M Checkin3

Mani Narasimhan
Syed Ali Hashim Moosavi
Zachary Buchanan

Abstract:

Global Positioning System (GPS) is widely used to navigate outdoors in many parts of the world. However the GPS technology doesn't work indoors and presents a challenge for navigating indoors in a shopping complex or an office building. This project is focused on a user centric design to develop an app for indoor navigation. We plan on using both surveys and interviews to better understand the users and their requirements. We will then use the results from the needfinding exercises to develop verbal, textual and wireframe prototypes for evaluation. The prototypes will then be evaluated both qualitatively and cognitively for further enhancements.

Introduction:

There are many outdoor navigation applications that ensure that we don't get lost while trying to reach our destination. However, there is a high probability of getting lost in a shopping complex, apartment complex, hospitals, museums, multi-storied office buildings and so on. Navigating indoor spaces is a problem without many viable commercial solutions. The key roadblock in indoor navigation is that a traditional GPS doesn't work indoors. The technology used for indoor navigation ranges from WiFi to radio waves to magnetic fields. Many current systems rely on WiFi or on Bluetooth beacons installed around a given building, which can communicate with a user's phone and offer real-time directions similar to GPS. Based on a recent report from MARKETSANDMARKETS[1] the indoor location market is estimated to grow to $40.99B by 2022. Another report, from Opus Research, estimated that, as of 2014, there were some 200 startups working on indoor navigation systems[2].

The benefits of indoor navigation apps go beyond the commercial sector. For example, patients visiting a hospital can use it to reach the right doctor and department. Similarly, visitors visiting the patients could use the app. as well. In addition, students, freshmen in particular, at a University could use the app to find and reach their classroom on time.

In this project we intend to take a user centric design approach to devise an app that can be used to navigate indoors.

1. https://www.marketsandmarkets.com/PressReleases/indoor-location.asp
2. https://www.smithsonianmag.com/innovation/rise-indoor-navigation-180967632/

Needfinding Plan:

Survey:

The objective of needfinding is to understand the users and their preferences. We chose surveys as one of the methods because of the opportunity to reach a diverse audience in a short time frame. We also wanted a broad understanding of how many users encounter the difficulty of navigating indoors and what tools they currently use to accomplish this task. In addition, we realized that we have a broad set of questions and preferred to use surveys first with the possibility of conducting interviews based on the results from the surveys. First, we wanted to identify the age group of users to understand the correlation between the indoor navigation app usage and age. Next, we wanted to identify the need for an indoor navigation app by asking if the users had experienced any challenges in locating a coffee shop or a suite in a multi-storied office building. In addition, we included specific questions to gauge the interests of users in an indoor navigation app. Also, since indoor navigation is an activity that exists, we wanted to understand how the users circumvent this problem today. Furthermore, we understand that many users might be familiar with an outdoor navigation app, so wanted to get a pulse on the familiarity of such apps for indoor navigation. This would help us understand the level of expertise users would have in using such apps. Since the technology required in such apps is quite complex, we wanted to understand the type of smartphone the users currently use today. Moreover, we felt that users might not want to carry a smartphone while walking around a building trying to locate a specific room. Therefore, we targeted questions to find out the specific attire the users would prefer to house an indoor navigation app.

Overall, our needfinding exercise is focused on understanding who the users are, what tools/methods they use today, what tools/methods they prefer to use in the future and wether indoor navigation is a big enough opportunity that warrants a specific solution.

Think-aloud:

As before the primary objective in a think-aloud protocol is to better understand the user and their preferences. First, we would create different contexts for each task involved in indoor navigation. Specifically, the user would be asked to think aloud about the steps they would take in locating a coffee shop in a shopping mall. The idea is to learn the sequence of tasks they would undertake to reach their destination. In addition, they will be asked to articulate their thoughts on how they will assess their progress towards the goal and take corrective action as needed. Moreover, the users will be asked about their emotions if they are unable to locate the coffee shop on time, would they feel frustrated and what actions would they pursue to overcome such feelings. Next, the same exercise will be repeated, however this time the user will be asked to discuss about locating a suite in an office building for attending an interview. This situation is created from a participant point of view where the surroundings play a factor in how easily the user can reach their goal. Since this context is much more serious than the previous task of locating a coffee shop at leisure, it will give more perspective on potential solutions and their usability.

At this point, the think-aloud session will involve discussions about potential solutions. Specifically, the users will discuss various tools that are available as of today and how the key takeaways from those can be applied to a smartphone app. In addition, this will help us

understand the salient features required in an indoor navigation app. Moreover, the users will be asked about the availability of such an app in a smartphone, smart watch, and glasses to gauge their preferences on a specific device.

Needfinding Execution:

Survey:

The results of our first needfinding method, surveys, are shown in Appendix 1. Our goal in this needfinding method was to find more about the user base for indoor navigation solutions. Our survey results showed that although many users have had experiences where they struggle to navigate in large buildings, few have looked for apps or devices that could solve their problems; and even fewer of those that looked were able to find any solution that remotely solved their problems. The data inventory and the requirements we defined are shown in Appendix 2.

Over fifty percent of those who took our survey responded that they use the outdoor walking navigation features of their outdoor navigation apps, such as Google Maps. This shows that many users are willing to use their mobile device to navigate while walking, and would most likely use indoor navigation features if they were available.

To learn more about what the users would be willing to purchase to help them navigate indoors, we asked the question shown in appendix 1.12. This question showed that most users would prefer to use things they would wear everyday to help them navigate indoors, such as a smartwatch or AR glasses. Adding a smartphone option in this question would have been helpful to determine if users would prefer to use a smartphone over all the on-body options we provided.

There were two main biases to control for in our survey procedures. The first was social desirability bias. This bias could show itself when we ask the participant if they would use an app if one was available. To control for this bias, we asked the user this question in a way that did not show what answer was the one we wanted. This question is shown in Appendix 1.2. The second bias was recall bias. This question could become a problem in a few different parts of our survey. One of the examples is seen in Appendix 1.10. To control for this we did our best to use a range for the user to select, so they did not need to pinpoint exactly how many times they had done something in the past.

Think-aloud:

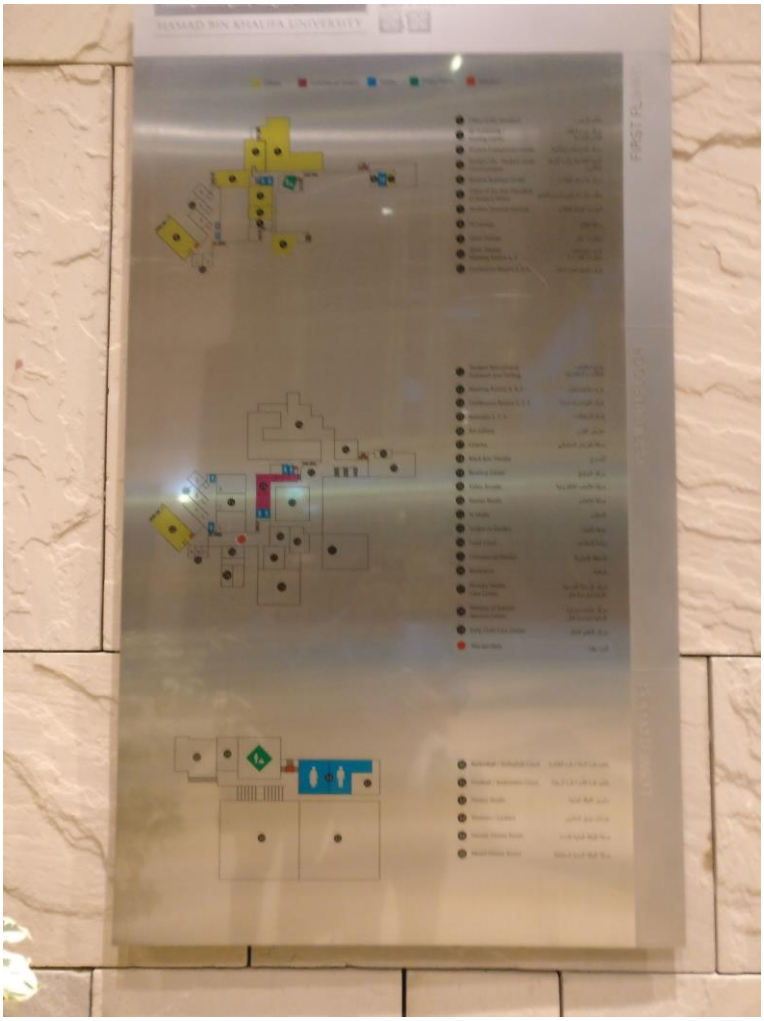
As mentioned in the needfinding plan the users were asked to think aloud about different scenarios such as locating a coffee shop in a mall and a suite in an office building. In locating the coffee shop the users felt like they had many resources at their disposal. They would first refer to the map in the mall directory to orient themselves and plan their movements towards the destination. In addition, they felt like they can use nearby stores as landmarks which can help them move in the right direction even if their understanding of the map is not thorough. Also, they acknowledged the possibility of asking others in the mall to get to their location easily. However, many of these don't apply in an office building where they might not see others on the walkway to ask directions or have other landmarks to refer to. In such cases, a map of the building is their primary tool in mapping out their path to the final destination. Also, time is a factor in the latter because they usually go to office buildings for business activities that are usually more time sensitive.

As existing outdoor navigation app users they felt that an app in a smartphone would be perfect. Specifically, the users preferred an app that showed the path to the destination on a map of that particular facility. However, the users expressed that using an outdoor navigation app to reach a building and then entering a suite number in an indoor navigation app to reach their destination would be redundant. Instead, they preferred an indoor navigation app that synced up well with an outdoor navigation app. All the user would have to do is enter the entire address in the outdoor navigation app, once the user reaches the building the indoor navigation app should pick up the address that the user entered before and guide the user to their destination. The users preferred that the app map out the path and display it in an appropriate color. In addition, they preferred that the app show the number of steps required to reach that suite along with the estimate time to do so. These two variables can be used as measures by the user to monitor their progress towards the goal. Much like an outdoor navigation app, the users preferred the app display the directions to the destination in text as well. Also, the users preferred that the app should enable them to specify if they want to take an elevator or a staircase in reaching their destination.

Continued Needfinding:

Once we collected responses from the users in the surveys, we got a sense of how many users have the challenge of navigating around an indoor facility like a mall, office or museum. On quick observation, we realized that most of the users use some static maps like the directories/fire escape maps on the walls. Keeping this in mind, we would like to perform a naturalistic observation going forward to understand how the users use these directories/maps to navigate around the respective facility. In addition to that, we would like to recruit interview participants, who have used any tools for navigating doors.

Following is a map used within a university for navigating between different landmarks within one of the university buildings.



When I was performing the observation, I noticed that many people were looking for the closest washrooms. They were also looking for offices of particular staff part of the different departments that were situated in the university. The way the map is designed made it difficult for one person

to orient themselves appropriately and direct themselves to the washroom as a number of details like the walls, rooms and other barriers were abstracted away. For navigation, each of these barriers plays an important role as the user decides which way to take based on this metadata about the route. Additionally, I noticed that there were only a limited number of landmarks mapped on the particular signage. Because of this, the signage was not very useful and only limited number of users were using it. Moreover, even though the user got an idea for where the destination landmark was, they did not real-time directions along the route so they had to use more than one of these maps along the way to reach their destination.

Brainstorming:

Individual brainstorming was conducted first. Each member of our group conducted their individual brainstorm process by constraining themselves to come up with at least 10 ideas over a couple of days. Examples of our ideas from this stage are shown in Figure 1. We constrained our solutions to be of a digital nature, since our needfinding showed that an indoor navigation solution that paired with their outdoor navigation was important. To move from individual brainstorming to group brainstorming, we further filtered our individual ideas by ones that best met the requirements from needfinding and seemed to have the most promise. We then brought these ideas together in a group conversation where we defended the design alternatives we thought of. Finally, we picked from the alternatives, the designs that best fit the requirements highlighted in needfinding to move to the prototyping stage.

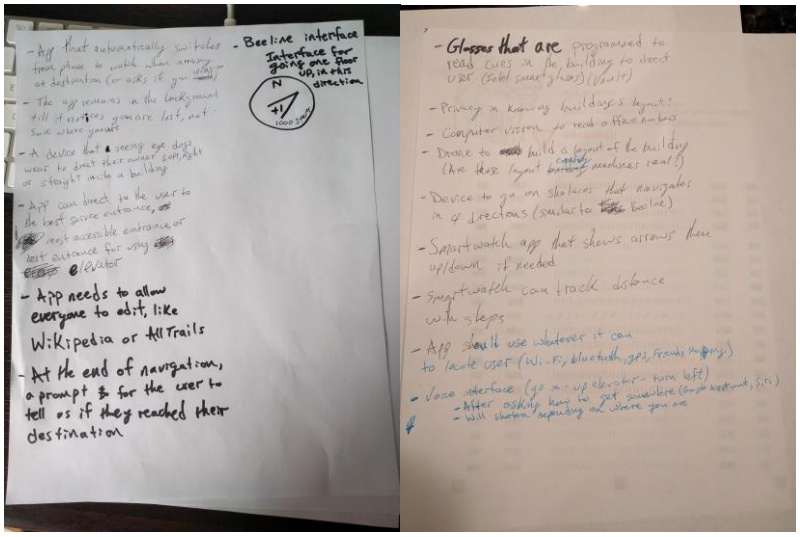


Figure 1

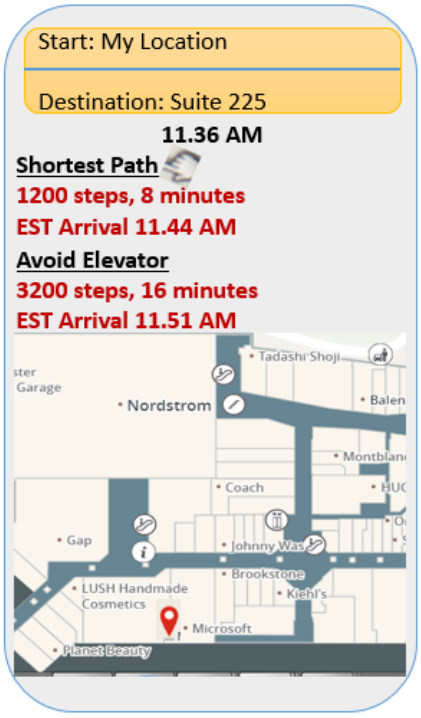
Prototypes:

Prototype 1 - Floor plan based Indoor navigation

After both individual and group brainstorming sessions we chose three ideas to further develop into prototypes. The following illustrations show that users can use a smartphone based app for indoor navigation. First, the user would select the app and input their destination. The app will then calculate multiple routes that the users can select depending upon their preferences. For example, if the users prefer to take the stairs rather than an elevator they can do so, assuming such options are feasible. The app will also display the number of steps and the time required to reach the destination. The app will display the directions on a map of the corresponding facility enabling the users to zoom in and out as needed. In addition, the users will also have the option of viewing the entire directions as text.

Select App.

Choose Route

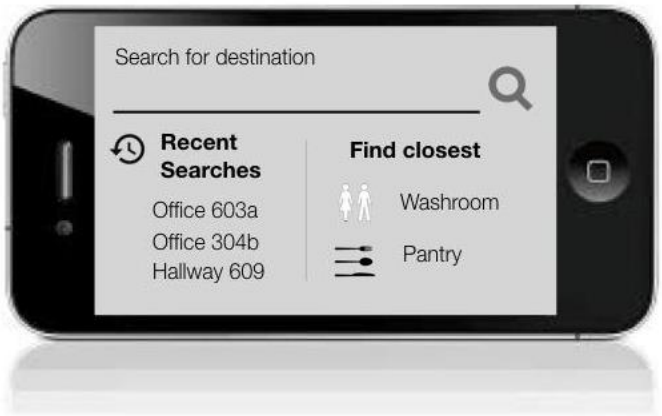


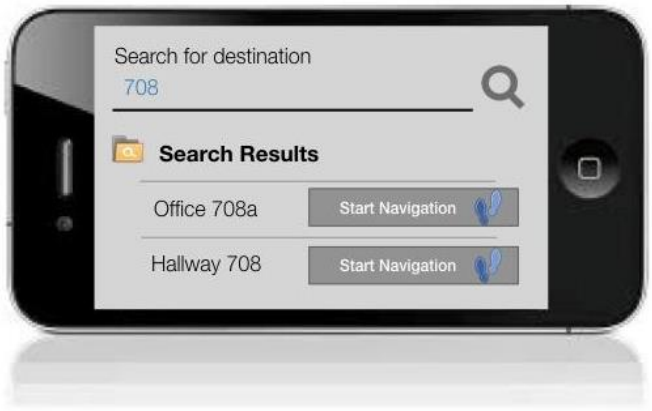
Navigate

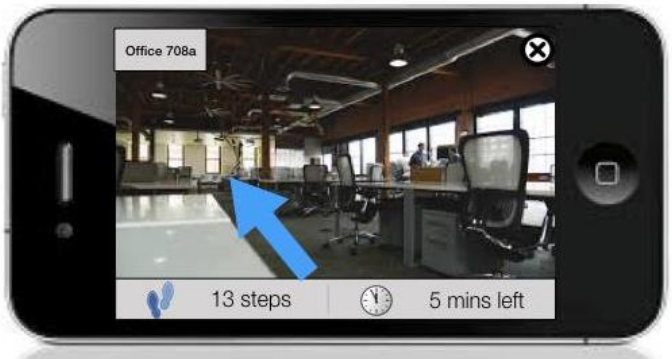
Navigate

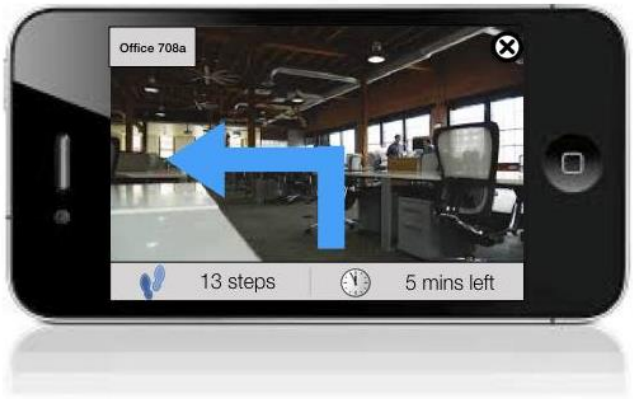
Prototype 2 - Augmented Reality based Indoor Navigation

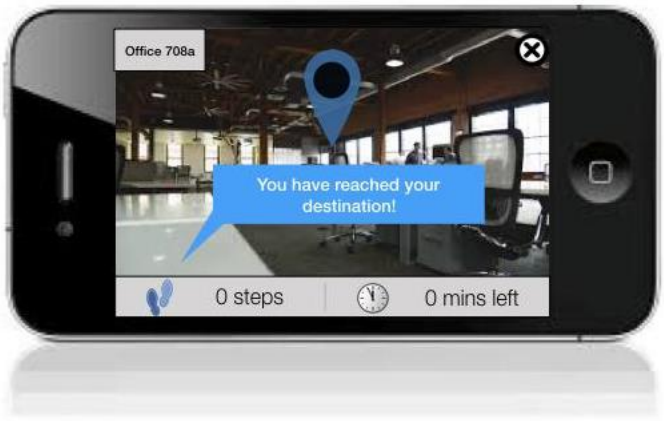
In this prototype, we use the phone camera to show an augmented reality based overlay of instructions based on the view of the user. Firstly, the user enters their destination using the screen below. For discoverability, suggestions like recent searches and closest common locations are shown at the landing page of the mobile app itself. Once, the destination is selected, then an overlay is presented on the path to give the user an idea of the direction they need to head to. The number of steps & remaining time are both shown in a bottom status bar.




Search for destination
708
Search Results
Office 708a
Start Navigation
Hallway 708
Start Navigation


Office 708a
13 steps
5 mins left


Office 708a
13 steps
5 mins left



Prototype 3 - Watch based indoor navigation

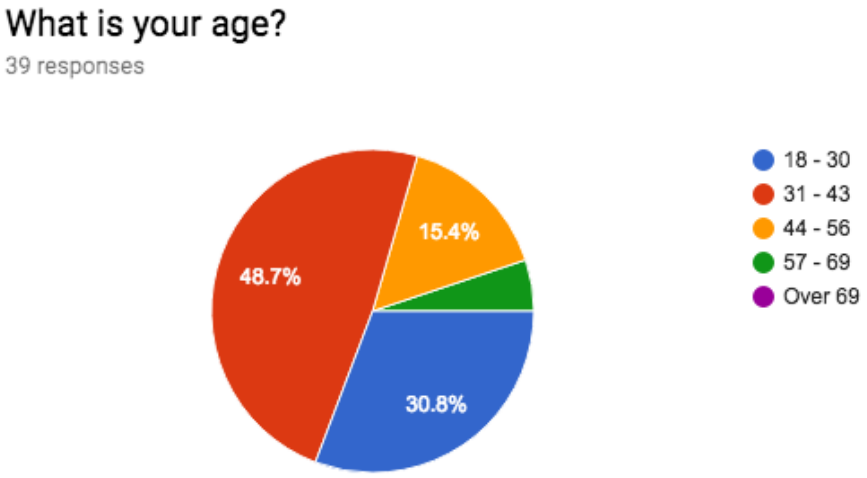
This interface prototype is intended to be used on an apple watch device. The assumption is that the user would be searching for a location on their mobile device or desktop, and once they have arrived at a step where they will be walking the rest of the way to get there, they will push the location to their watch. The watch app will then allow them to start the walking navigation with a simple arrow interface that tells the user which direction they should start walking, and about how many steps are needed to get to the destination. The user will also be shown what floor they need to get to in the top left corner of the interface. Plus one floor would mean that they needed to go up a floor to reach their destination.

A gif of the interface in action can be found here:

https://drive.google.com/file/d/1c1Jbtnk2pk0sq45ouWwWu1PoigK_bCkI/view?usp=sharing

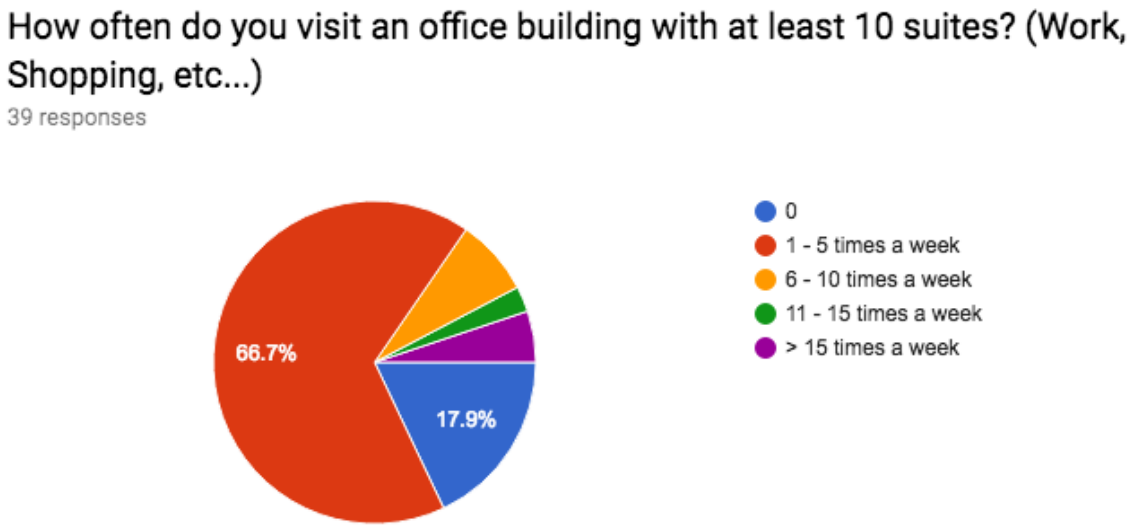
Appendix 1:

1.1



1.2

1.3

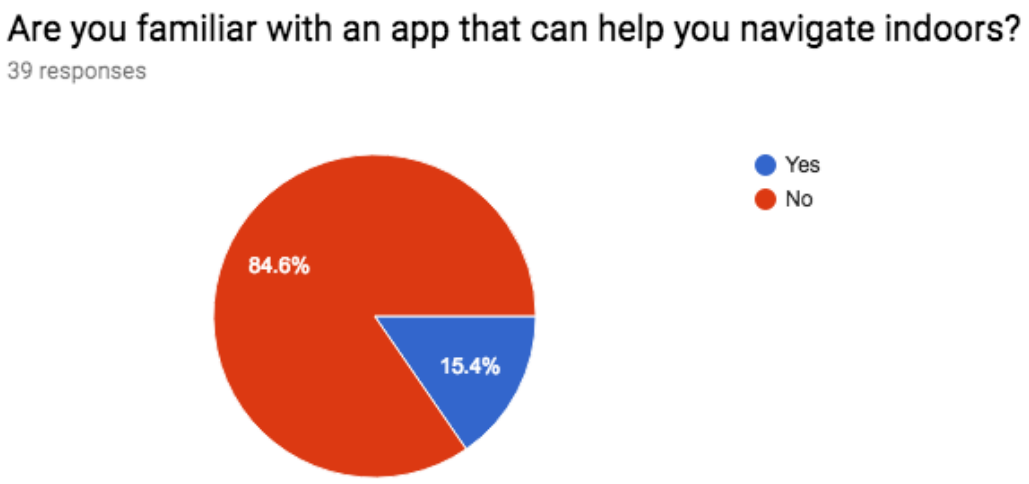


1.4

What methods do you currently use to navigate within a building you are not familiar with?
A mall directory -- billboard.
asking around, floor plans
by the suite number
directions/maps
Directory at elevators.
directory, workers
Fire escape diagram; reception
Google maps
Indoor Map (physical)
intuition
Just ask people around
look at the in building map
Look for a map
look for a map
Look for a map or guide
map

Map
Map Kiosk
None
Physical map or signs in the facility
posted signs
Printed maps. Floor listings posted in the elevator bay.
Reception
Room numbers, asking people who work there
Signage and logic
signboards, ask other people, enquiry desk
Signs, Apple Maps app
the floor plan usually posted in the lobby
Trial an Error, look for a map or directory
Try to find a map
Use indoor maps posted on the walls or like what they do in malls; look for signs; ask someone when I'm lost
walk around

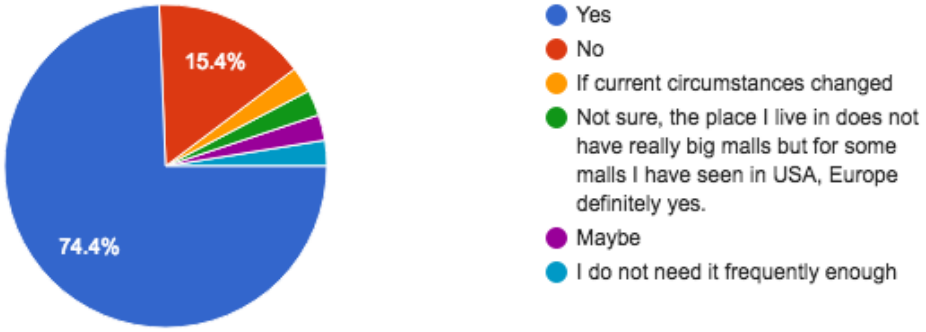
1.5



1.6

If there was an indoor navigation app, would you be interested in using it?

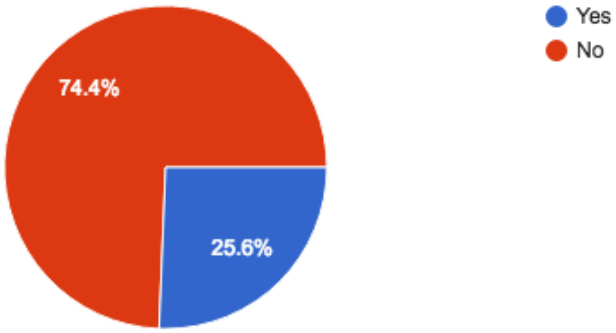
39 responses



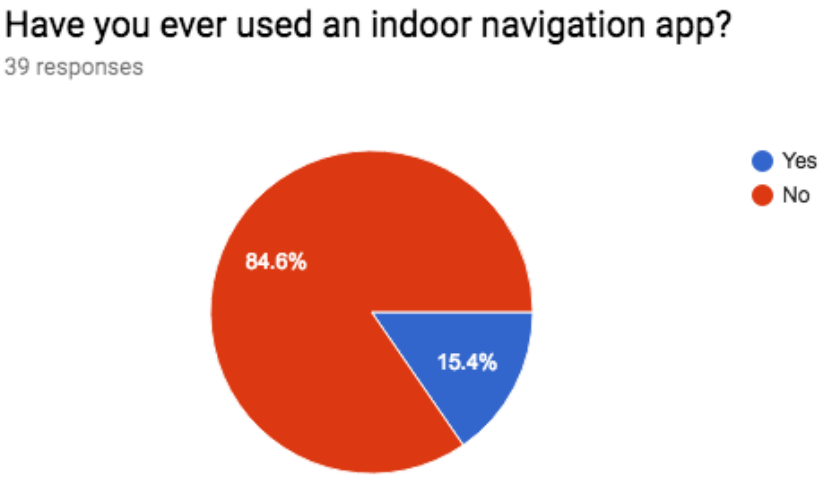
1.7

Have you ever looked for an indoor navigation app or device to download or purchase?

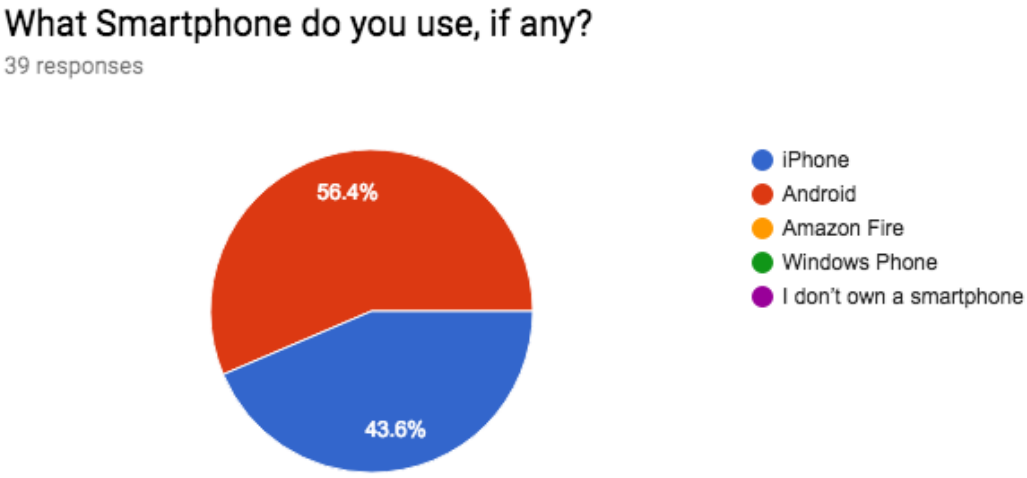
39 responses



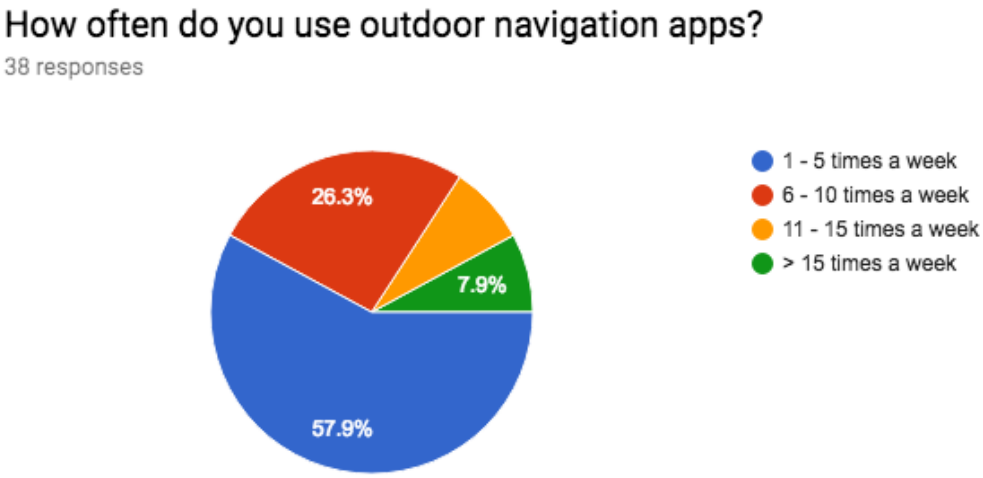
1.8


Have you ever used an indoor navigation app?
39 responses
84.6%
15.4%
Yes
No

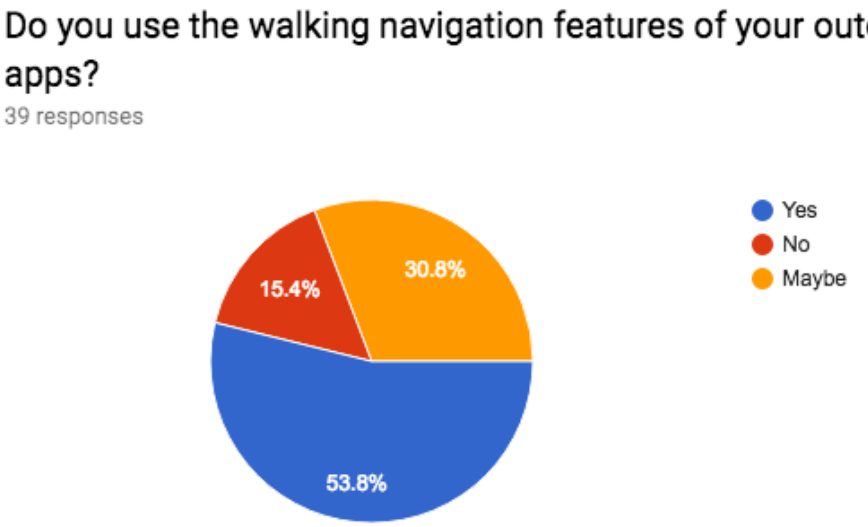
1.9


What Smartphone do you use, if any?
39 responses
56.4%
43.6%
iPhone
Android
Amazon Fire
Windows Phone
I don't own a smartphone

1.10


How often do you use outdoor navigation apps?
38 responses
26.3%
7.9%
57.9%
1 - 5 times a week
6 - 10 times a week
11 - 15 times a week
> 15 times a week

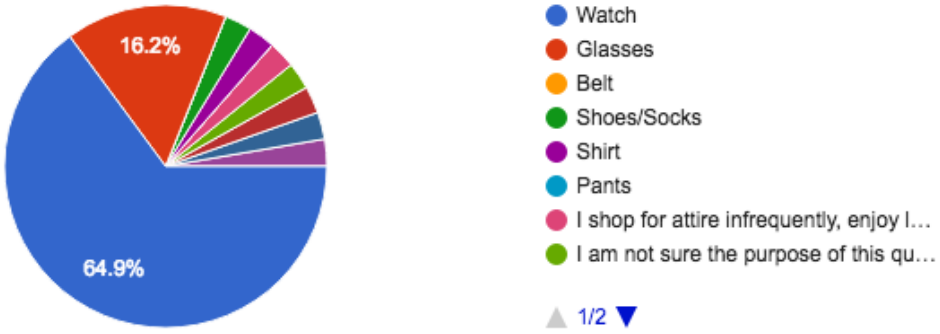
1.11


Do you use the walking navigation features of your outdoor navigation apps?
39 responses
15.4%
30.8%
53.8%
Yes
No
Maybe

1.12

If you were to buy a piece of attire that had indoor navigation features built in, what type of clothing would you most prefer?

37 responses



Appendix 2:

2.1 Data Inventory:

Our data showed that, while many of our users only visited large buildings less than six times per week, the experience can often be frustrating and many wish that they had an indoor navigation solution to help them. Therefore, our users can be defined as anyone who must visit a large, complex building where it would be helpful to be guided to their destination. The users will be at, or planning to go to a destination inside a building they have not previously reached.

There will be many different scenarios where the user might need help getting to their destination inside a building, they could be meeting with a business partner, walking through the mall with their kids, or friends and family visiting a patient at a hospital. Each of these mentioned scenarios comes with different constraints placed on the user. They could be under time constraints to get to the meeting, attention constraints if they are paying attention to their kids, or emotional constraints if they are visiting a loved on in a hospital.

The goal of the user is to get to their destination, usually in the fastest time possible. Their tasks are finding the building, looking up where in the building the destination is located, getting to the correct floor, and finally getting to the correct suite. Their subtasks during this navigation process are determining the floor number they are on and therefore if they need to go up or down, making sure they are walking in the right direction, be that N-S-E-W or by suite number, and finally stopping once they have reached the correct destination.

2.2 Defining Requirements

From the data we have gathered so far, it seems that users want to be able to use a device they already own to navigate indoors. The solution should therefore be something they already own, or are provided by the building itself. More needfinding will be done to further constrain the solution, beyond this point.