



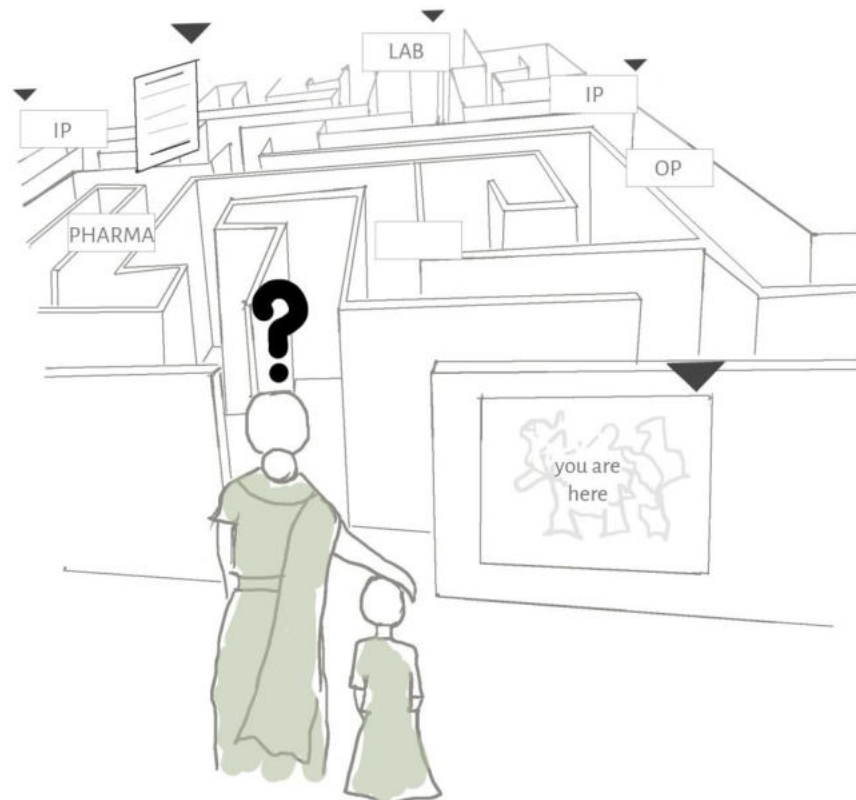
Indoor navigation in hospitals

Semester III Project

LABEEBA | 146330008

Guided by Prof. RAVI POOVAIAH

The hospital maze



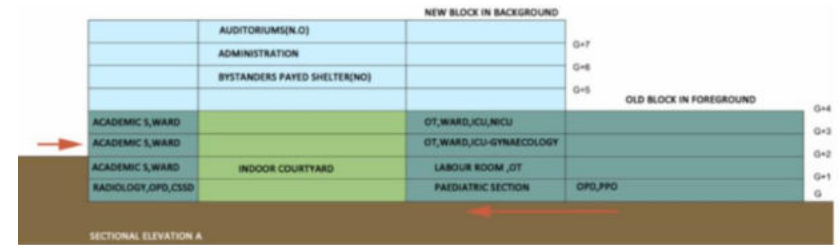
Way finding and navigation

Way finding involves finding routes between pairs of locations.

Navigation involves traveling and receiving continuous real-time guidance while on a chosen route which will help the user.

Navigation is very important in hospital atmosphere

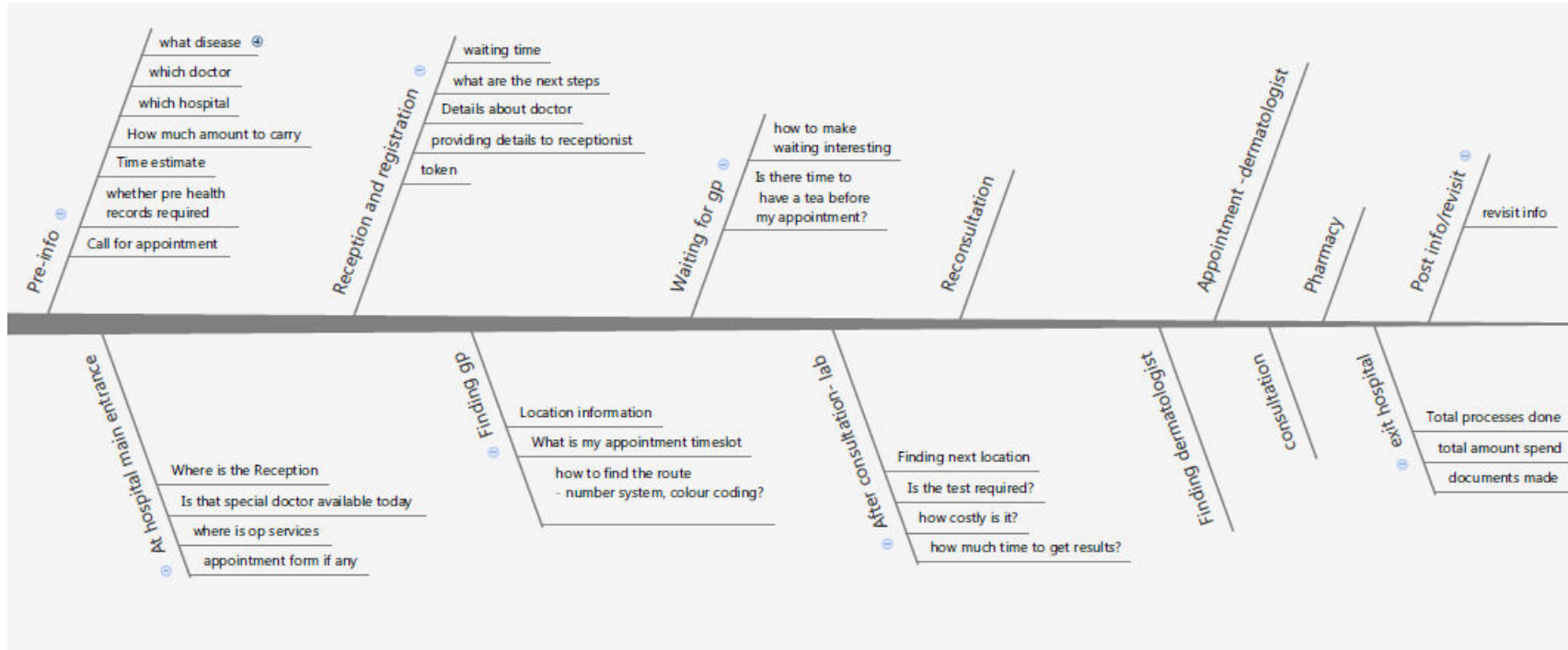
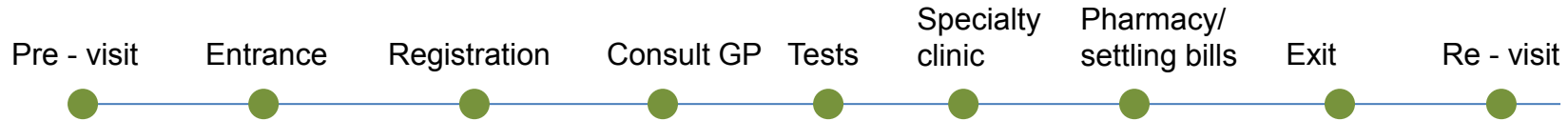
Indoor and Outdoor



Different physical elements
 Different functions
 3D data vs 2D map data
 Positioning Technology
 Indoor and outdoor spaces in hospital

Primary Study

User Study 1 - Typical user journey



User Study 1 - Navigation steps

Knowing where he/she is

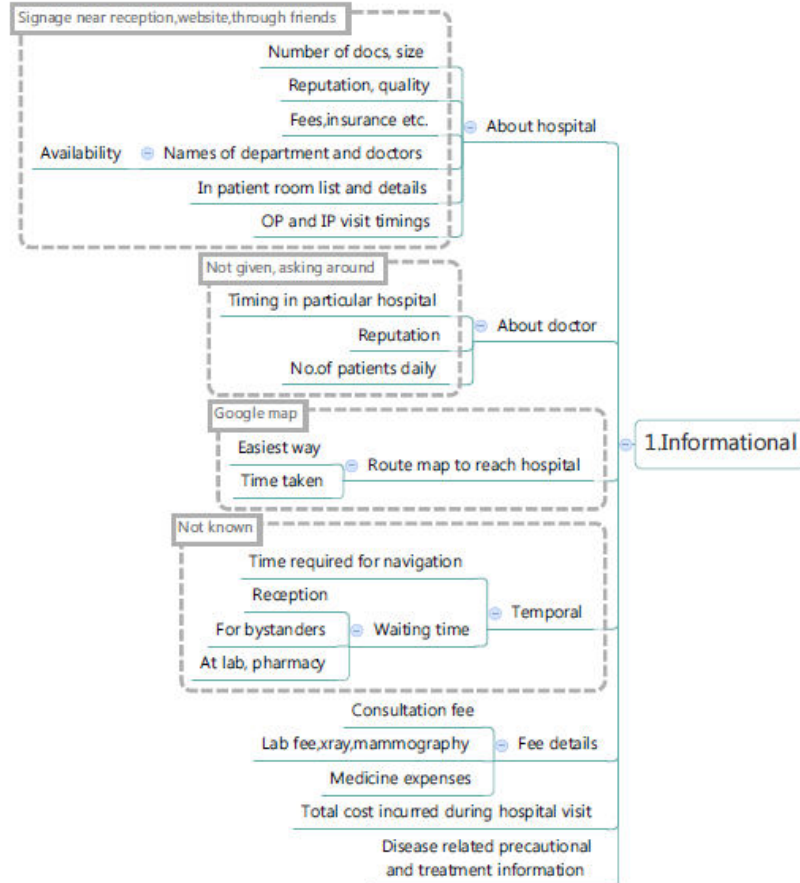
Knowing his/her destination

Knowing which route gets him/her to destination

Ability to follow route

Knowing when he/she has reached destination

User Study 1 - Information study



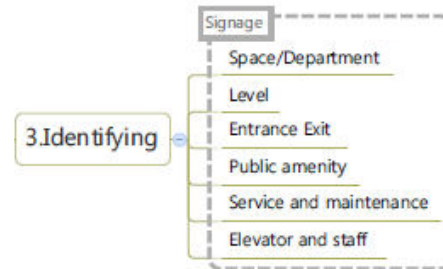
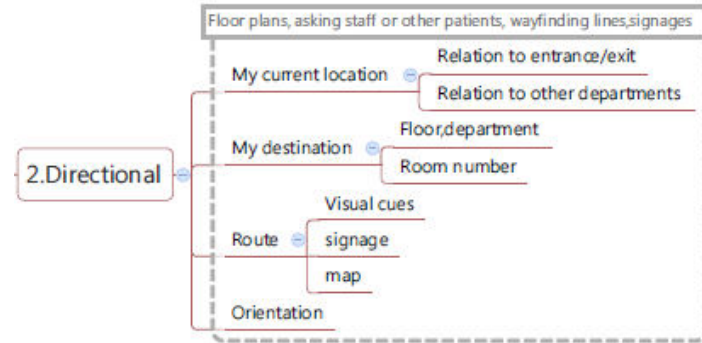
To analyze the lack of information in current system

- Time required
- Waiting time
- OPD timings and changes

User Study 1 - Information study

To analyze the lack of information in current system

- Users current location
- Route
- Orientation



User Study 1 - Findings

Number of interviews – 10

User group – 4 college students
(IITB)

5 working parent

1 Receptionist



WAYFINDING

5 steps

Signages and bands preferred

No to maps



INFORMATION

OPD doctor timings

Time for navigation

Waiting time in OPD, Pharmacy

New Doctors and facilities



SERVICE

Final billing and insurance

Faster receipt of reports

Reduce number of processes

User Study 2 – KEM Hospital

2300 beds

Funded by municipal corporation of greater Mumbai

Layout – Old block ; New block ; Emergency department

OPD service process



User Study 2 – KEM Hospital

Signage and Way finding



Signage in old ward complex



Very crude signage system in new block



Number system
Asking around and guide desks
main way of navigation

User study 2 - Target User

- OPD Patients
- OPD Patient and bystander
- Visitors
- First time patient
- Re- visit patient

Findings

- Users are very unique when they deal with way finding based on their age, gender, literacy.
- Each user has his or her own level of knowing.
- First time visitor is totally confused.
- Few visitors who are aware of their ignorance do not want to know how to navigate , but they want an escort to their destination.
- Few who lack knowledge are too embarrassed to ask questions, so they will try to navigate on their own.
- Understands new technologies after beginner level instructions
- Comfortable with smartphones

User Study 2 - Findings

Incongruity in instructions given



Lack of confidence.
Users preferred asking around

Strategies of asking around

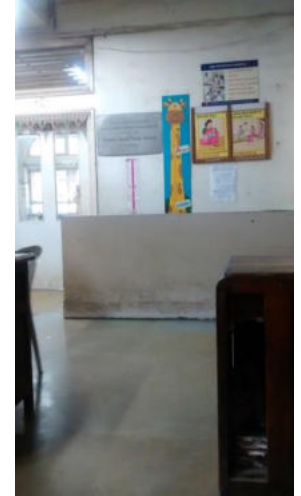
Location - Points of break of visual access

Number of times

Asking multiple people

Selection of right person to ask

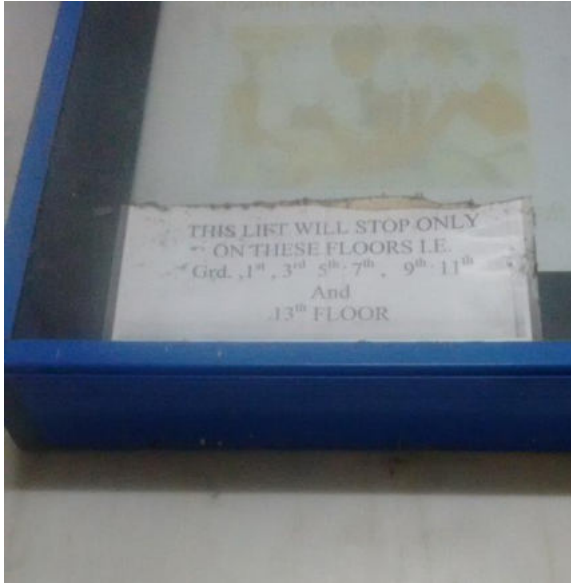
Validating if instructions right or wrong



Common rules of the OP
Might be unknown to new

User Study 2 - Findings

Illegibility of signage



Lift signage



Placing issue

User Study 2 - Findings

Design for both slow and fast paced users.

Need for progressive disclosure of instructions

Variety in choice of route to destination

Reduce the current complexity of signage, layout and floors

Major areas of confusion

1. At entrance
2. Junctions with 2 or more diversions
3. Junctions with 2 signboards
4. Large lobby
5. Lift area without a lift lobby
6. Exit from staircase and lift
7. Over crowded areas
8. Low lit spaces

User Study 2 - Findings

Mental model

Mental model of the route in case of indoor spaces are not in the form of 2d maps or routes but as 3d experiences – images, events, activity.

Test : Users were asked to explain the route to a friend in the best way possible.

Findings : Temporary elements and landmarks

Inadequacy to establish landmarks due to temporary elements in scene



Secondary Study

Cognition in Indoor navigation

Research Insights

Place legibility

Imageability (quality in a physical object which gives it a high probability of evoking a strong image to any given observer)

Factors that influence way finding performance within built environments:

1. Visual access
2. The degree of architectural differentiation
3. The use of signs and room numbers to provide identification or directional information
4. Plan configuration

Asking people to estimate directions to indoor locations was greatly facilitated by visual access between locations

Cognition in Indoor navigation

Research Findings

Difference in studying maps and actually navigation

Maps - Acquire survey knowledge

Resides in memory in images

Actual navigation - Procedural knowledge of routes

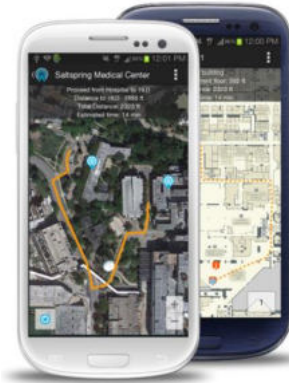
In complex indoor structure, it is very difficult to learn the entire layout from navigating daily

Hot spots with navigational difficulty - entrance halls, survey places, floors, dead ends, interior building structures, public and private spaces, and stairways.

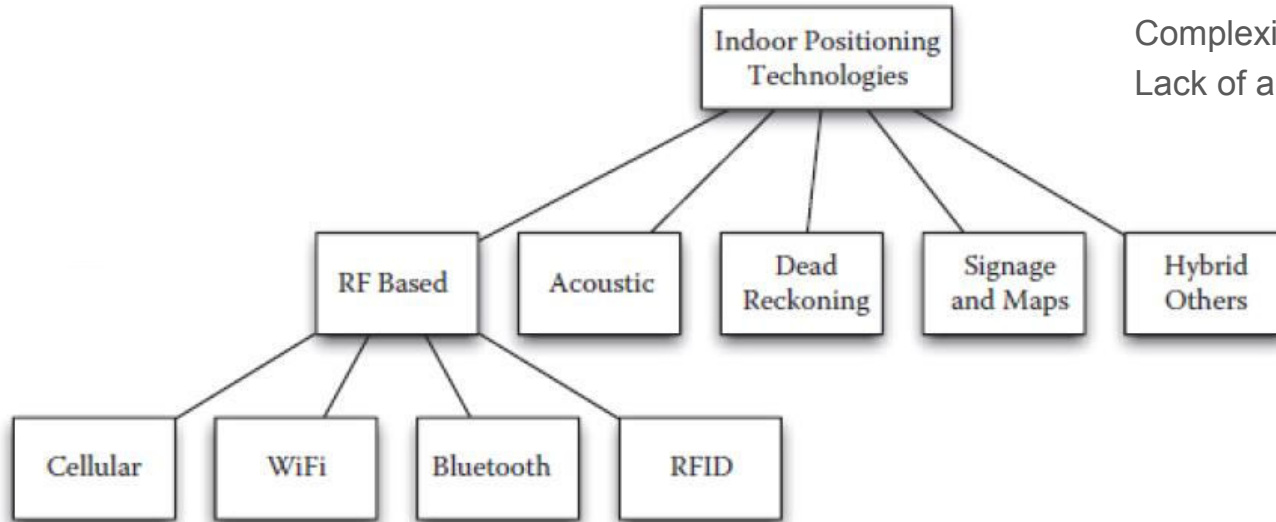
Photographs effective than map information Eg. Subway exits

Current Trends in Indoor Navigation

Current trends



Technology in localization



Each technology suitable for particular kind of navigation

Affordability in current ecosystem

Complexity of service

Lack of accuracy and error

Restated Objectives

Primary

Provide confidence to the hospital users that they can reach their destination with minimum errors.

<Problems> Preconceived notions, uncertainty in manual instructions, Urgency, More areas of confusion, Non distinguishable landmarks.

Secondary

Reduce the complexity of system by giving adequate information

Integrating solution for first time visitor and frequent visitor / fast and slow visitor

Easy adaptation to the product

Low cost on infrastructure

Restated Objectives

Final Needs

Progressive feedback and instructions for navigation – Phone based application preferred

3D imagery mental model – 3d view, image, video etc.

Activity based instructions

Effective information regarding doctor and hospital timings which help in hospital visit.

Clarity of instructions and destination names.

Ideation

Concept 1

Map based application augmented with model street view

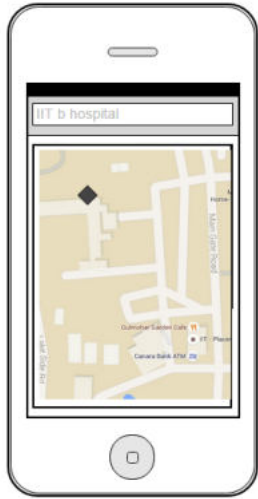
Continuous positioning and localization

Similar to Google indoors but with more accuracy

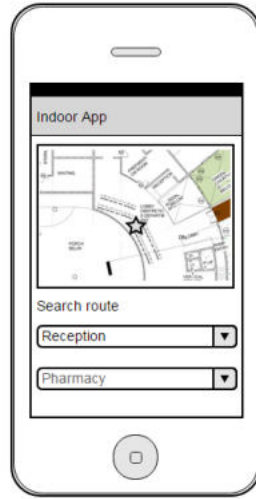
Indoor plan and model updated in an existing online app.

Only two zoom levels used to avoid distractions

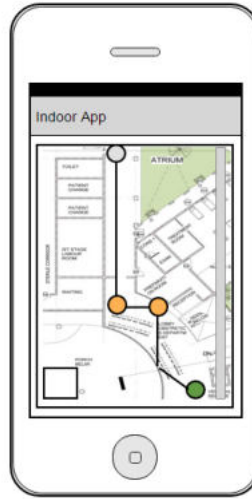
Other additional features are progress, time.



App integrated into Google maps



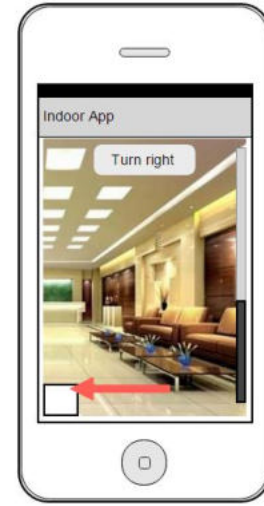
Map based route selection



Only 2 levels of zoom for map navigation

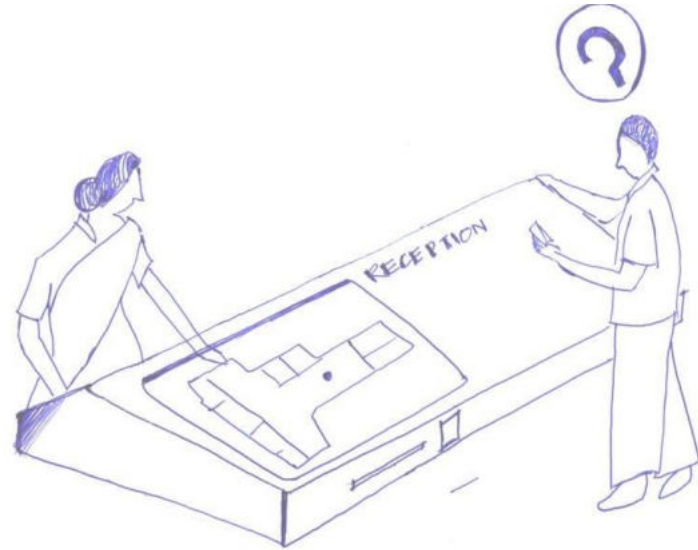
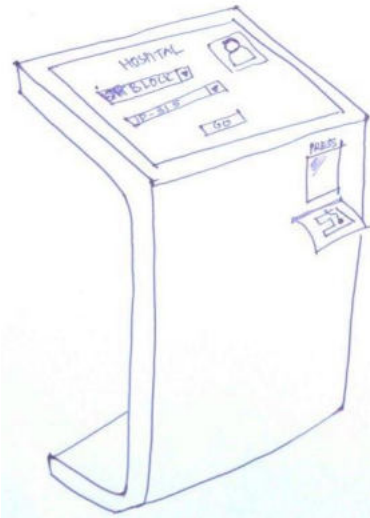


3D model as main navigation interface

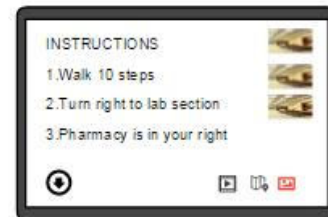


Activity based instructions at nodes

Concept 2



Self assist kiosk at Landmarks and reception



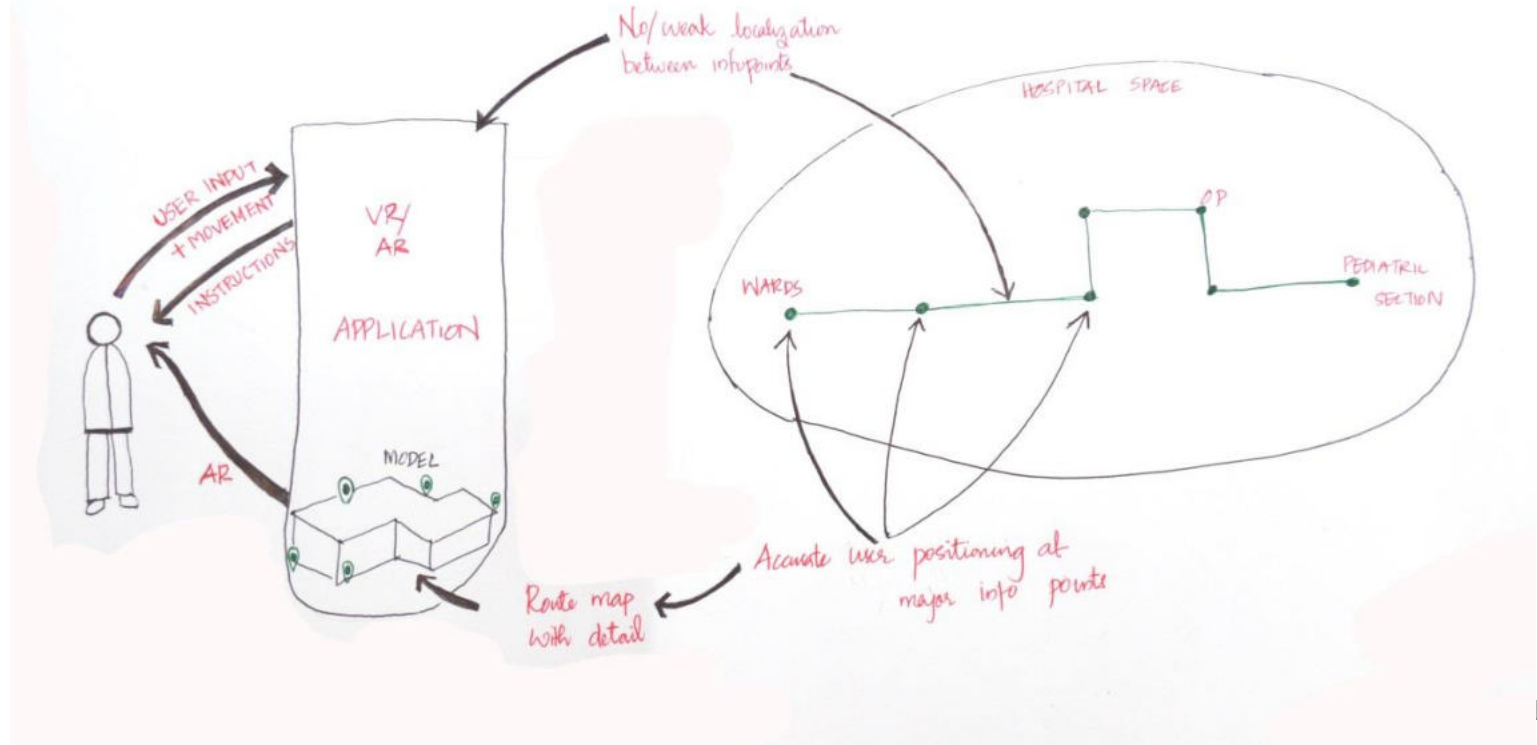
Concerns

Users prefer progressively getting instructions

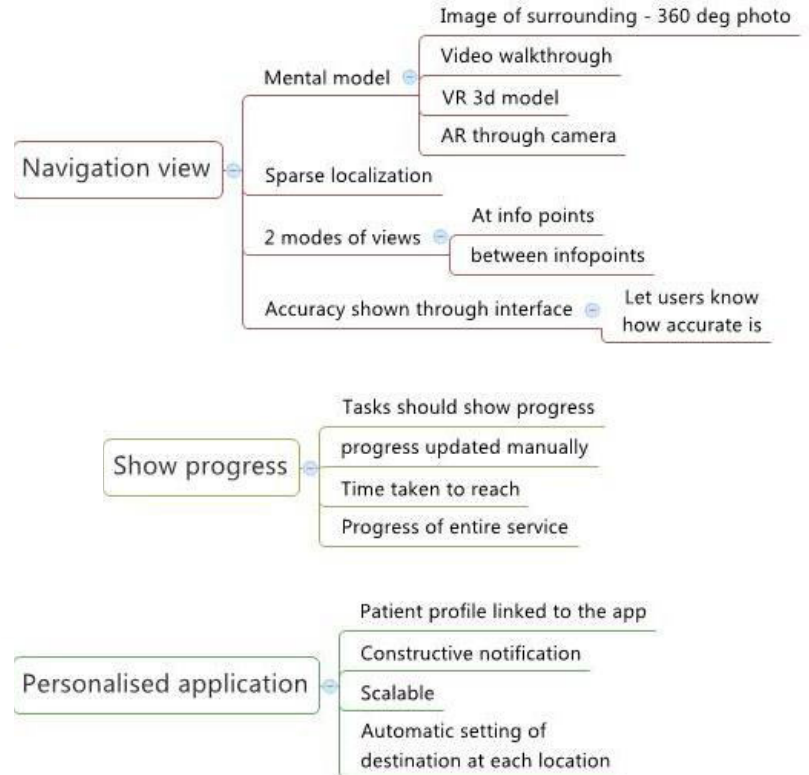
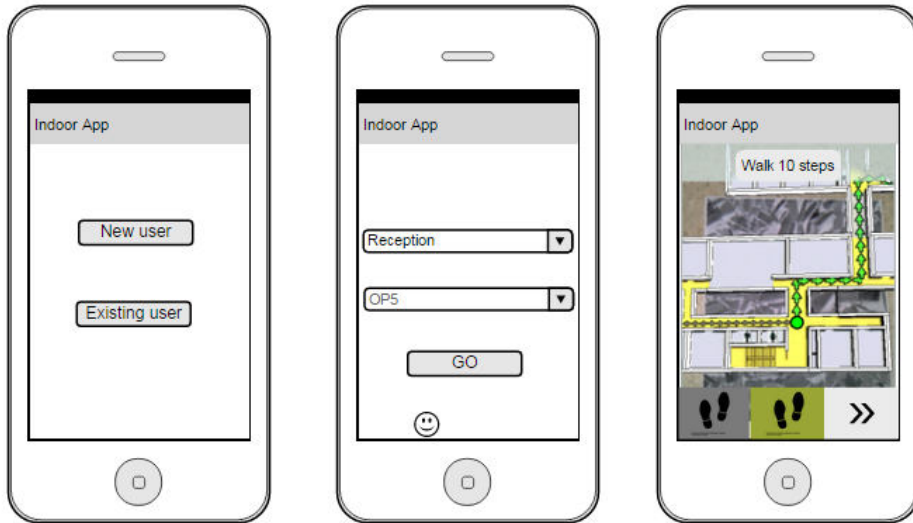
Pace of navigation not considered

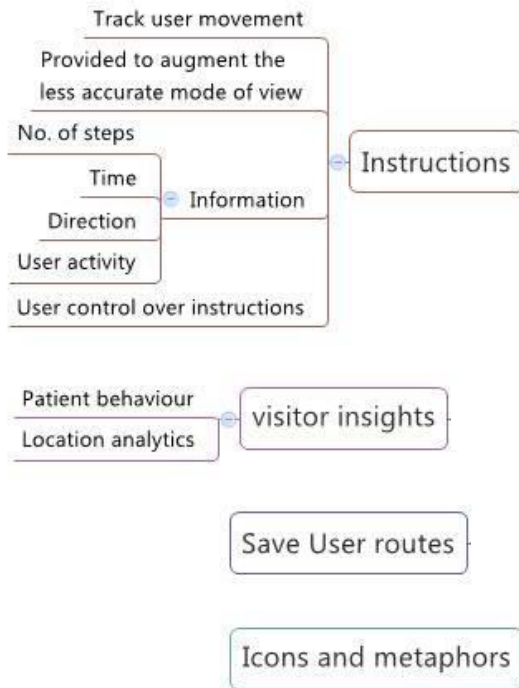
Concept 3

Mixed reality application using building model



Concept 3





Concept 4

Using augmented reality and instructions with continuous localization

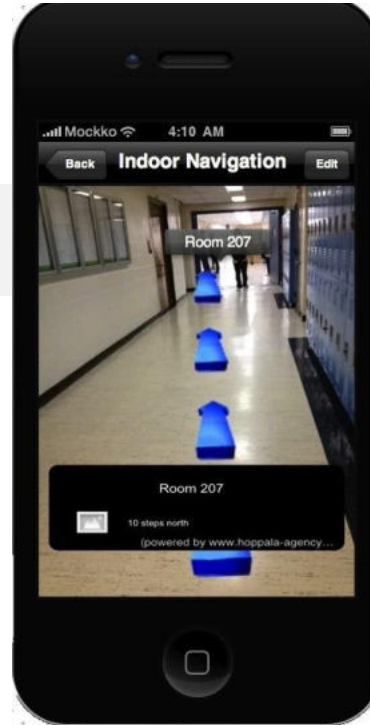
Concept 5

Preparing walkthroughs/set of images for prominent routes

User location not mapped

Reduced complexity and good for current ecosystem

Lower infrastructure requirement



Final Concept

Introduction

Image based navigation system with special junctions as guiding nodes with activity based instructions.

Why?

- Support KEM infrastructure

- Easy to adapt for a less educated user

- Reduce complexity of usage

- Supports both fast and slow paced users

Features

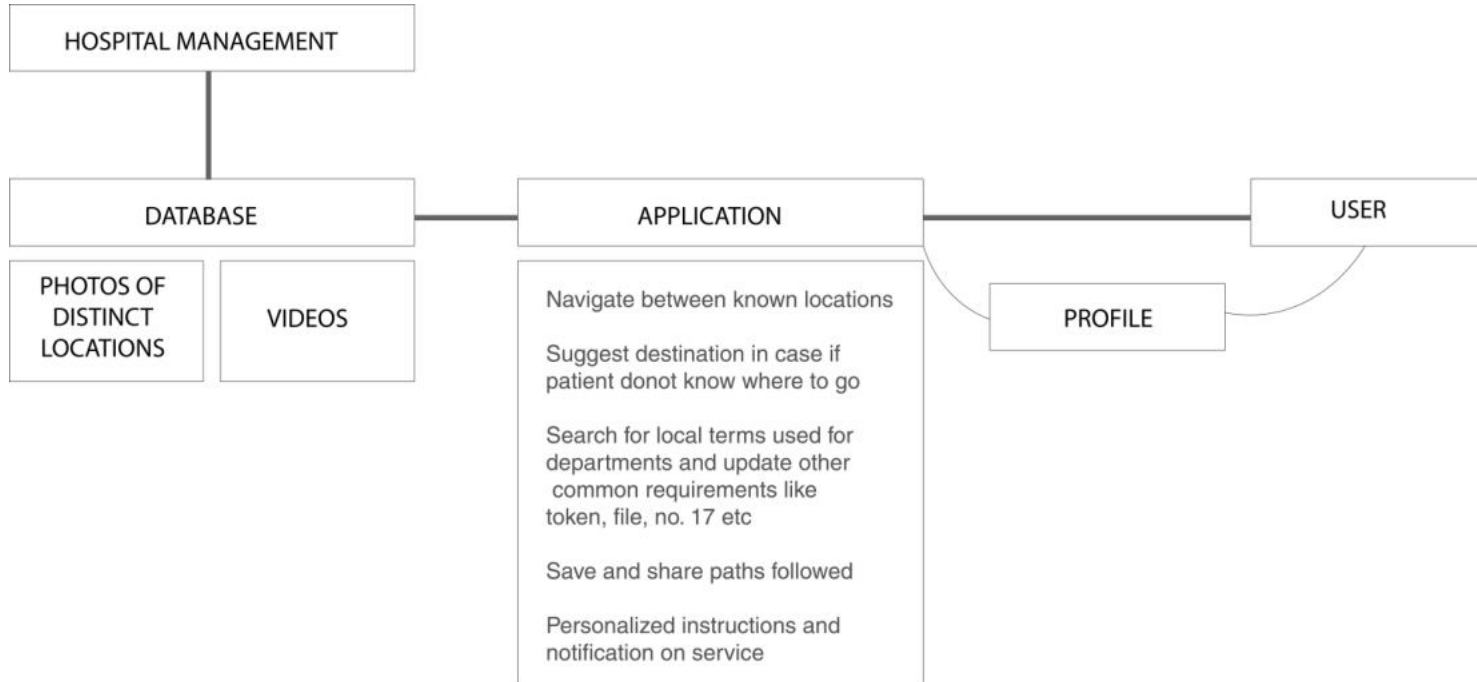
- Navigation with photos

- Offline and online mode

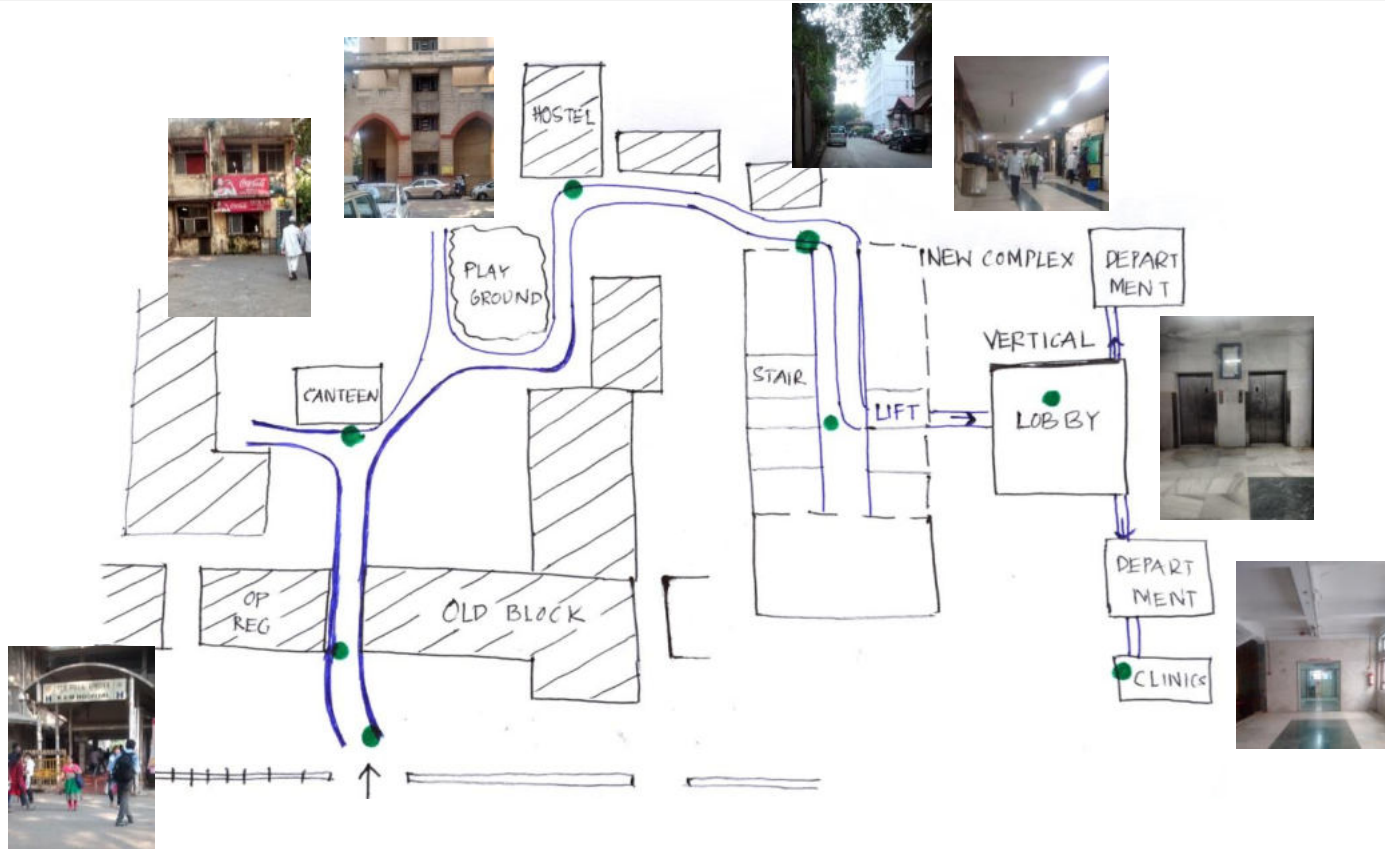
- Profile

- Back end - Uploads and update the photos and videos at decided landmarks

Conceptual model



Design Development - Route



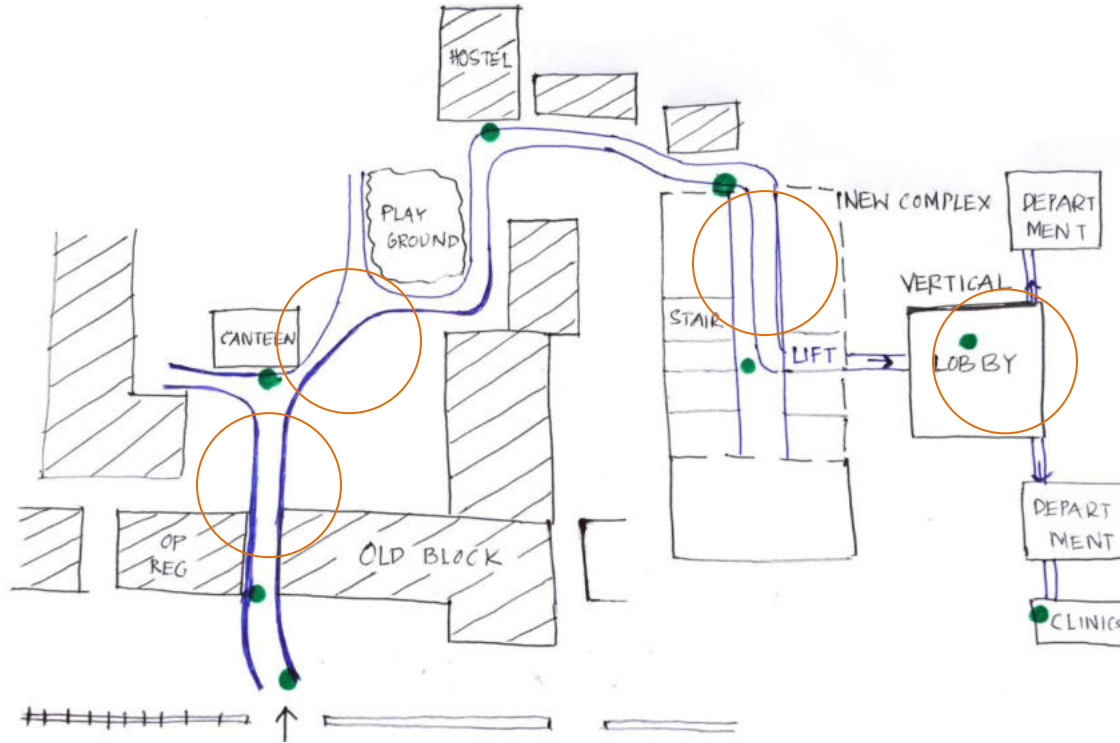
Initial prototype

Features in navigation interface

1. Photos of selected landmarks
2. Number of footsteps to the destination
3. For orientation and direction
 - Arrows
 - Zoom and pan animations
 - Videos for 2 steps
4. Instructions with step progress



Findings— Major areas of confusion



Pilot test - Findings

Landmark photos with arrows showed better results



Photos at all deviations in path

People in image not a problem

Distinct elements required in image

Addition of temporary elements

Videos induced confusion and also took longer time in loading

Pilot test : Findings

Instructions

Confusion when to follow instructions – before or after landmark photo

Number of steps created added confusion

Orientation and instructions did not match

More information required

- Closed lift

- Security desks

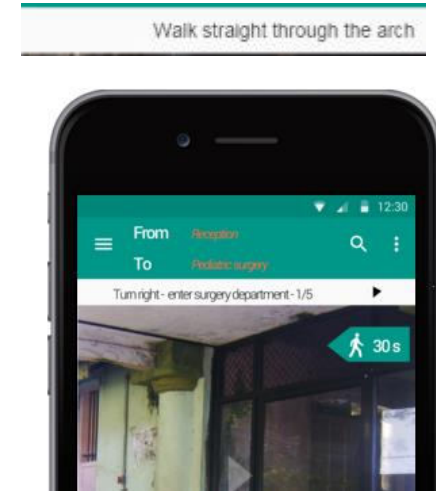
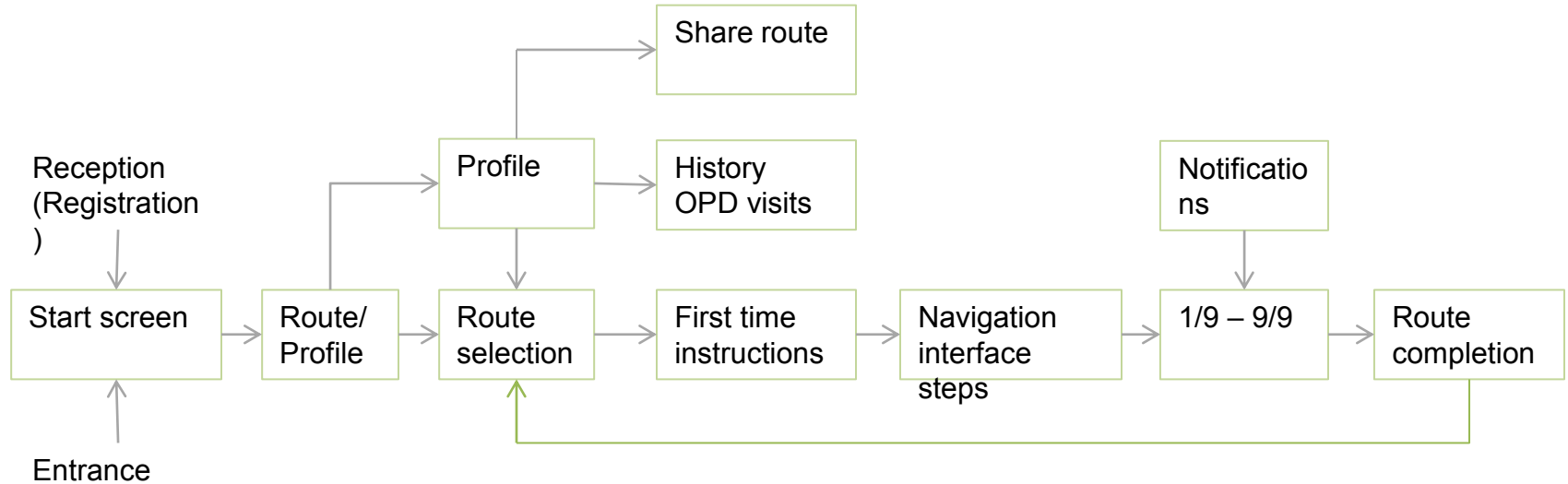


Image selection Criteria - Indoors

1. Routes with similar character, less evident turns
2. Visual access
3. Elements in the scene – People, Signage, cafe
4. Permanent and temporary elements in the scene
5. Lighting of the scene



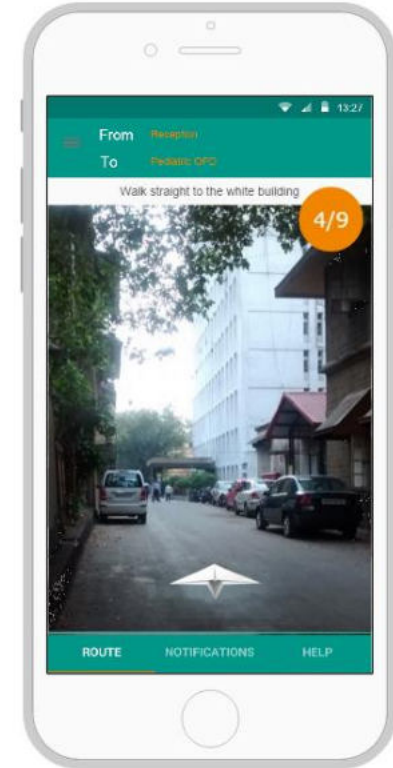
Task flow



Prototype

Scenarios

1. OPD visitor receives app at entrance through QR code and navigates to location without using profile.
2. OPD patient receives app through registration at reception and is directed to destination, uses profile.
3. Patient searches for unknown terms and details.



Evaluation Plan - Goals

1. To find issues the user face while navigating using the final design.
2. Whether the proposed product helped in reducing the uncertainty patients had while navigating the route using signage's and improved their confidence to navigate.

Evaluation Plan - Criteria

User criteria

Education Level : 12th std and above

Age : 25 – 40 years

English proficiency : Fair

Smartphone usage : beginner

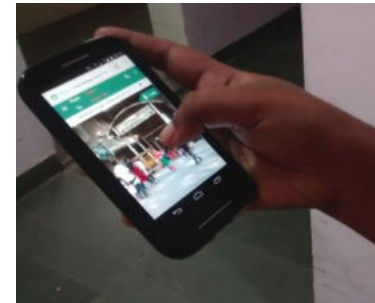
Total number of users : 6

First time visitors to the hospital

Testing ecosystem

KEM Hospital, Parel

Routes : From main entrance to pediatric OPD



Evaluation Plan - Task

Task

3 of the users are asked to traverse the route using signage

3 of the users are given the application to navigate

Introduction

The participants were introduced to the application and how to use it.

The participants were asked to voice out their problems while navigating with the tester accompanying them.

Participants were asked few questions regarding the experience at the end.

Evaluation Criteria

Task completed with or without assistance.

Time taken, if completed

Doubts while doing task.

User feedback

Evaluation Plan – Findings

Signage

Completion

2/3 completed the task with help

Application

Completion

2/3 completed the task without help

Findings

Time taken was almost same (10-15min) due to lift related issues.

Instructions were easily followed

Confusion near lift area

Distinct elements in the scene can be highlighted for easier perception

One user asked for route map

Tracking current location for less errors

Language specific app

Visual Design

Color palette

Green for hospital and Orange to impart attention for details to the users.

Typeface

Roboto is created specifically for the requirements of UI in Android platforms.

Platform

The UI was developed for Android kitkat



Learnings from project

Design processes from primary study to final design

Insights into research and Indian thinking in navigation

Soft prototypes using marvel, proto.io and basic of Phonegap

Pilot testing and evaluation

Thank you