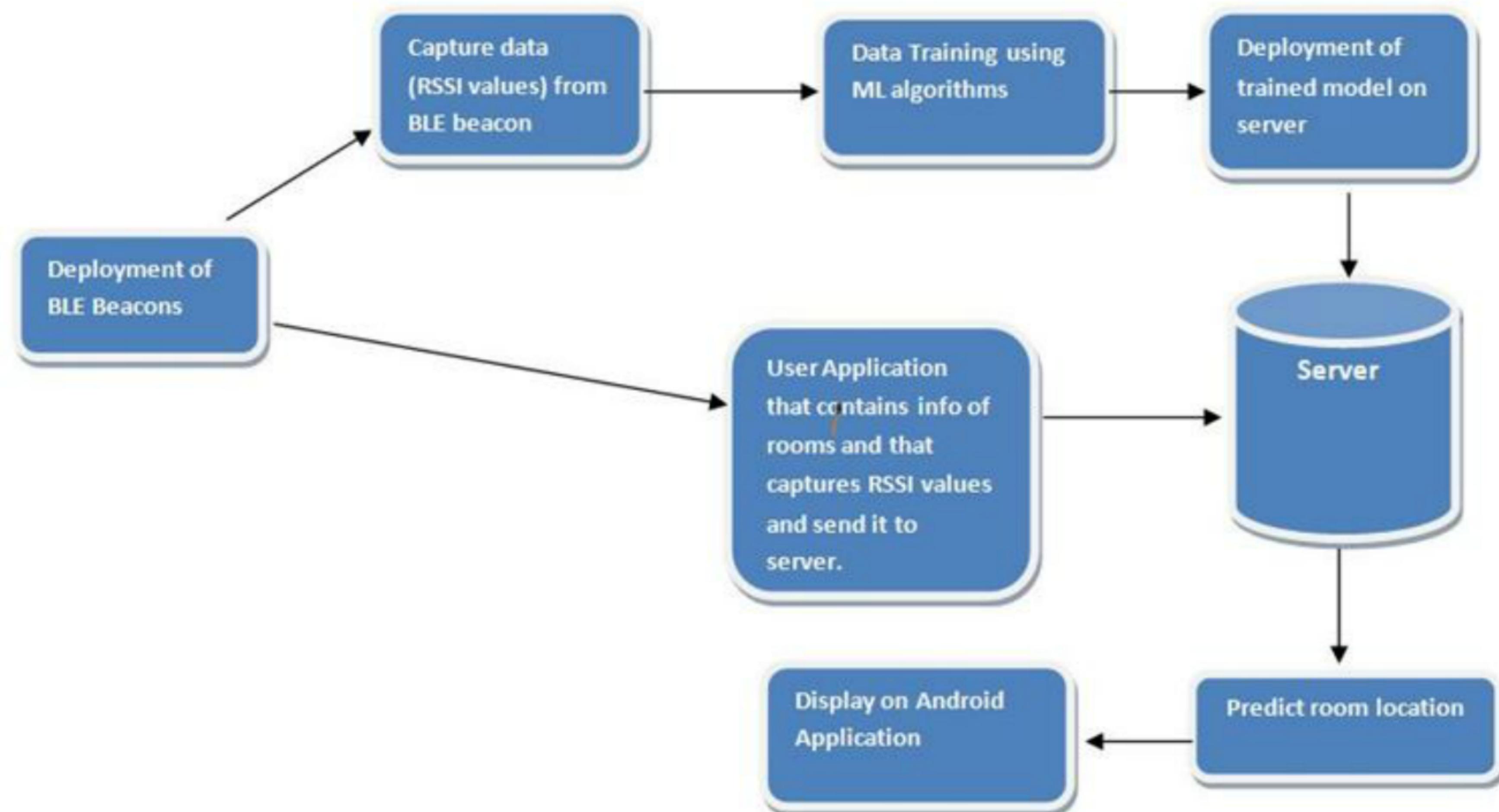
Whenever a visitor goes to university campus or visits a new place, he does not know about the specifications of that area i.e. what happens in that specific room or what courses have been taught in a particular and its nearby labs. So, we are developing a system which assists them in determining the textual and pictorial information of a particular area and its nearby locations. For this purpose, we first find the indoor location of a user by using BLE beacons and FP values, and then provide information to him automatically on his android application.

Goal

Our goal is to provide ease and guidance to users regarding current and nearby locations automatically via installed application on device by estimating his indoor location. The guidance involves the textual and pictorial information.



Proposed System

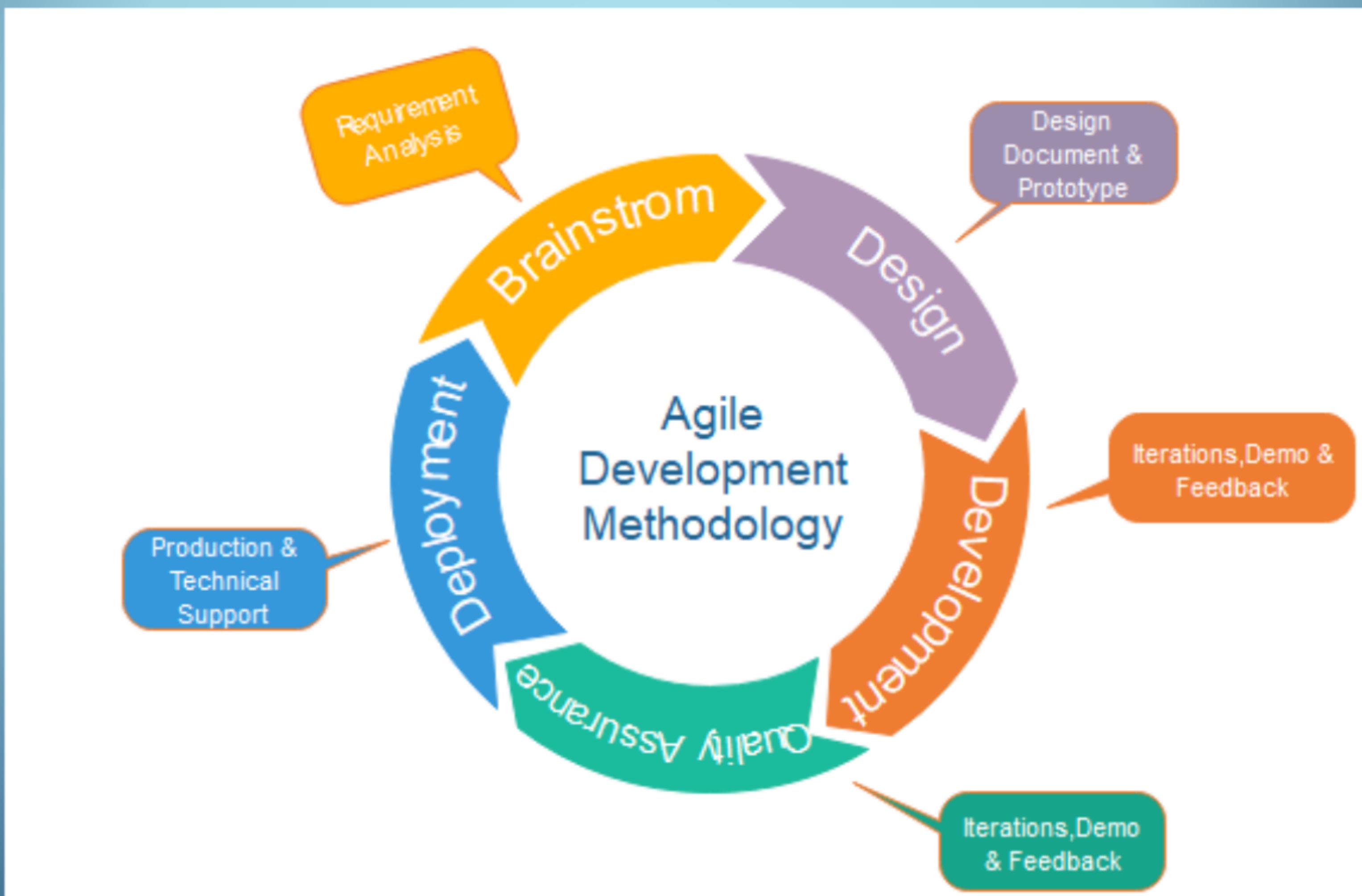


Description

- It navigates the user location
- It also give the user's nearby location
- It provides information of the current location of user i.e. the room's pictures and in textual description it will tell about the office hours or if it is a lab then how many teachers are teaching in that lab and the schedule.
- User can see that if his nearby place is room or lab. It will provide the room number and pictures.
- Most of us don't use guide boards because it is time consuming. This app will navigate you to your required labs.

SDLC

Agile Model



Functional Requirement

Hardware

Deployment of BLE beacons on the ceiling is the requirement to capture fingerprints of BLE beacons with different mobile devices. At what angle and at what part of the ceiling these beacons should display, all we get it know before their deployment.



Software Requirements

1. Data Capturing Application

- **Bluetooth scanning for nearby devices**
- **Connectivity of BLE beacons with mobile Bluetooth**
- **Capture RSSI values for nearby beacons**
- **Add delay factor to capture FP's**
- **Automatic restart Bluetooth scanning for nearby devices once it stops**
- **Generate .csv file for each BLE beacon**
- **Use .csv files to train a model**

Software Requirements

2. Admin Android Application

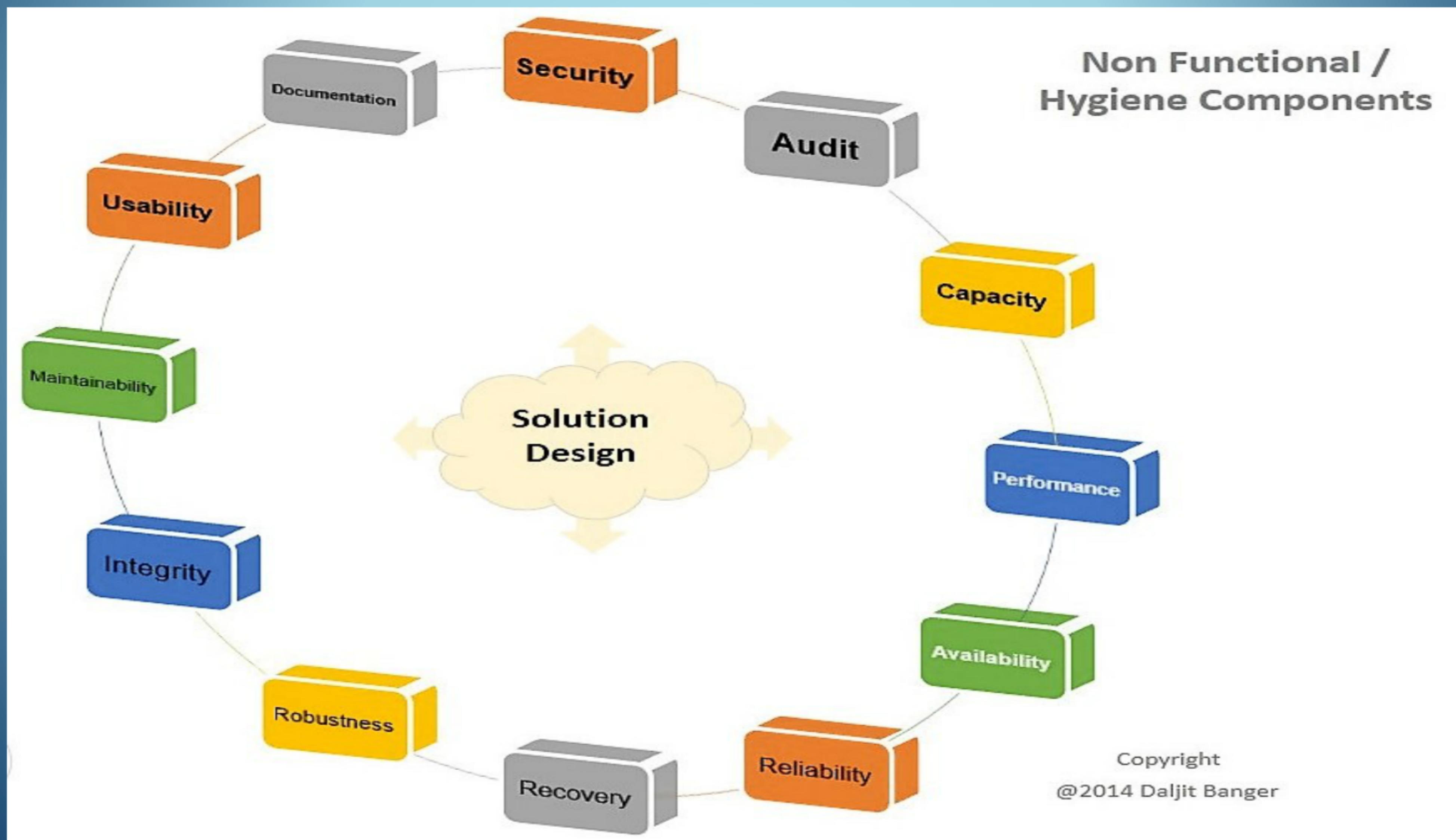
- **Admin can register in this app.**
- **He/she can login his/her account.**
- **Admin has all the records of data.**
- **Store information to database in images, audios and text form at of rooms and their nearby rooms.**
- **Allow admin to edit or update the information about rooms.**
- **Admin has all those functionalities which a user has.**

Software Requirements

3. Smart Guide: Android Application

- Trained model load in android application.
- Get the prediction of room from trained model.
- Allow user to know his indoor location.
- Fetch information of that particular room.
- Provide information of the room to the user.
- User can get information of nearby rooms.

Non- Functional Requirements



Target Audience



- **Visitors of the University campus**
- **New Students and Staff of the campus**
- **Software house visitors (Development, QA, Frontier)**
- **Airport assistance seekers**
- **Government small Institutes**
- **Medical departments exploration in hospitals**

Use Cases(1)

Use Case Name	Login/Sign in
Actor	Admin
Description	Admin have to make himself registered as an admin
Pre-conditions	Admin must have his login ID
Normal flow	<ol style="list-style-type: none">1- Admin opens webserver.2- Enter his login ID and password.3- Click to "login as an admin"
Post-condition	Users have the access to webserver and he can alter the information in the webserver.

Use Cases(2)

Use Case Name	Alteration in rooms and labs information
Actor	Admin
Description	Admin can change the required information w.r.t changing environment i.e. change of any teacher, change of any lab etc.
Pre-conditions	Admin must have the authority to access the webserver of the application.
Normal flow	<ul style="list-style-type: none">4- Admin access to the server where he can change picture or the text of specific room/lab.5- Admin can also change the office timing of teacher's room and schedule of the labs.
Post-condition	Up to date information will be given to the user.

Use Cases(3)

Use Case Name	Amendments in room staff information
Actor	Admin
Description	If the teacher changes his lab, the admin has the authority to change his lab information and if lab attendant is changed then admin can modify it.
Pre-conditions	<ol style="list-style-type: none">1- Admin has access to web server.2- He should have up to date information.
Normal flow	<ol style="list-style-type: none">1- Admin opens the server and checks for the specific teacher or staff.2- Update/delete/insert the information.
Post-condition	Up to date information of the room staff will be provided.

Use Cases(4)

Use Case Name	Access to the application
Actor	User
Description	User has to step into the application for the benefits of the app through his mobile phone.
Pre-conditions	1- The mobile must have Android OS. 2- The application must be downloaded on the phone.
Normal flow	1- The app will be downloaded through Google PlayStore. 2- User opens the app the front page appears showing “Welcome to CSE Department”.
Post-condition	Application will be opened and front page will show that this app will guide the user in CSE department.

Use Cases(5)

Use Case Name	Checking the location and explore nearby places
Actor	User
Description	User can find out where he is standing right now and what the neighboring locations are.
Pre-conditions	<ul style="list-style-type: none">1- Bluetooth connectivity must be turned on.2- Bluetooth must be connected to beacon.3- User must be in department premises.
Normal flow	<ul style="list-style-type: none">1- After main page, another page appears with two buttons.2- User can check his current location by clicking first button showing “My current location” which gives the user its current location.3- Next button shows “Nearby Rooms/Labs” by clicking that user get to know about the surrounding rooms and labs around him.
Post-condition	<ul style="list-style-type: none">1- User will able to know his location at that moment.2- He will also know the neighboring rooms and labs.

Use Cases(6)

Use Case Name	Pictures, schedule and office timings of rooms & labs.
Actor	User
Description	The information of current and neighboring rooms and labs through pictures and texts with the extension of office timing of the teacher's room can be seen
Pre-conditions	User must know the location where he is standing and the nearby labs and rooms.
Normal flow	<ol style="list-style-type: none">1- When the user clicks current location button, next screen gives 3 buttons.<ul style="list-style-type: none">• One gives the pictures of the room.• Second gives the schedule and name of lab attendant if it is lab.• Third gives the office timing if the room belongs to any teacher.2- When the user clicks the nearby rooms button, then the next screen shows rooms or labs nearby him and when the user clicks any of the room button he will be provided with the images, schedule and office timings.
Post-condition	User will be given the information i.e. pictures, schedule, office timing of his current position and the nearby rooms and labs.

Use Cases(7)

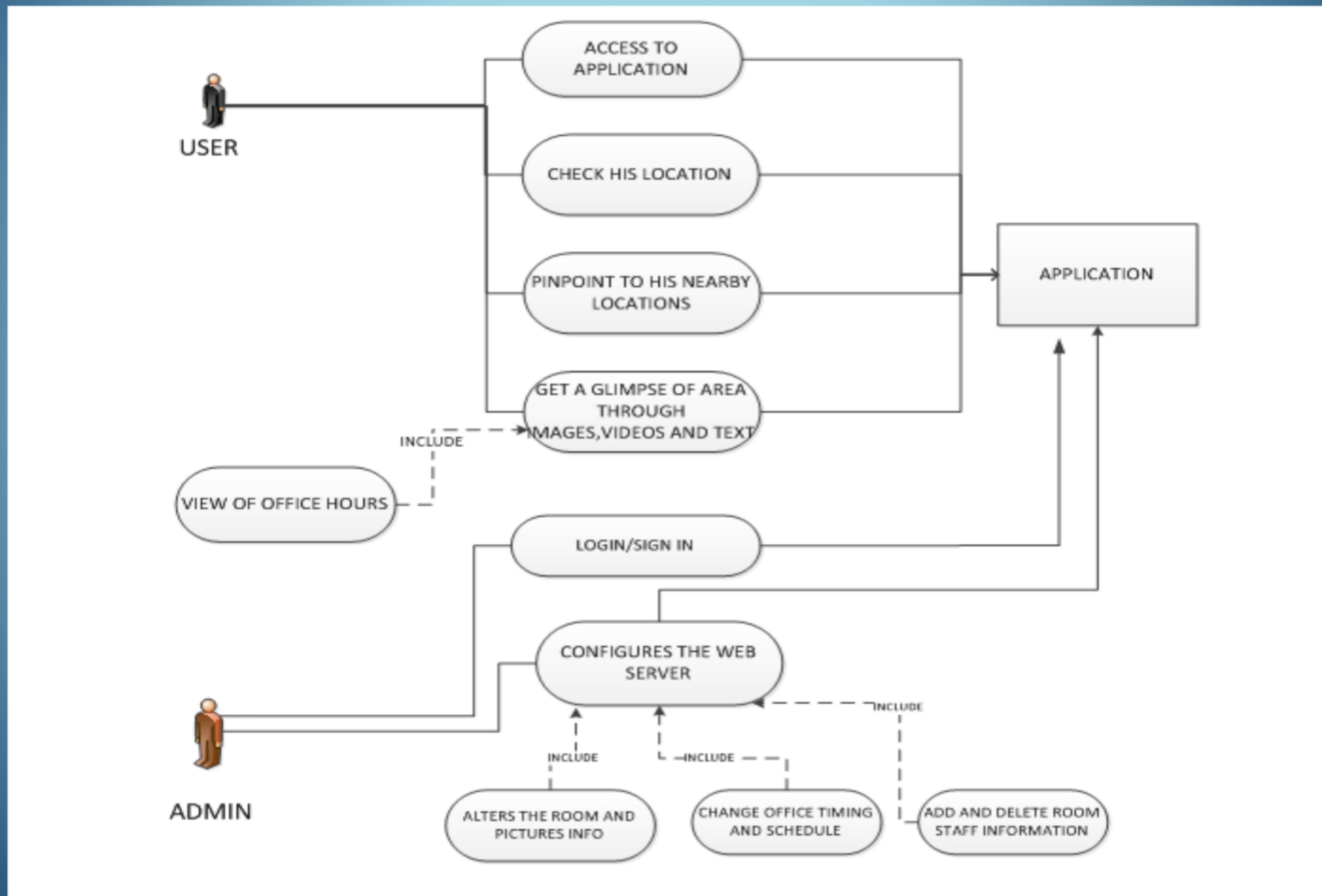
Use Case Name	Room/Lab staff information
Actor	User
Description	In this use case, User can have the knowledge of the working staff or the teacher's name in the room or lab
Pre-conditions	<ol style="list-style-type: none">1- User should have the information of his current position by having the pictures, schedule and office timing of that room or lab.2- He should have the pictures, schedule and office timing about the nearby rooms and labs.
Normal flow	<ol style="list-style-type: none">1- When user is checking current location, another button is given which says "Staff Information" and by clicking that the user will know the teacher's name, his skills and which subjects he teaches.2- When the user clicks nearby rooms/labs it will also give the staff information button and by clicking that user will know the teacher's skill and if it is lab then he will know which teachers are using this lab and for what subjects.
Post-condition	User will know the skills of teacher of specific room and what he teaches as well as he will know which teachers are teaching in specific lab.

Technology Used

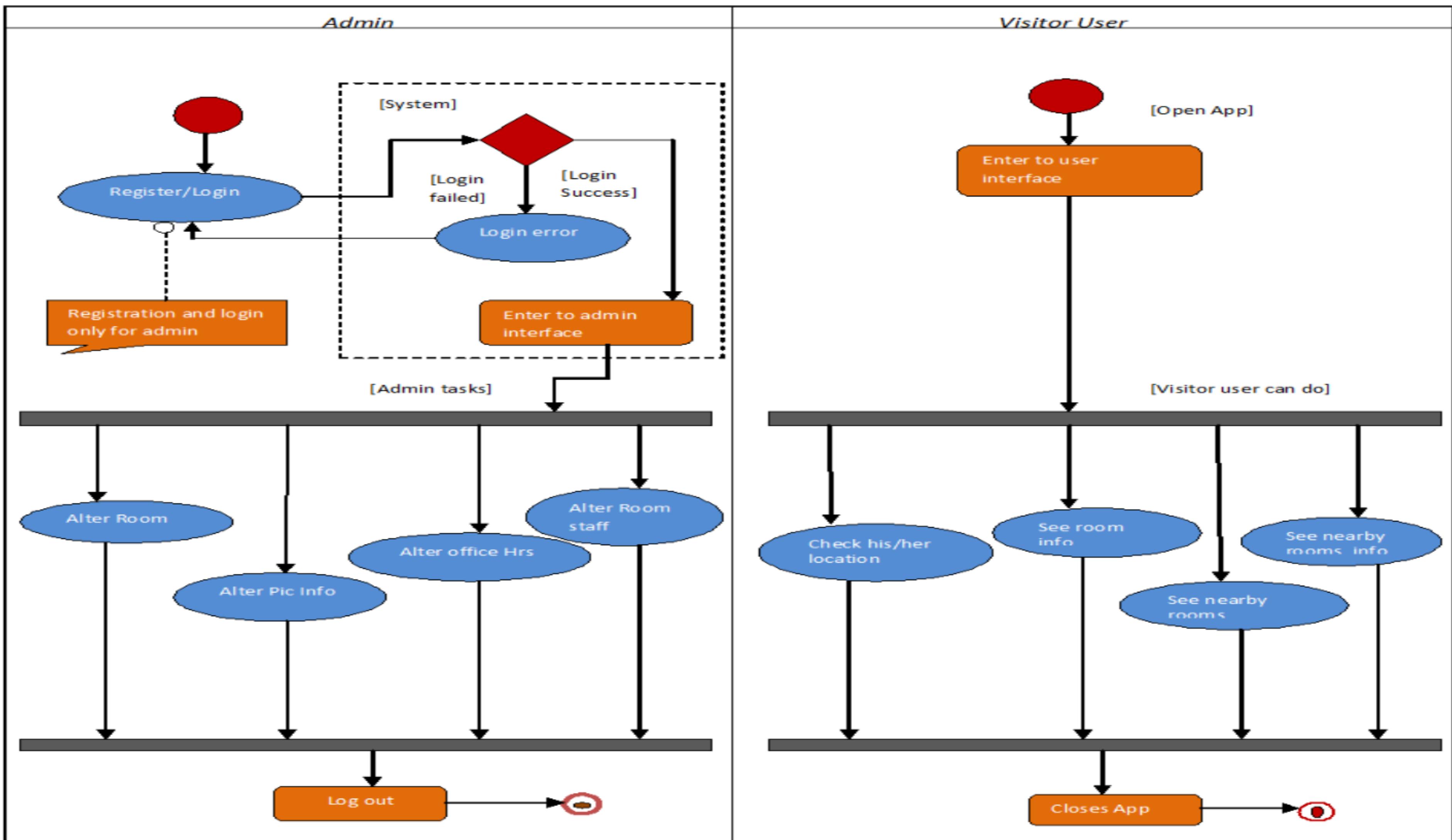
- **Android Studio 3.5 or above with JAVA development for making android applications**
- **Python IDE(Spyder) for the training of machine learning model**
- **MATLAB for the compilation of BLE beacons dataset**
- **PHP scripts used to access database by android studio**
- **MYSQL used for online database**



Use Case Diagram



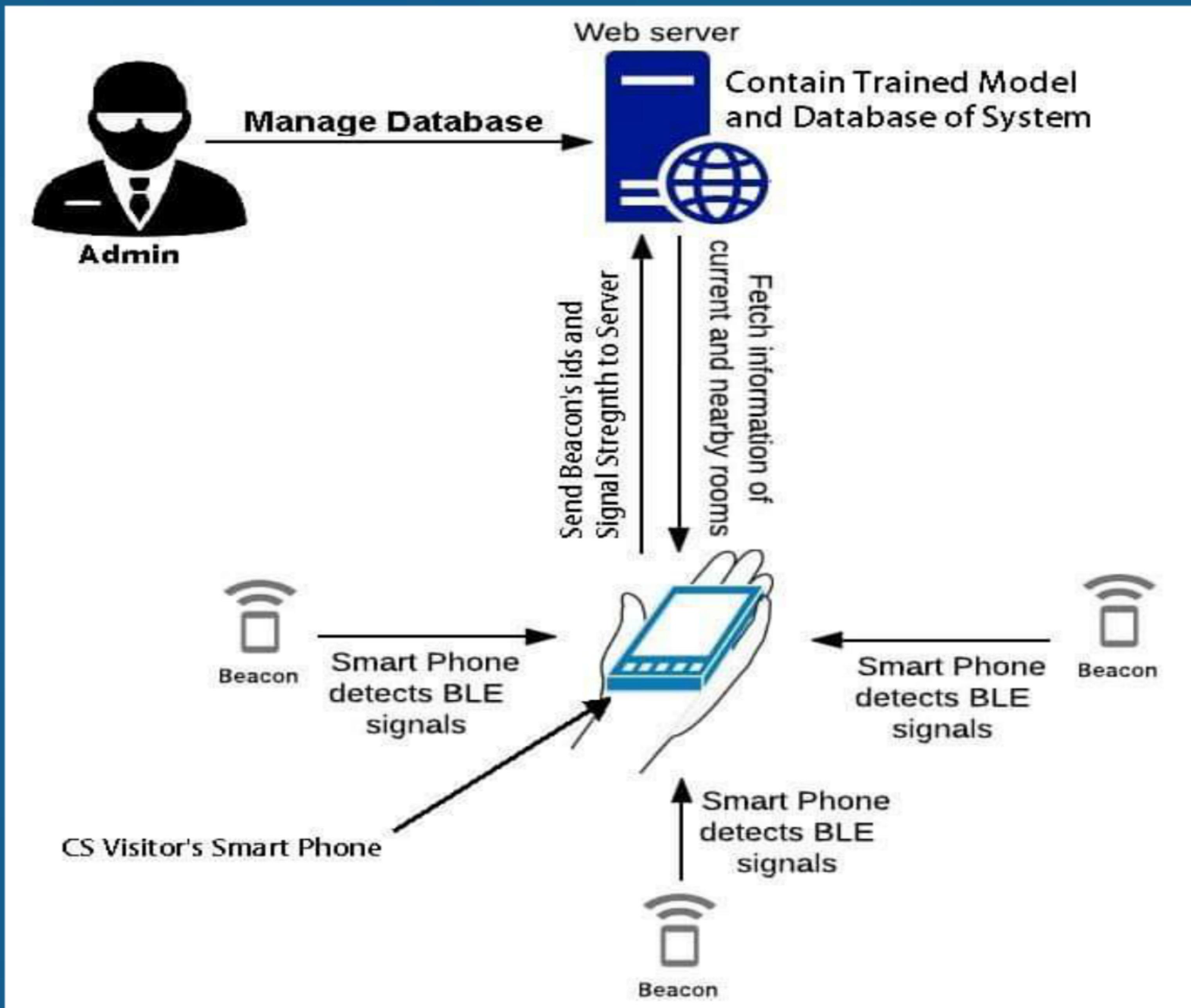
Activity Diagram



Data Base Diagram

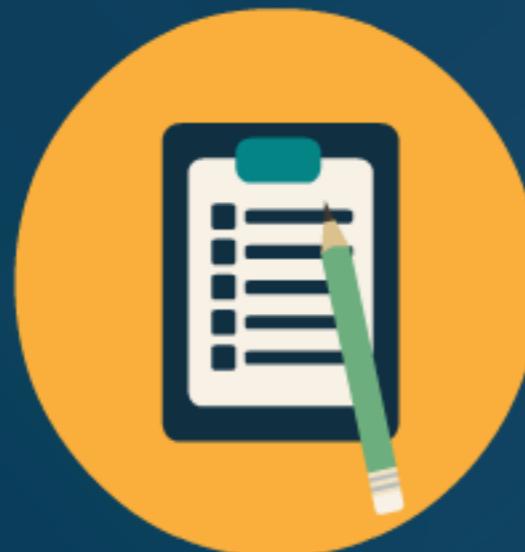


Architecture Diagram



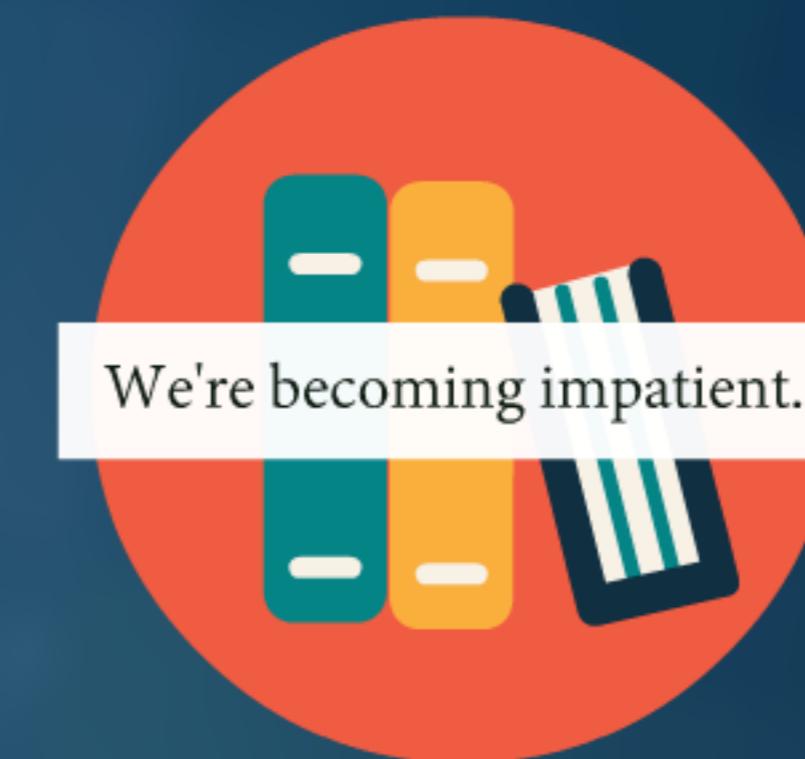
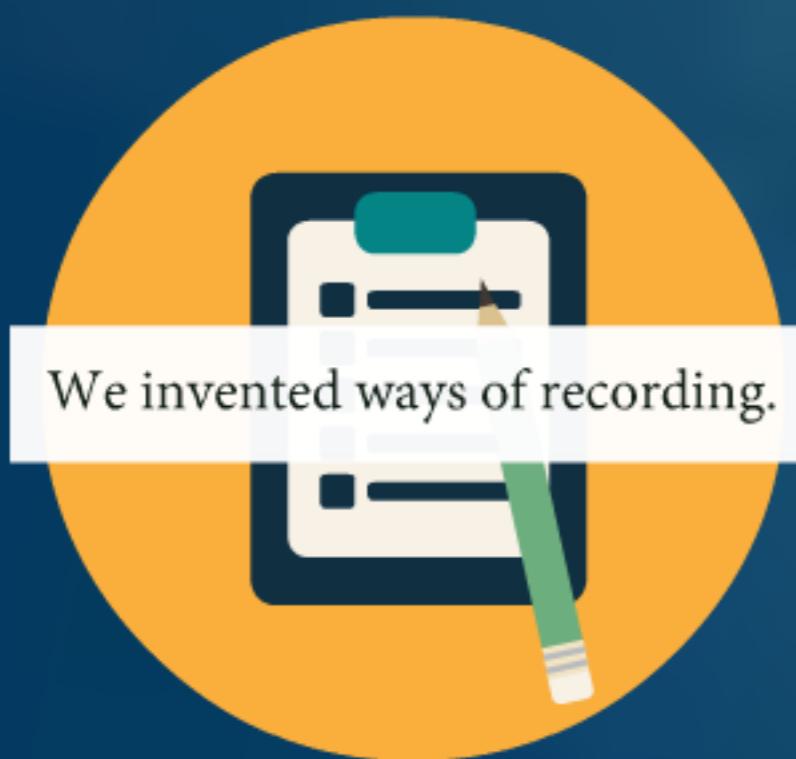
Commercialization and Research work

- Grow up project from small scale to big scale
- Current approaches to solve the problem
- Proposed solution to the problem
- Our concept is better than the existing systems
- Idea should has a commercial application
- Successfully deliver this project



Commercialization and Research work

- **Software house information (Development, QA, Frontier)**
- **Airport assisting system**
- **University Campus smart information system**
- **Government small Institutes**
- **Medical departments exploration in hospitals**

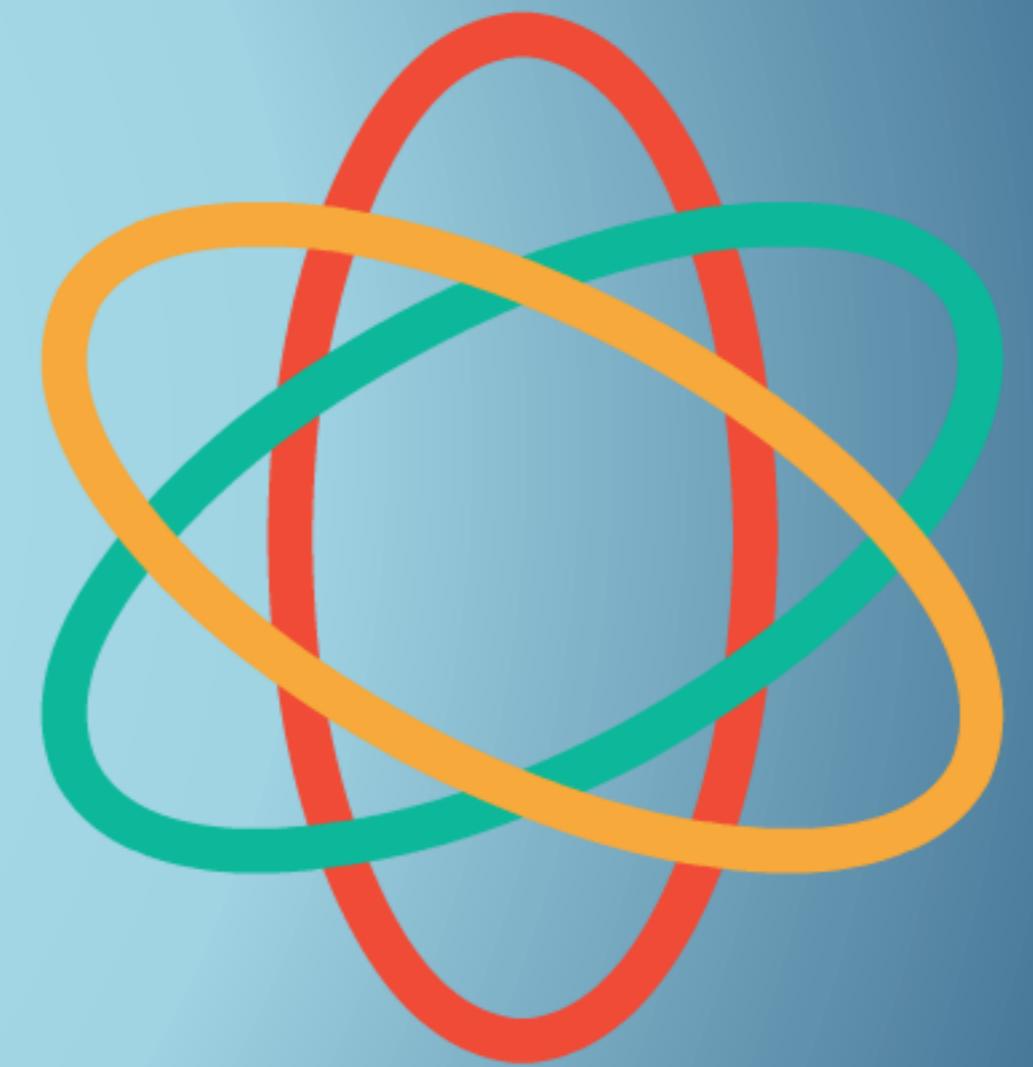


Existing System

System Type	Methodology	Weakness	Accuracy Achieved
Image based indoor localization	Convolution Neural Network(CNN)	-Time consuming effort required to built data set -Low accuracy	74.09%
By using Capacitive Sensors	Pressure sensing systems that detect presence	-Deployment of sensors in floor is expensive -Impractical	73.01%
By using Zigbee sensors	K- Nearest Neighbors(KNN)	-Expensive -Medium Scalability	76%
By using Wi-Fi	Deep Learning algorithms	-Consumes more power -Wi-Fi signals are not accessible to some areas	71%

Drawbacks of Existing System

- Costly Hardware Requirement
- High effort required for deployment of infrastructure
- Time consuming effort required for built data sets
- More Power consumption
- Obtrusiveness
- Less Accurate
- Wi-Fi signals are not accessible every where
- Find indoor positioning for different purposes, not for university guidance



KPIs(Key Performance Indicators)



KPIs(Key Performance Indicators)

KPIs of our system are:

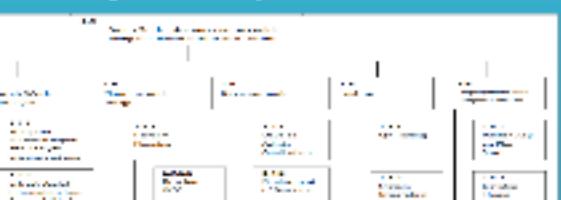
- Working Demonstration of our system
- Make this system functional in atleast in building
-

KPIs(Key Performance Indicators)

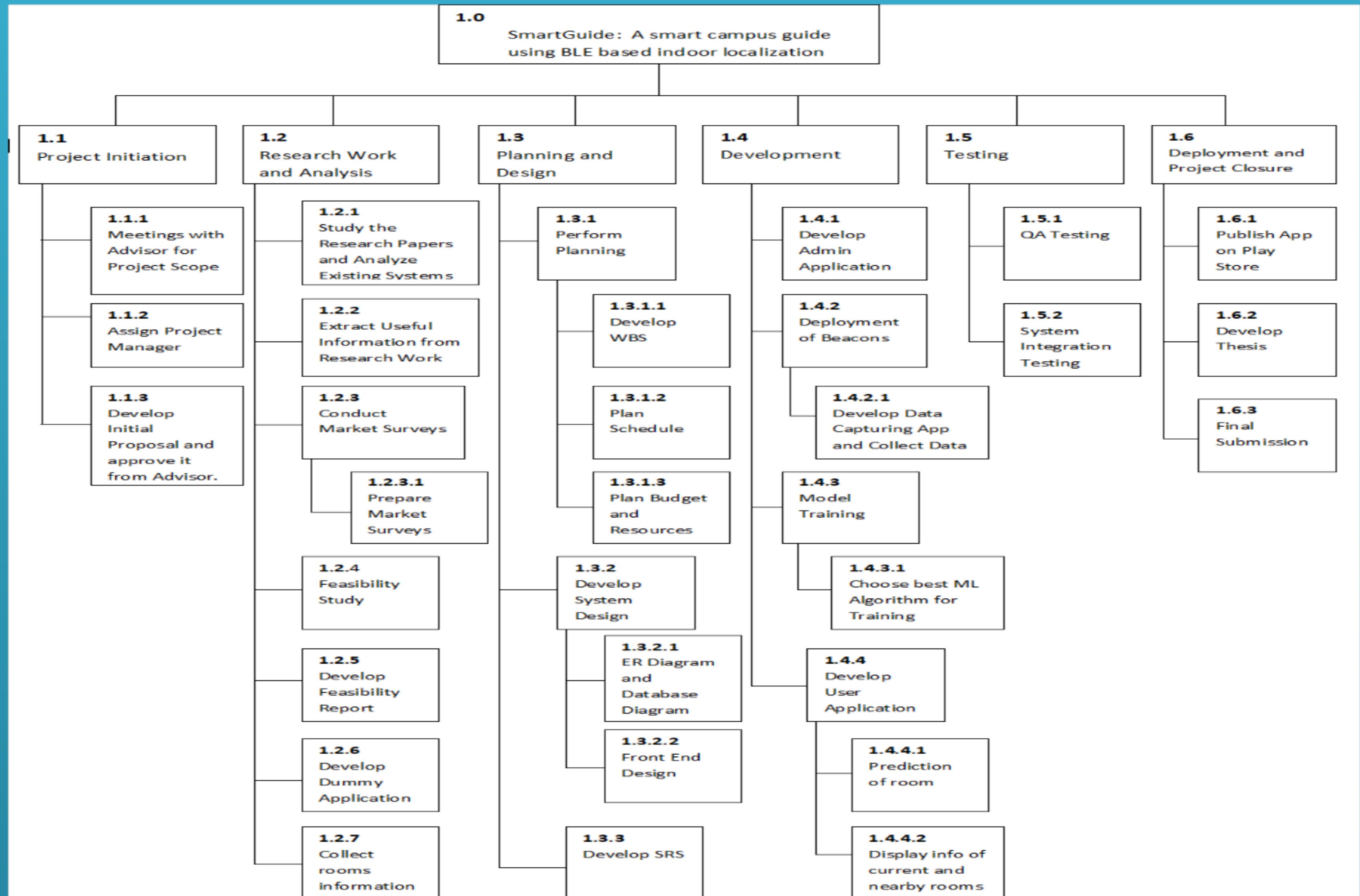
Sr. No.	Modules	Price in Rs
1	BLE Beacons(6 Beacons)	10,200 (1700*6)
2	Publishing of Android Application	4,000
3	Report and Thesis Printing	8000/-
4	Total	22,200/~

Milestones

Milestone No.	Milestone	Completion Date
001	Project Kick-Off	20 Sep 2019
002	Research Work and Complete Analysis	01 Nov 2019
003	Complete Planning and Design	20 Nov 2019
004	Complete Backend Coding	20 Feb 2020
005	Complete Testing	28 Feb 2020
006	Complete Implementation and Deployment	10 Mar 2020
007	Project Closure	15 Mar 2020



Project Plan (WBS)



Project Plan (Gantt Chart)

WBS ID	Start – End Date	Status	Duration	Sep 2019	Oct 2019	Nov 2019
1.1	Sep 10 – Sep 20	100%	10			
1.1.1	Sep 10 - Sep 19	✓	10			
1.1.2	Sep 16 - Sep 19	✓	04			
1.1.3	Sep 17 - Sep 20	✓	04			
1.2	Sep 21 – Nov 01	100%	42			
1.2.1	Sep 21 - Oct 02	✓	12			
1.2.2	Sep 26 - Oct 09	✓	14			
1.2.3	Sep 30 - Oct 09	✓	10			
1.2.4	Oct 03 - Oct 06	✓	04			
1.2.5	Oct 05 - Oct 23	✓	19			
1.2.6	Oct 23 - Nov 1	✓	10			
1.2.7	Oct 30 - Nov 1	✓	03			
1.3	Nov 2 – Nov 20	100%	19			
1.3.1	Nov 2 - Nov 11	✓	10			
1.3.2	Nov 3 - Nov 18	✓	16			
1.3.3	Nov 14 - Nov 20	✓	07			

WBS ID	Start – End Date	Status	Duration	Nov 2019	Dec 2019	Jan 2020	Feb 2020	Mar 2020
1.4	Nov 21 – Feb 20	50%	90					
1.4.1	Nov 21 - Dec 20	✓	30					
1.4.2	Dec 15 - Jan 28	✓	43					
1.4.3	Jan 29 - Feb 05	⚠	08					
1.4.4	Jan 20 - Feb 20	⚠	30					
1.5	Feb 21 – Mar 01	0%	10					
1.5.1	Feb 21 - Feb 25	⚠	05					
1.5.2	Feb 23 - Mar 01	⚠	08					
1.6	Mar 02 – Mar 15	0%	14					
1.6.1	Mar 02 - Mar 07	⚠	06					
1.6.2	Mar 03 - Mar 15	⚠	13					
1.6.3	Mar 05 - Mar 15	⚠	11					

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1.2.1	Sep 21 - Oct 02	✓	12			
1.2.2	Sep 26 - Oct 09	✓	14			
1.2.3	Sep 30 - Oct 09	✓	10			
1.2.4	Oct 03 - Oct 06	✓	04			
1.2.5	Oct 05 - Oct 23	✓	19			
1.2.6	Oct 23 - Nov 1	✓	10			
1.2.7	Oct 30 - Nov 1	✓	03			
1.3	Nov 2 – Nov 20	100%	19			
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1.6.1	Mar 02 - Mar 07	⚠	06					
1.6.2	Mar 03 - Mar 15	⚠	13					
1.6.3	Mar 05 - Mar 15	⚠	11					

Samples

DEVICE_NAME	MAC_ADDRESS	RSSI
AIRL1	D5:9E:76:EE:30:EE	72
null	10:01:F2:01:2B:1C	70
null	08:49:4B:BE:08:F4	62
AIRL1	D5:9E:76:EE:30:EE	71
AIRL2	C2:6C:15:0C:C1:C7	71

	A	B	C
1	DEVICE_NAME	MAC_ADDRESS	RSSI
2	AIRL1	D5:9E:76:EE:30:EE	73
3			

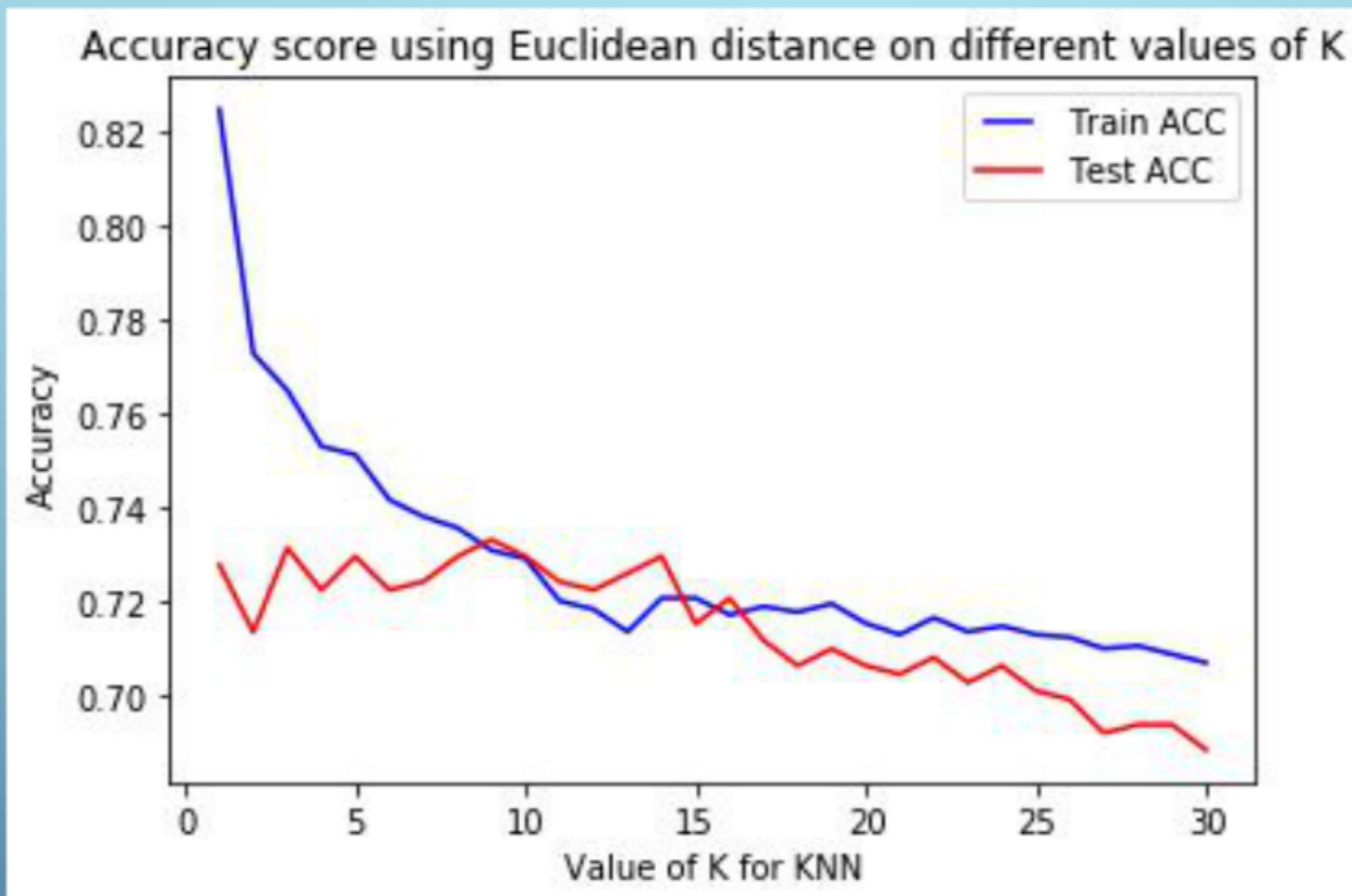
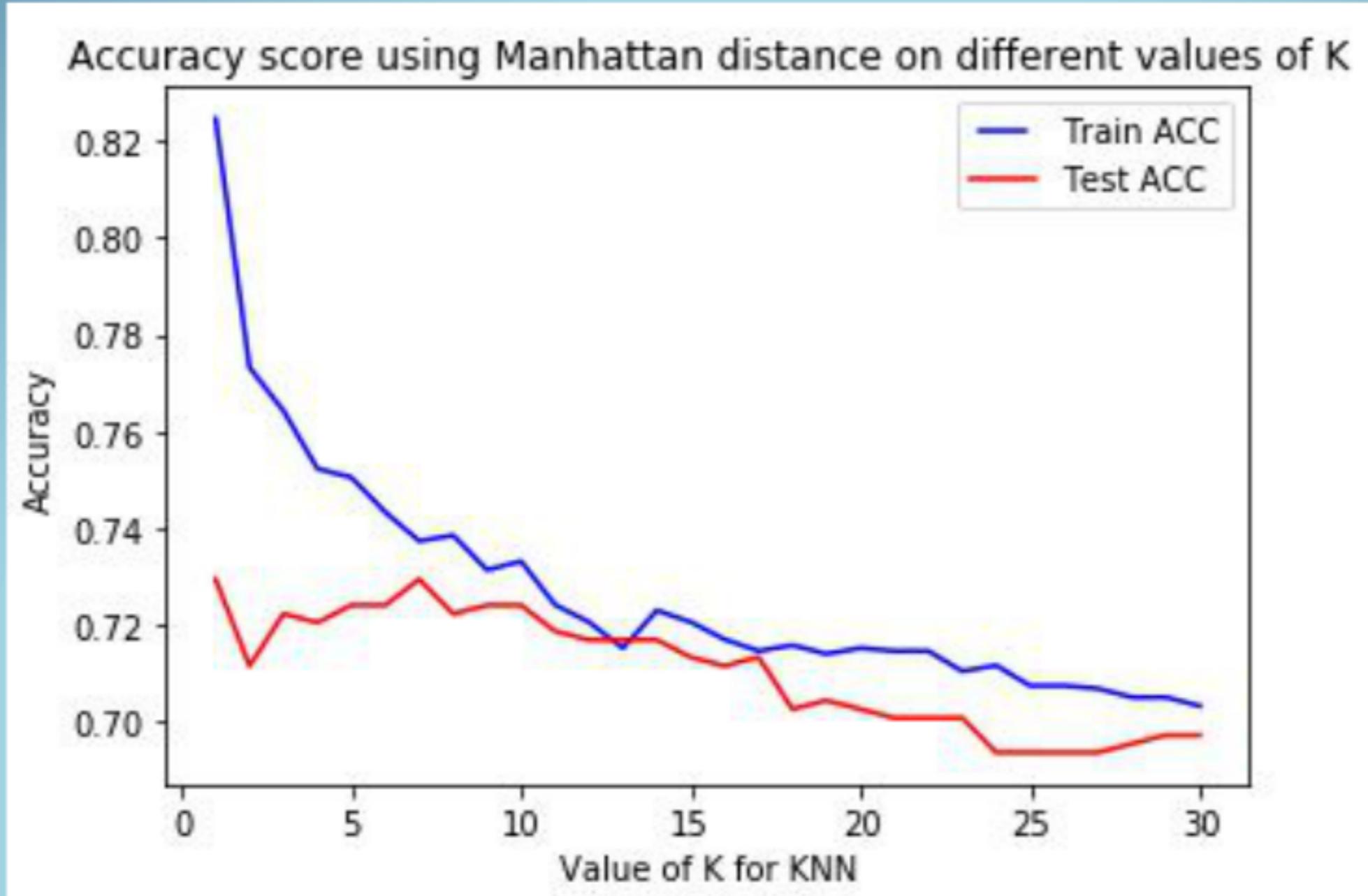
Prepared Dataset

	A	B	C
1	MacAddr1	MacAddr2	RoomLabel
2	-66	-74	1
3	-72	-66	1
4	-73	-78	1
5	-70	-75	1
6	-78	-73	1
7	-72	-67	1
8	-74	-69	1
9	-72	-77	1
10	-68	-71	1
11	-70	-70	1
12	-69	-64	2
13	-78	-73	2
14	NaN	NaN	2
15	-73	-68	2
16	-73	-68	2
17	-75	-70	2
18	-70	-65	2
19	NaN	NaN	2
20	-73	-64	2
21	-77	-72	2
22	-70	-65	2
23			

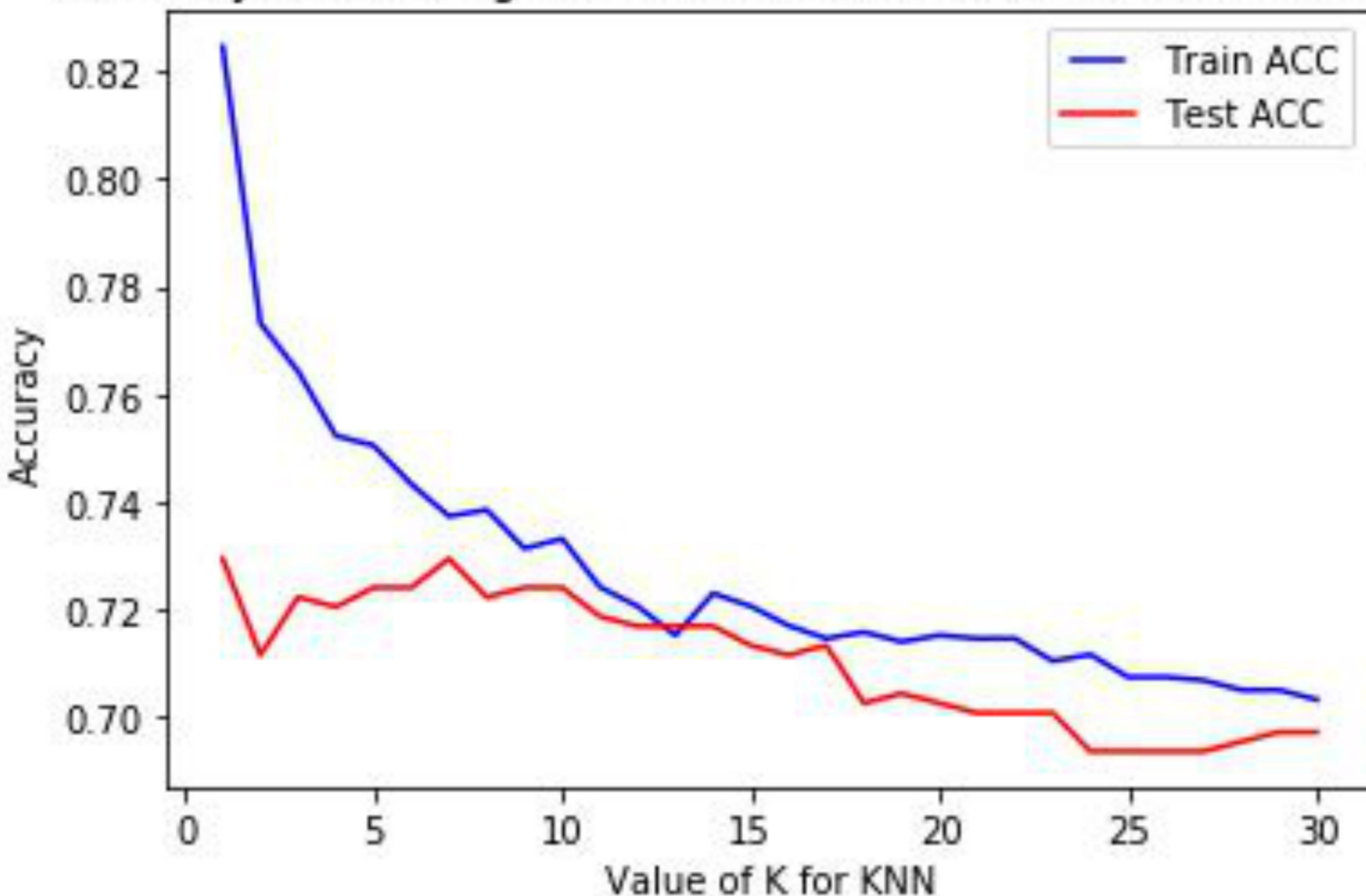
ALGORITHMS USED FOR MODEL TRAINING

- Random Forest
- Decision Tree
- KNN

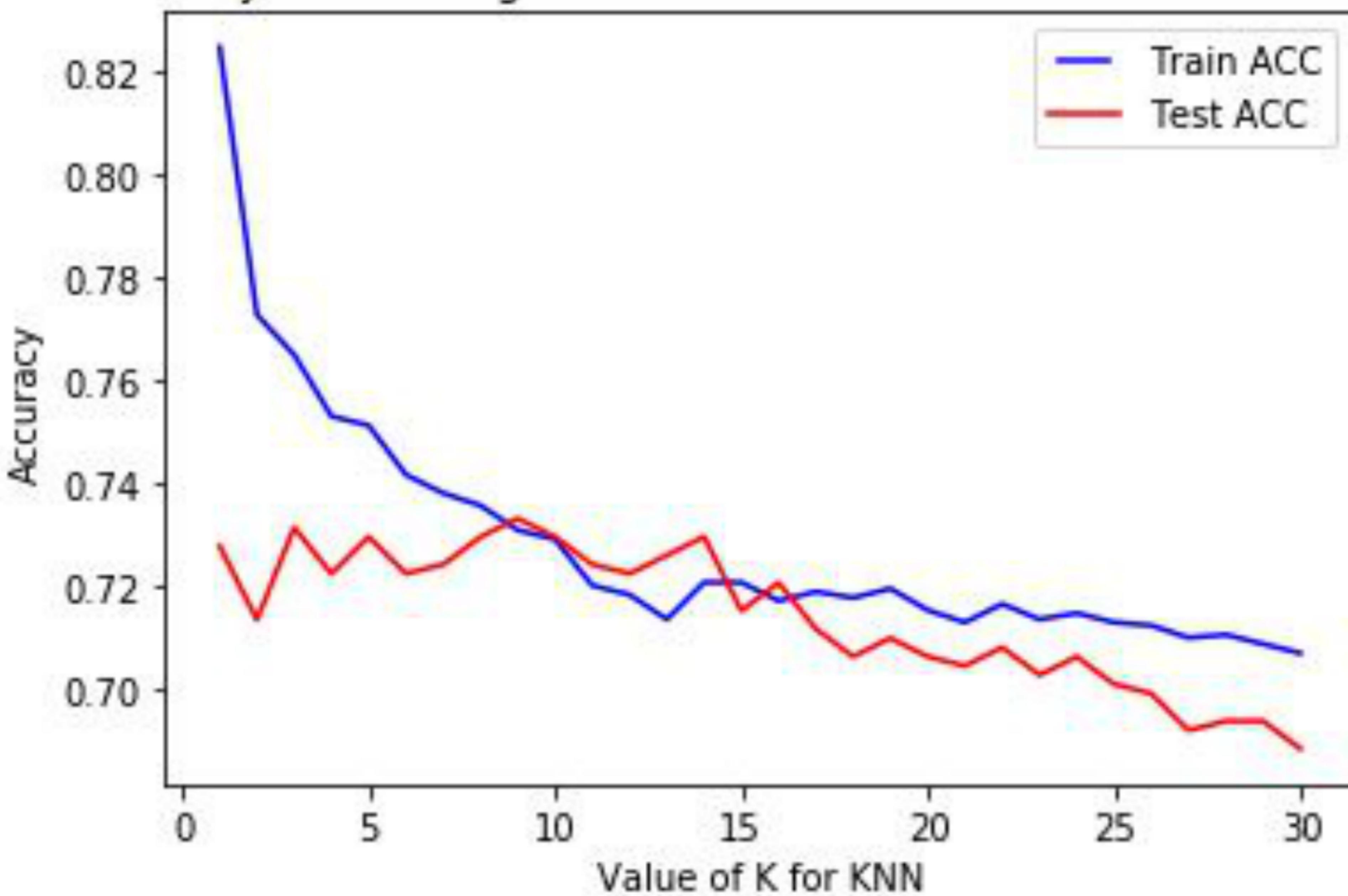
Results



Accuracy score using Manhattan distance on different values of K



Accuracy score using Euclidean distance on different values of K



Thank You!!!