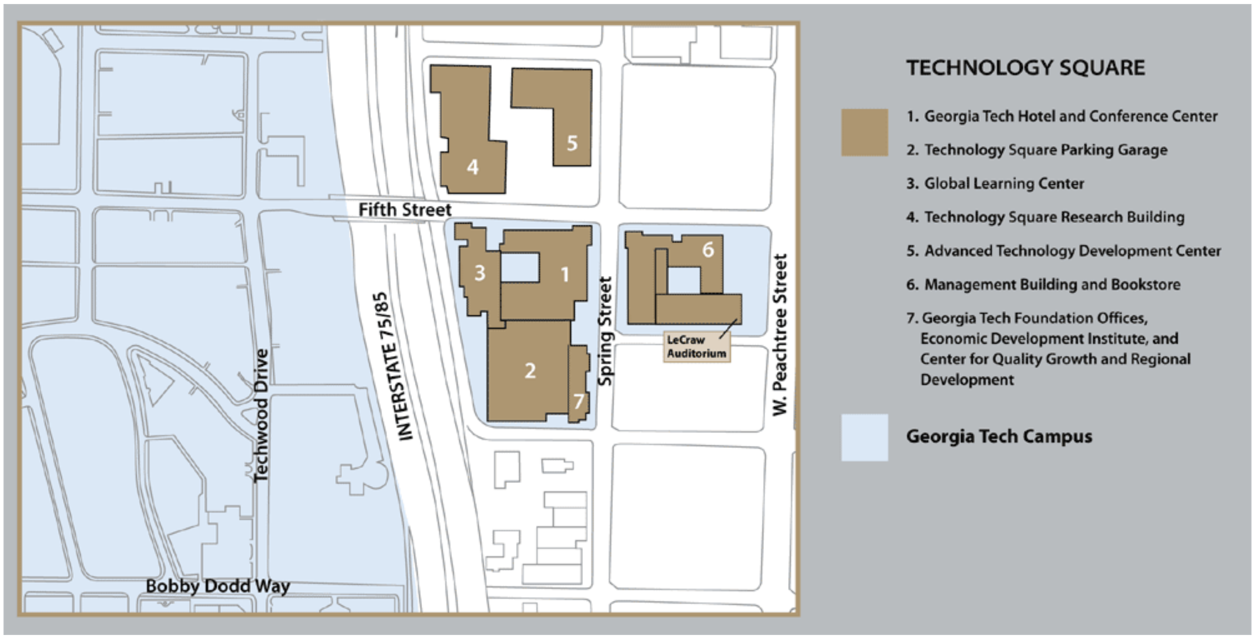
Tech Square
RESEARCH BUILDING
@ Centergy

[TSRB]

Introduction

Technology Square Research Building (TSRB) is located adjacent to Technology Square at Georgia Institute of Technology. This area is home to many other buildings and spaces for business, education, research, retail and service, including the neighborhood's first major bookstore. TSRB offices and labs are full of researchers from diverse organizations and TSRB has several venues for conferences and meetings. (1) The main research organizations inside the building are: Georgia Electronic Design Center (GEDC), the Graphics, Visualization and Usability (GVU) Center and the Center for Research on Embedded Systems and Technologies (CREST). (2)



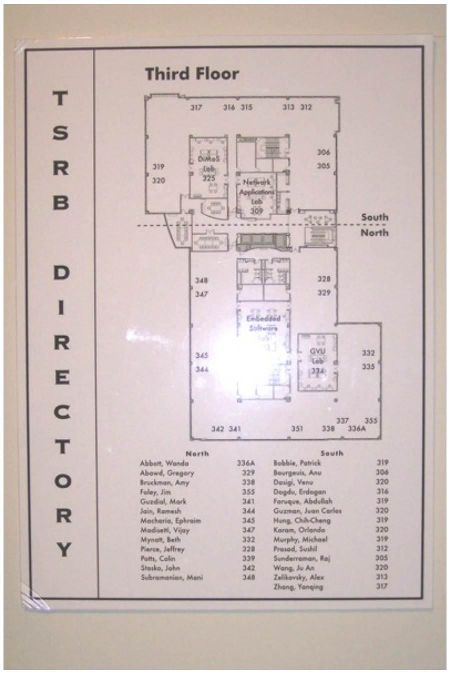
[Location #4 is the TSRB building]

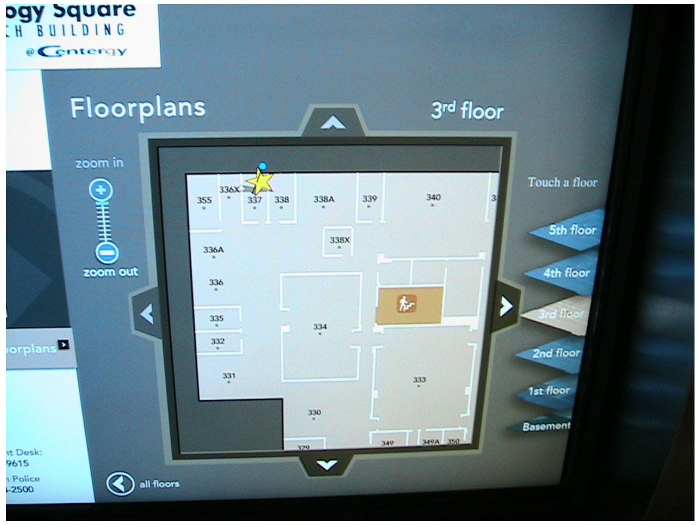
All of the research organizations are related to the development of new technologies. The GEDC supports research that fosters the development of new communications technology in wireless/RF, wired/copper and fiber channel applications. Home of the nation's largest university-based mixed-signal research team, Georgia Tech's GEDC collaborates with more than 40 member companies and federal agency partners, conducting approximately $10 million in research each year. (3) The GVU Center organization combines in-depth studies of human capabilities, needs, and practices, cutting-edge graphical display techniques, augmented spaces that merge physical and virtual elements, intelligent sensing, and novel input, output and wearable technologies.(4) And CREST, whose website says that their mission is to reduce by orders of magnitude the non-recurring engineering costs and time-to-solution of embedded systems, accelerating their pervasive growth and positive impact on all aspects of our lives.(5)

Many companies come to Georgia Tech and give conferences to the students inside TSRB (e.g. Google, Microsoft). Many seminars like the GVU Brown bag are also offered at the conferences rooms. This means that the buildings in not only used by researchers but also by students and professors alike. Even people that don’t know much about the area or are not Georgia Tech students/faculty come to the TSRB to give or attend conferences.

How do people know where to go inside the building if they don’t know that information?

In the current navigational system, the best way for a first time visitor to know where to go is having someone to lead them. If the person doesn’t have that option, then s/he will ask around for directions. Some people might look for physical directories that are located in each floor. None or very few of the first time visitors notice the electronic directory (kiosk) in the lobby area, which helps users locate the office or lab in a map.





[Left – Physical directory located in each floor. Right – electronic directory (kiosk).]

Why is it important to have assistant in the navigational task?

Knowing where to go is one thing and following a path to get to a destination is another. TSRB is a five-story building, and almost each story has four entrances to get to different areas of labs and offices. There are also lots of partitions that divide research groups into one by one, therefore it is not easy to look around the entire structure of the office. The task of recognizing where you are and where are you heading is difficult because:

- Each floor has four doors which lead to different hallways with no signs showing which rooms are behind which door.
- Cubical areas are maze-like; and most are not properly numbered or labelled.
- Not all labels are current or accurate

Mission statement

Our mission is to help people to get to their destination inside the TSRB building easily. We want to design a system that is predictable (easy to learn), reliable (it will give the same answer in different occasions) and accurate (right results). As a result, the design will get the users to their destinations quickly.

System requirements

Security

The kiosk which works as a directory for the building, labels and maps are all located inside so they don't have to suffer from vandalism. There is a tight security in the building with security personnel and cameras.

Maintenance

Labels and maps are able to be replaced at any time if they get wore down or there are any changes in the room numbers and their respective labels. The kiosk has to be fully functional all the time. This system has the option to be updated when some changes occurred to the data.

Funding

The existing navigational system consists on labels and physical maps, and also an electronic kiosk. The replacement of labels and maps doesn't cost much but anytime a change occurs on the rooms' layout, they have to be changed. However, the kiosk maintenance is expensive if it happens to break but changing the data is easier and less expensive. Funding is provided by Georgia Institute of Technology.

Users of the navigational system

Our users are people that are having problems with finding where to go and how to get to their destinations inside TSRB. These can be the following:

Students

- students looking for a lab
- students looking for a person (e.g. David White)
- looking for lecture room

Other professors and researchers

- looking for lab or specific person in a lab
- less likely to be looking for administrative personnel
- looking for lecture room

Visitors from other universities

- looking for lab
- looking for lecture room

Visitors from companies (e.g. Google)

- looking for lecture room
- looking for contact person regarding recruiting

With this information we can assume:

- High level of education (most people involved in university or highly skilled jobs)
- Exposure to technology (it's a tech school)
- Most users undergrad or grad age through retirement age (about 16-70)

Users' tasks

1- Information Collection

- Where is the destination – room#, map
- How to get to the destination – directions

2- Execution

- Follow directions to navigate to destination

Analysis of Existing System

Mission scenario

Someone goes into TSRB wanting to go to David White's office. He knows the name but does not know the room number. He walks into the building not knowing where to go or which floor the office might be on. He locates the directory kiosk in the lobby and decides to look up David White to find his office number. He clicks on the "Individuals" tab, then types in "David White" in the search screen. David White's name comes up in the search results. He touches the screen and goes to David White's profile where he sees the room number. He clicks on the star icon that takes him to a map where he sees the location of the office and he tries to figure out where to get there from his current location. The map disappears and he goes to the elevator to go up to the third floor, but by the time he gets there he has forgotten the rest of the way to the room. He wanders around looking for the room number and asks some people where the office is, and after some time is able to locate it.

Environmental Analysis

General Information

Technology Square Research Building (TSRB) is located nearby Technology Square, Georgia Institute of Technology. TSRB is a five-story building and has one main entrance of TSRB on the first floor. The approaches to go upstairs are two – one is to get on the elevator (four elevators), the other stairs. On each floor except for the first floor, there are four entrances to get into an office. Offices are mainly open space and there are a number of research labs and faculty offices. In an office, there are also lots of partitions to divide research labs into one by one so that it is not easy to look around the entire structure of the office.

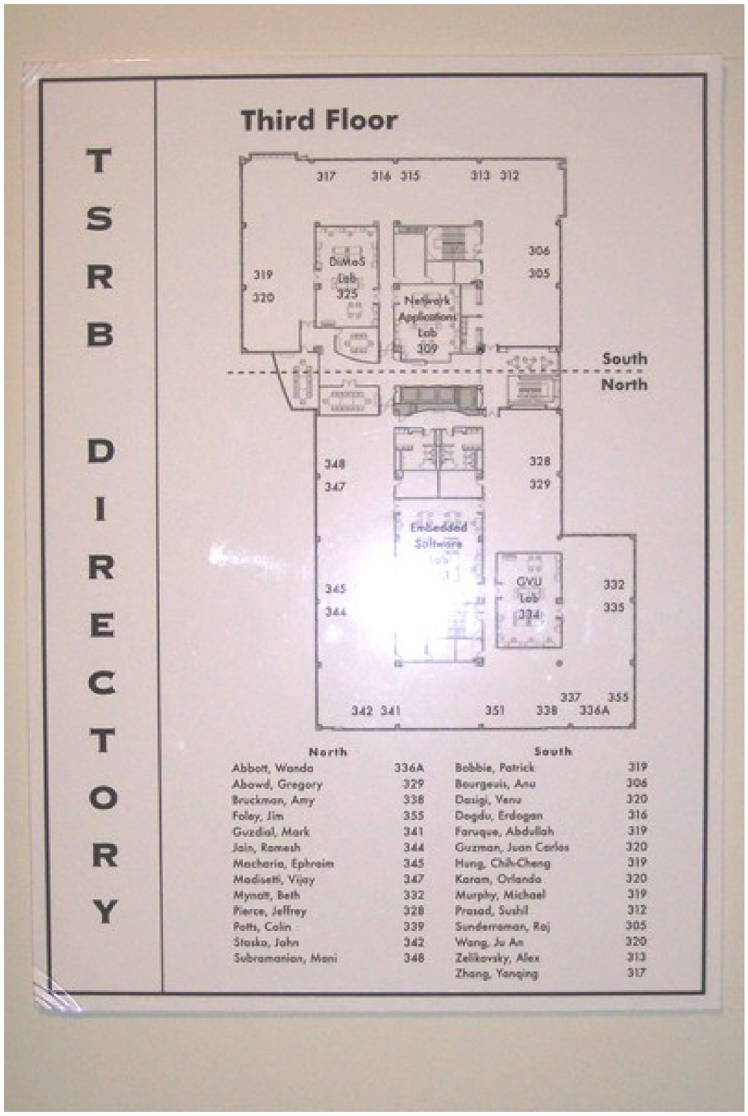
In addition, TSRB, as a research building, is generally not noisy. In TSRB, there are lots of seminars such as research presentations or career fair as well as lectures. Thus, the floating population is presumably thousands of people who are (graduate or undergraduate) students, faculty, and visitors to go into the building in a day.

Current Navigation System

People can currently access two navigation systems in TSRB – one is a kiosk and the other a floor map put up on the wall. On the first floor, there are the information desk, a few comfortable chairs, and one kiosk which stands in front of the information desk. A telephone is put on a little desk next to the kiosk in order to call to the person whom the visitor is meeting.

[Pictures of the first floor of TSRB]

If a visitor arrives at the right floor, he or she can see a floor map on the wall. Because the background color of the map is similar to that of the wall, this map is unable to attract public gaze. A person is able to catch the destination as matching a room number and a person's name not a lab's name – the map doesn't provide a list of labs.



[A map of the third floor of TSRB]

Preliminary Task Analysis

We interviewed potential users asking open-ended questions like: What would you like to do with a campus navigation system? What are your difficulties if any when using this type of system? The responses will give us an insight about the user needs. This analysis will help us evaluate the existing system and design a new one.

The users want a system that does the following:

Basic Functions

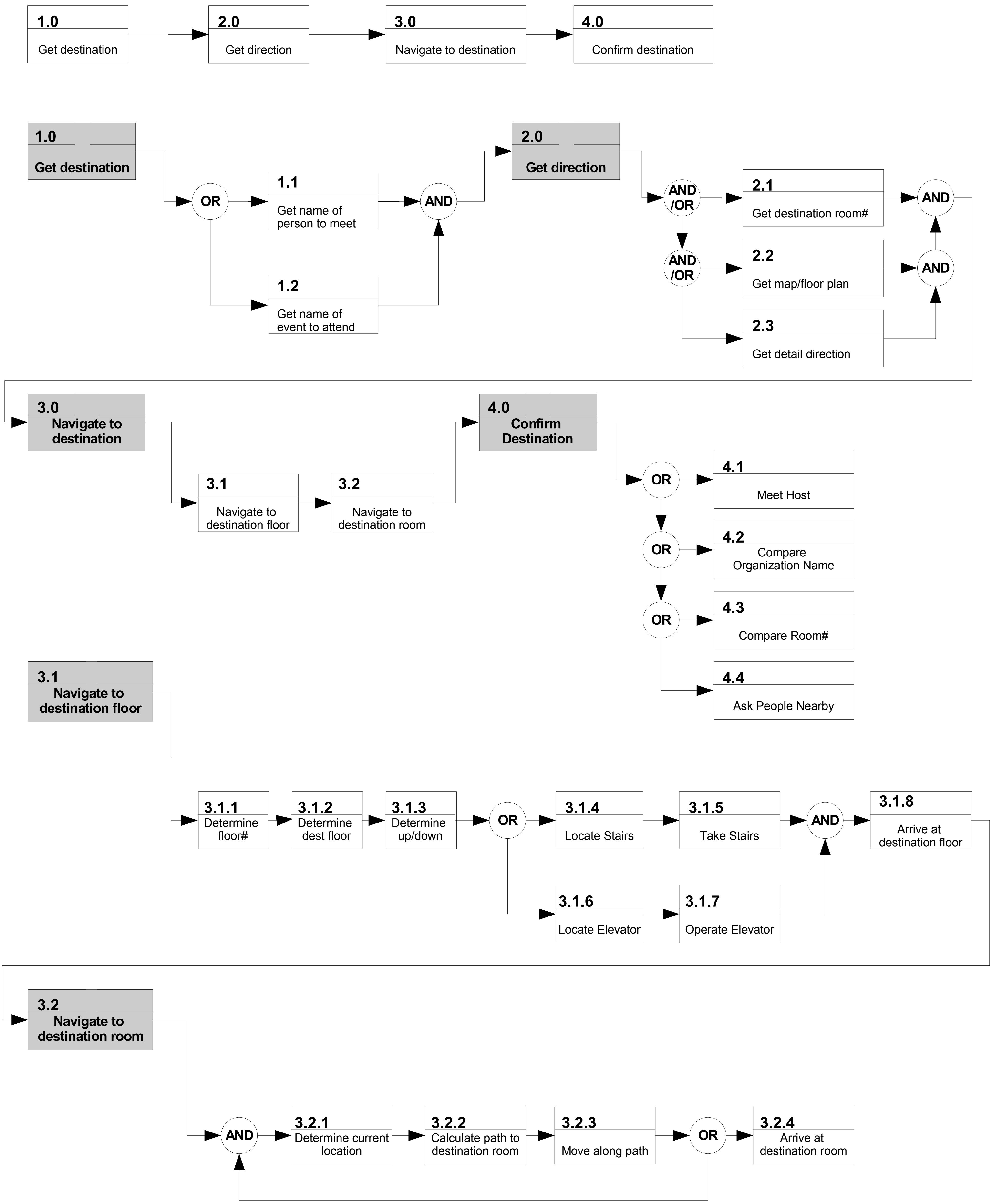
1. tells them the fastest way to the target place
2. tells them the easiest way to the target place
3. shows detailed map on every level of the building
4. estimates the distances and time to the destination

5. displays the names of all rooms and what can users do in the particular room
6. has voice function so users can talk to it directly

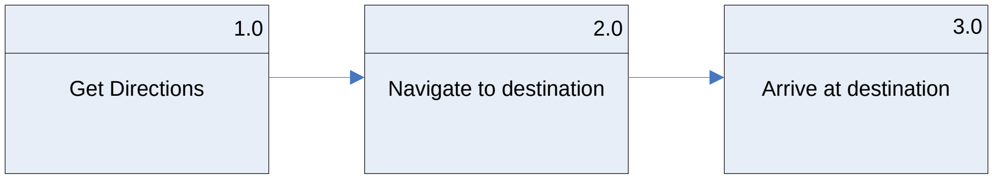
Advanced Functions

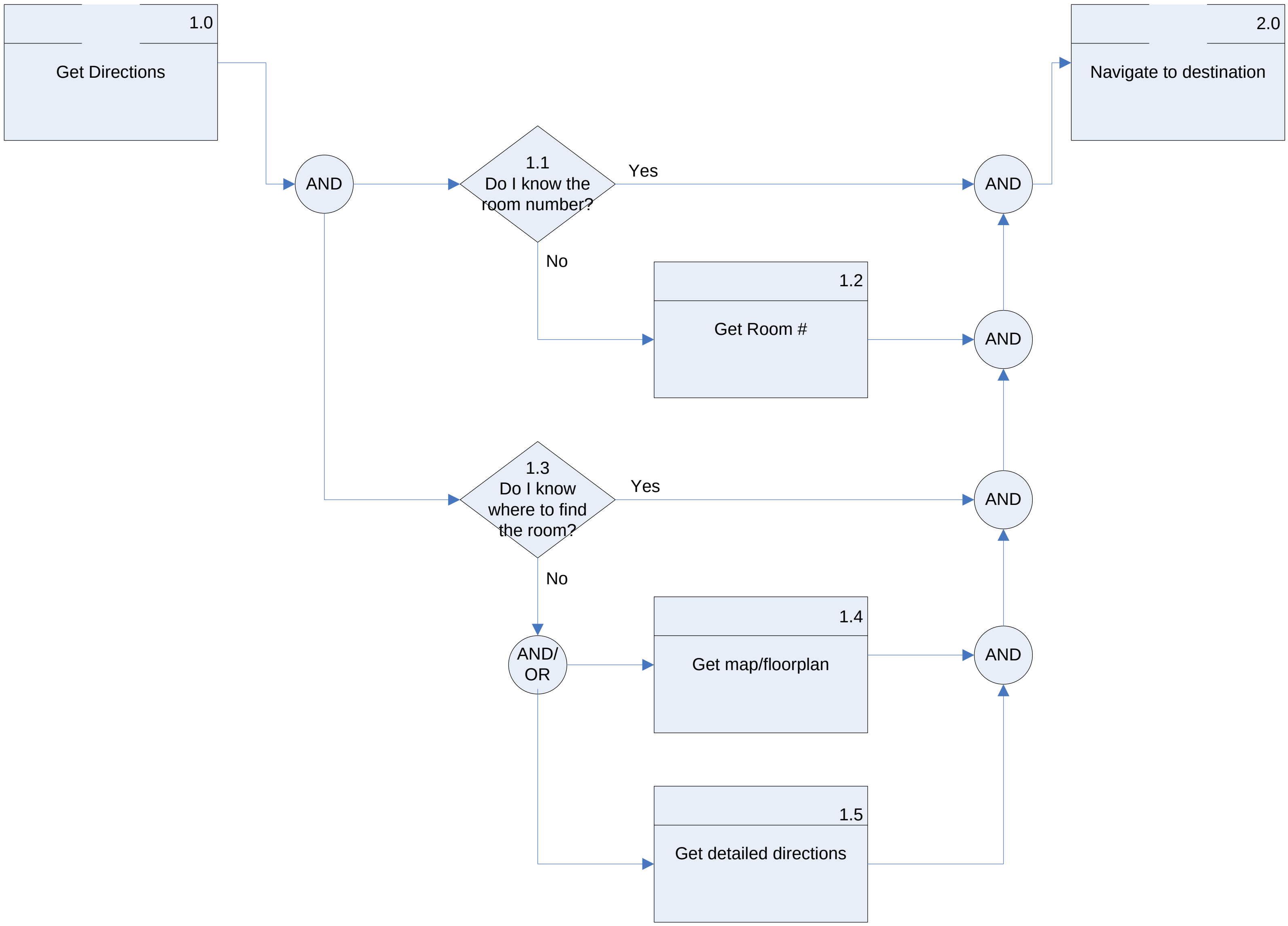
7. plans the route for users if they have multiple destinations
8. tells users where the people they are looking for are, and if they are available now
9. tells users where they can eat, entertain, exercise inside the building
10. connects the person users are looking for directly
11. shows the route when the users input where they want to go, then users could print the map out

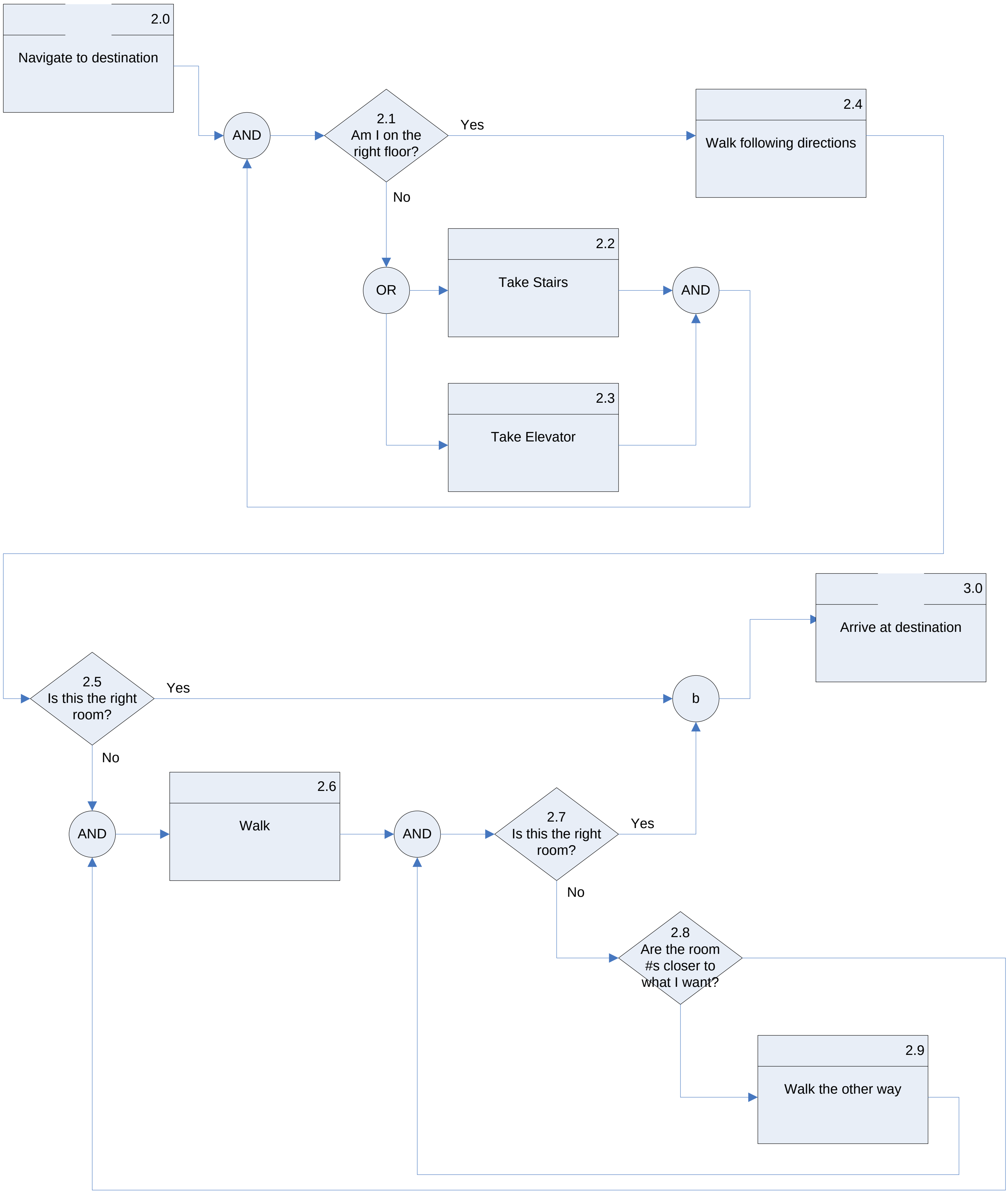
Functional Flow Diagrams



Decision Action Diagram






2.0
Navigate to destination
AND
2.1
Am I on the right floor?
Yes
No
2.4
Walk following directions
OR
2.2
Take Stairs
AND
2.3
Take Elevator
3.0
Arrive at destination
2.5
Is this the right room?
Yes
b
No
AND
2.6
Walk
AND
2.7
Is this the right room?
Yes
No
2.8
Are the room #s closer to what I want?
2.9
Walk the other way

Alternative Analysis

Functions	Alternative 1 Human	Alternative 2 Machine	Alternative 3 Human/Machine
1- Find out what's the exact room number of the place the user would want to go.	The users would browse a physical directory with organizations and people's names with their respective room numbers till they find the one that they want.	The machine would search and match people's names/ organizations with their respective room numbers.	The machine would search and match people's names/ organizations with their respective room numbers.
2- Locate the place (using the number) in the building.	Once the users know the number, they would locate that number in a physical map of the building.	An indicator would show up in the map over the exact desired location.	An indicator would show up in the map over the exact desired location.
3- Find out the users' current location.	The users would look for their current location in the physical map.	An indicator would show up in the map over the exact current location.	An indicator would show up in the map over the exact current location.
4- Create a path to get to the desired place.	An imaginary line should be drawn between current and desired location.	A path would be created for the users.	A path would be created for the users.
	The physical map layout should be	The machine would save the path and	The machine would save the path and let

5- Remember the path.	remembered in order to follow the path.	let this information be available to the user at any time.	this information be available to the user at any time.
6- Navigate the building following the path. -Go to the desired floor. -Finding and taking the elevator if needed.	Users would walk around the building following the path. -Remember which floor. -Look around for elevators.	The machine would lead the users around the building following the path. -Machine would tell which floor. -Machine would tell where the elevators are.	Users would walk around the building following the path. -Machine would tell which floor. -Machine would tell where the elevators are.
7- Recognize the location once the users have arrived.	By looking at the room number or name and matching it with the desired location number/name.	An indicator will tell the users that they had arrived to their desired location.	By looking at the room number or name and matching it with the desired location number/name.

Evaluation of Alternatives

The analysis of the alternatives is based on a number of criteria. Each analysis has a number which states the way in which that criterion is assessed on the alternative. (1 = bad; 3= has some good and bad points; 5= good). The analysis based on the cost criterion don't have a number because is irrelevant to our analysis. Cost will not influence in our decision about which alternative is the best. Alternative 3 has the highest total, so by this evaluation it is the best of the three alternatives.

Criteria for Evaluation	Alternative 1 Human	Alternative 2 Machine	Alternative 3 Human/Machine
1- Speed (measure in time)	The users would have a lot of mental processing to do and this could increase the time	The machine would reduce users mental processing which reduces time. However leading	The machine would reduce users mental processing which reduces time. To save more time, the

	spent using this design. (1)	the users to their desired location could increase time spent. (3)	users would walk following a machine pre-determined path. (5)
2- Accuracy (measure in good answers, right results)	The level of accuracy is high. The users would find the question and answer it themselves. (5)	The level of accuracy is high but depends on data archives. (3)	The level of accuracy is high but depends on data archives. (3)
3- Reliability (measure in number of errors and malfunctions)	The users could forget the path easily or come out with a wrong path because of a mismatch in the room numbers. (1)	The machine would always remind the users about the path so they don't get lost. Any mismatch comes from the users' input (3)	The machine would always remind the users about the path so they don't get lost. Any mismatch comes from the users' input (3)
4- User preference (what people may want or expect)	This design is expected by the users because is the standard way to navigate inside a building. Although, it's not necessarily what they want. (3)	It's not expected by the user, but it could be very helpful not to memorize the directions to get to the desired location. (3)	It's not expected by the user, but it could be very helpful not to memorize the directions to get to the desired location. (3)
5- Cost (amount of money needed to implement it)	Low cost.	High cost.	Medium cost.
TOTAL	10	12	14

Task Analysis

Number	Describe	Stimulus Display	Processing	Response	Possible error
1.0	Get destination				
1.1	Get to search page of individuals, organizations, or events	Menu list	Determine how to search	Push the button	Push the wrong button
1.2	Get name of person to meet or event to attend	List of people, organizations or events on the navigation system	Visual search for the person or event's name	Scroll or push the name button (search)	Wrong person or event's name Mismatch of organization Wrong destination
1.3	Get detail information about the individual or event	Name of target individual or event	Visual search for the button	Push the name button	Push the wrong name button Forget the target name
1.4	Get destination room number	All information about the individual or event	Visual search for the destination room number		Can't find the room number
2.0	Get direction				
2.1	Get map	Destination room number	Visual search for the button	Click "map" bottom	Can't find the map button
2.2	Get detail direction	Map of the destination	Visual search for the destination,		Can't memorize the

			and route planning		route Can't find where he/ she is now Have difficulty reading the map
3.0	Navigate to destination				
3.1	Navigate to destination floor	Direction of the elevators or stairs	Search for the elevators or the stairs	Take elevator or walk upstairs	Can't find elevator or stairs Forget room number
3.2	Navigate to destination room	Room number in front of each room	Search for the room number	Walk around	Can't find correct room number Forget room number
4.0	Confirm Destination	Correct room number	Compare room number	Walk to the right room	Mismatch room number

We found some problems when we performed a task analysis. Instead using a standard symbol to represent the control of showing map, the system uses a "star" icon. Users may not understand what it means and have trouble finding the map. Additionally, the map direction doesn't correspond to the physical direction of the building and it doesn't tell users where they are currently, so it takes a lot of effort for them to read the map and it becomes more likely that users will make mistakes. Most important of all, there are no devices or tools to help users remember the map and the directions they must follow. After they leave the kiosk, it is likely that they will totally forget the route. To minimize these potential errors, we will try to redesign the system so that it can prevent users from making mistakes and lead them to their destination as efficiently as possible.

Mental Workload Analysis – NASA TLX

Functions	Mental demand	Physical demand	Temporal demand	Performance	Effort	Frustration level
1- Find out what's the exact room number of the place the user would want to go.	**High** - remember a name - searching room# by a name - deciding room#	**Low** - walking shortly - standing	**Low** - slow or leisurely	**Good** - easy to get the information	**Low** or **High** - easy: asking a person or using kiosk	**High** - stressed
2- Locate the place (using the number) in the building.	**Low** - deciding the floor	**Low** - standing	**Low** - slow or leisurely	**Good**	**Low**	**Low**
3- Find out the users' current location.	**Low** - looking around or ask a person	**Low** - walking shortly - standing	**Low** - slow or leisurely	**Good**	**Low**	**Low**
4- Create a path to get to the desired place.	**High** - looking a map - thinking the way - deciding the way	**Low** - standing	**Low** - slow or leisurely	**Good**	**High** - hard to decide which way is the best	**High** - stressed - discouraged
5- Remember the path.	**High** - remembering	**Low** - standing	**Low** - slow or leisurely	**Poor** - hard to succeed	**High** - hard to remember	**High** - stressed
6- Navigate the building following the path. -Go to the desired floor. -Finding and taking the elevator if needed.	**Low** - looking around - deciding the method to use	**High** - walking	**Low** - slow or leisurely	**Good**	**Low**	**Low**
7- Recognize the location once the users have arrived.	**High** - remembering the path - searching room# or a person - thinking whether it's the right way or not	**High** - walking	**Low** - slow or leisurely	**Poor** - hard to succeed	**High** - hard to accomplish	**High** - stressed - discouraged - confused

	- deciding the way - looking around					

Users visiting someone in TSRB depend on their memory to get to a room. Almost all functions are allocated to the human. The kiosk on the first floor helps them find the room number and the location of the room. However, when a user leaves the kiosk, there nothing to let him or her know the way. Therefore, a user must entirely memorize how to get to a room and rely on their brain from beginning to end. The more complex the route is, the higher the mental workload of the user is.

We measured the mental workload according to NASA-TLX and found several problems from each criteria.

Mental Demand

As we mentioned above, most functions are assigned to users. So, a user should remember the name of the person to meet, memorize the room number, figure out how to get to the place, and keep remembering the path while walking along the way. Because it's not easy to keep the information his or her brain for a long time, a user may keep asking people to find the way and memorizes it again and again until arriving at the destination.

Physical Demand

A user's body may feel fatigue as many times as he or she loses himself or herself and he or she has to keep walking and looking around (eye and neck movement) until arriving at the destination.

Performance

Users are generally successful in arriving at their destinations. However, users have to rely on their memories of the path to get to their destinations and they may forget the way, get lost, and wander around for a while before achieving their goal, which is not very efficient.

Effort

To achieve the goal, a user has to make much effort as a novice. First of all, a user must use the kiosk – specifically, the user interface of the kiosk – in order to get a room number. Unfortunately, the kiosk in TSRB does not display the route or provide "print" function. Therefore, a user must decide the way by himself or herself and memorize it. While navigating the building, a user must keep confirming the current spot based on his or her memory and trying to going to the right way again and again.

Frustration Level

The user is likely to become stressed and discouraged after repeatedly becoming lost in the building, which is likely due to the problems we found from the other criteria.

Interface Analysis

Check list	Evaluated	Ways to improve

	Result	
1. Are the controls used frequently closest to the user than those used infrequently?	N/A	
2. Are the controls used frequently bigger than those used infrequently?	N	Because there are not many controls in the same page, and they are already big enough, it's not necessary to make some of them bigger.
3. Are the most important controls closer to the user than less important controls?	N/A	
4. Are the controls used in a sequence placed in the order of the sequence?	N/A	
5. Are the controls which have a similar function grouped together?	Y	
6. Do the controls which have a similar function have similar look (size/color)?	Y	
7. Do the controls which have a similar function have similar feel (shape)?	N	The displays of the controls are computer screens, so it's impossible to feel the screen.
8. Do the controls which have a similar function outline grouping of the controls?	N	There is only one group, so outlining grouping of the control is not necessary.
9. Are the controls which have a similar function close to one another?	N	There is only one group, so the distances among all controls are the same.
10. Are the controls arranged in the same way as the physical object that's being controlled?	N/A	
11. Are the colors used on the controls distinguishable from each other?	Y	
12. Are the controls that could have serious consequences designed to prevent accidental activation?	N	The controls won't cause a big damage in the system, so it's not necessary. But there should be a "back" button allowing users to correct their mistakes.
13. Is the visual angle of symbols containing within a control between 0.69 and 1.43 degree?	Y	
14. Is the visual angle of text containing within a control between 0.69 and 1.43 degree?	Y	
15. If there is an emergency control, is it within reach?	N/A	
16. If there is an emergency control, does it have distinct size/ color?	N/A	

17. If there is an emergency control, does it have a cover?	N/A	
18. If there is an emergency control, does it have a warning label within 30 degree cone about the operators' normal line of sights?	N/A	
19. Does the control or operator's hand not obscure the display?	Y	
20. Is the control adjacent to its associated display?	Y	
21. Does the control look like its display?	N/A	
22. Can user see what happens immediately? If there is lag, can the system give feedback to the user about what's happening inside the system?	Y	
23. Can visual displays and controls be read under darkened conditions?	Y	
24. If more than one person is using the system, is everyone able to see the display/ control of the system?	Y	
25. If more than one person is using the system, is everyone able to have access to the display/ control of the system?	N	A multi-touch screen could be designed so that more than one person can manipulate it at the same time.
26. Is nomenclature consistent within different controls/displays that have similar function?	N/A	
27. Does the movement of the control correspond to the thing that's being controlled?	N/A	
28. Does the display represent the state of the system?	Y	
29. Does the display use standard symbols?	N	There are no symbols on the display, so we should add symbols on it. Then users who don't understand English can read it easily.
30. Does the display use standard nomenclature?	Y	
31. Do controls and displays follow the reading order? (left to right and top to bottom)	Y	
32. Are visual representations in the same orientation as the things represented?	N	We should change the direction of the displayed map to match the building, so users can recognize it easier.

When we examined the existing kiosk interface carefully and evaluated it with our check list, there were many design problems that we discovered. First, the direction of the map on the system doesn't correspond to users' direction when they interact with the system.

Second, there is only one scale in "zoom-in" and "zoom-out" functions. When users press these buttons, it takes a long time to zoom. Therefore, we recommend showing larger map on the system, so users don't have to zoom in, they can see the entire map clearly.

Third, no symbols are shown on the map, but if a person can't read English, he/ she may have difficulty using the system.

Fourth, the users cannot correct their mistakes easily because there is no "back" button. The only way is to do all the things again. It impedes people from finding their way efficiently, so the function of correcting mistakes should be added.

Fifth, when the system is idle for one minute, it runs screen protection program automatically. Users may need more time to go through all information.

Sixth, sometimes the users know where they want to go, but have no idea how to arrive there. Under this situation, what they need is searching by room number instead of by individual, organization, or events. So the system should provide this function as well.

Here are interface problems that need to be fixed, and we will try to provide an improved design later. As for multi-touch screen, because the kiosk system is designed for one person use, there is no need to change its interface that way.

Summary of Problems Found

After examining the existing navigation system carefully, we were able to uncover a lot of problems there. These problems could be largely divided into two parts: the Kiosk and Following directions through the building.

The Kiosk

The current appearance of the kiosk makes it hard to notice its existence because there is no recognizable label or sign for incoming students or visitors. Additionally, the kiosk is not facing the same direction as users' walking path. In this reason, users can't see the full screen right after entering into the building. Moreover, no one is using the kiosk, the screen of the kiosk does not give people any information on what the kiosk is about but keeps showing an advertisement of the TSRB repeatedly. As a result, people pass by the kiosk and find other ways to get to the room.

[The location of the kiosk / the appearance of the kiosk]

On the interface of the kiosk, we found many key problems that must be fixed. It is true that users have to figure out how to get there and it is not easy to get information on the screen of the kiosk at a glance. Then, which problems does the interface of the kiosk have now? Above of all, the virtual map on the screen is not oriented the same way as the building. This problem readily brings the mapping problem so users have difficulty thinking of their current location in the building. Unfortunately, the kiosk also doesn't show any mark about a user's current position on the virtual floor map.

[No "you-are-here" mark]

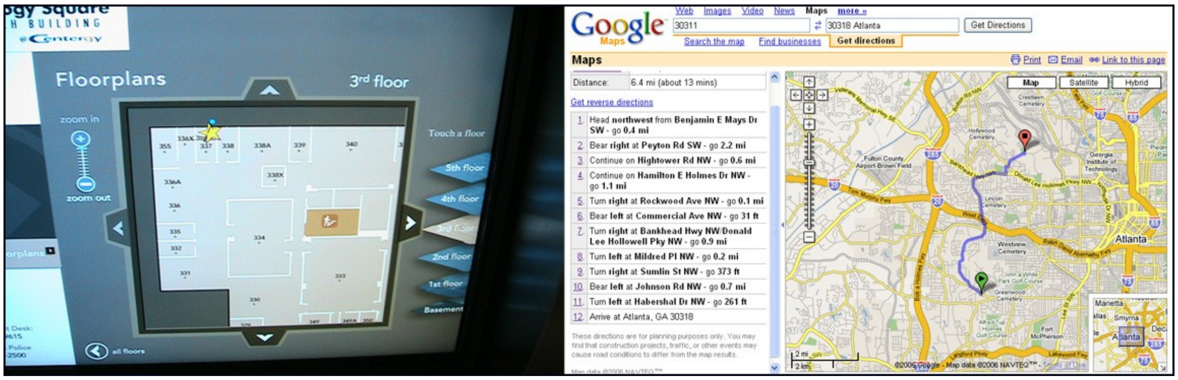
Second of all, there are only two levels of zoom on the map, so everything is either too big or too small to see. Though the image button of the scale looks like there are several steps of both "zoom-in" and "zoom-out," it has no meaning. Furthermore, when users press this button, it takes a long time to zoom.

As the third problem, there is only the destination mark on the virtual floor map; there is no route for how to get from one to the other. Here, users should try to look for the most effective route – the task is allocated to human. It should be allocated to the kiosk because human could make errors in getting the directions. As a good example, there are online maps like Mapquest and Google maps. These provide better interfaces such as text directions in order from Start Address to End Address. On the same screen, the destination mark is a mysterious star icon and few people think that this icon is a linked button to the Floorplans page.

Fourth, there is no "Back" button so the users can not correct their mistakes easily. The only way users have to do is to go back to the main screen -- it impedes people from finding their way efficiently.

Fifth, sometimes the users know the room number, but they have no idea how to arrive there. However, there is no menu to search for the way by the room number.

Sixth, when the system is idle for one minute, it runs screen protection program suddenly. Users may feel embarrassed in this situation because they need more time to go through all information.



[Left: Scale/Star icon/Not oriented correctly
Right: Google Map – Text directions in order/Path]

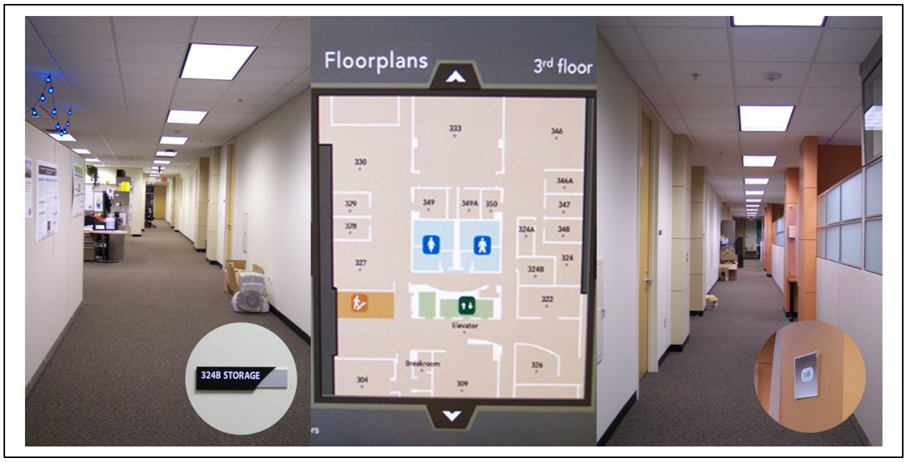
Following directions through the building

Users visiting in TSRB absolutely depend on their memory to get to a room -- almost all functions are allocated to human. According to our mental workload results base on NASA-TLX, "Mental Demand" and "Frustration Level" shows many high end-points among six levels. In other words, each function of navigating TSRB requires high mental/perceptual activities (Mental Demand) as well as highly stressful and discouraging (Frustration Level).

Users' journey to get to the room begins from the moment they leave the kiosk – there's no way to remind themselves of the path, so users must memorize where the room is and the path from beginning to end. Even before users leave the kiosk, there could be a problem: the path they chose might be wrong. The reason is because they have to figure it out from poorly oriented, poorly marked map. As time goes by, a lapse of memory also makes users go to the wrong direction. For instance, users may not remember where they have to go after walking out of the restroom. Users also must remember from top-view map, which does not match with the perspective of traveling through building.

When going upstairs, users could be confused where they should enter go because there are four identical doors doors with no sign showing which rooms are behind which doors. Moreover, as every office has a maze-like structure, it could be hard for users to coordinate rooms from top-view map with rooms in the office while walking along the hallway. Furthermore, the miserable fact is that not all rooms have their room numbers marked.

While wandering around the building, there is a high possibility for users to make errors such as going the wrong direction, and they may not get the right feedback to correct themselves. For example, if a user loses his way and asks someone to get the right track, he or she may get the proper directions or may not. If a user keeps losing his or her way frequently, he or she may even decide to go back to the kiosk to try again.



[Left: Room number
Center: Top-view map
Right: No room number]

Possible Solutions

Guide Robot

person communicates to robot where he/she wants to go

robot leads the person to the room

User Tasks:

- tell robot what person/lab
- follow robot to room

Machine Tasks:

- recognize name/lab
- find location
- find current location
- create path to destination
- remember path
- follow path through building
- recognize destination

Evaluation Criteria:

- Speed is fast: users don't have to bother with the bad kiosk, the robot takes them straight to the room.

- Accuracy might be good, but might not. How do you communicate with the robot? Speech recognition, especially for mispronounced names, is often very inaccurate.
- It may not be as reliable as the kiosk, as a robot may be more prone to break down.
- User preference—users might like it if it's cute and goes at a reasonable speed, but they might not like if they don't want to look like a visitor (but is wandering around looking lost really any better?) or if it's too slow or takes too much work to operate.
- Cost could be high to get good robot and to maintain it. On the other hand, the building is full of robotics researchers who may think of it as a research opportunity.

PDA navigation

After finding a room number on the kiosk, the user transfers the data from the kiosk to a PDA which then guides the user to his or her destination.

User Tasks:

- Find a person's room number or event room number on the kiosk [a user can select multiple locations]
- Set a map on a PDA from the kiosk
- Bring a PDA and keep watching the map until getting to the room.
- Returning the PDA to a box or somewhere when finished.
- If a user changes his or her mind, he or she can search other room number and select it.

Machine Tasks:

(kiosk:)

- search a room number by a name or an event
- show an appropriate map/location
- connect to a PDA and move data such as a name, a room number, and a map/location into the PDA

(PDA:)

- keep showing a user's current location
- show a mark of the route on the screen and the user's present location
- if the user goes the wrong way, the PDA sounds the alarm or vibrates.

Evaluation Criteria:

- Speed might be fast or might not be fast: a user doesn't need to stop to remember the path to get to a room but just keep go along the path as a PDA navigation displays. However, looking for a room number on the kiosk could take time if a user doesn't know an exact name of the person they are visiting or a title of the event. Regardless, this will be faster than the current system, especially if the other recommended changes are made to the kiosk.

- Accuracy will be improved because the machines will chose and then display the route so the user does not have to figure out (possibly incorrectly) what route he or she should take and then try to remember all of the directions.
- The kiosk should be quite reliable, as it is indoors and is mostly only used by visitors and people new to the building. The PDAs may be unreliable if there are none available for people to use (all currently in use, lost or stolen), or if they do not get charged frequently enough.
- User preference: A user can entirely rely upon a PDA based on the fact that they don't need to memorize a map. The kiosk and the PDA's touch screen could be the right size to see the map conveniently. The orientation of the map is easy for user to reconize his or her current location because it is the same direction as the building.
- Cost could be reasonable to get several PDAs and one kiosk.

Arrow Light

A light would be projected to the floor guiding the user to their destinations.

The user would interact at first with the electronic directory (kiosk) to search for destination. Afterwards the kiosk would ask if the user wants the system to lead him/her. If the user says yes then a light projected from the ceiling will show up on the floor. The user would need to follow the light to get to their destination.

Problems:

Some problems with the current light on the halls, it might be difficult to If there are many users using the system, lights could be confusing. If the users want to go somewhere else, the light will not follow them to guide him later for their destination.

Evaluation Criteria:

- Speed: Mixed result. The system will lead the users to their destination but the speed depends on how well the users recognize the lights on the floor.
- Accuracy: Good accuracy because the light will show the path that the user chose to follow from the data gathered from the kiosk.
- Reliability: Good reliability because it is using the same database as the kiosk. If errors occur it is because there were problems with the input data on the kiosk.
- User preference: Mixed result. Users may like the lights because it is creative and looks like disco lights leading you. But users might feel awkward because then everyone else in the building will know that they are new.

- Cost: High cost. The system will have a kiosk and also several devices in each floor that will project the lights. Another requirements would be sensors that will recognize the users. The users will carry some device in their hands which the system would recognized and beam the lights in front of them.

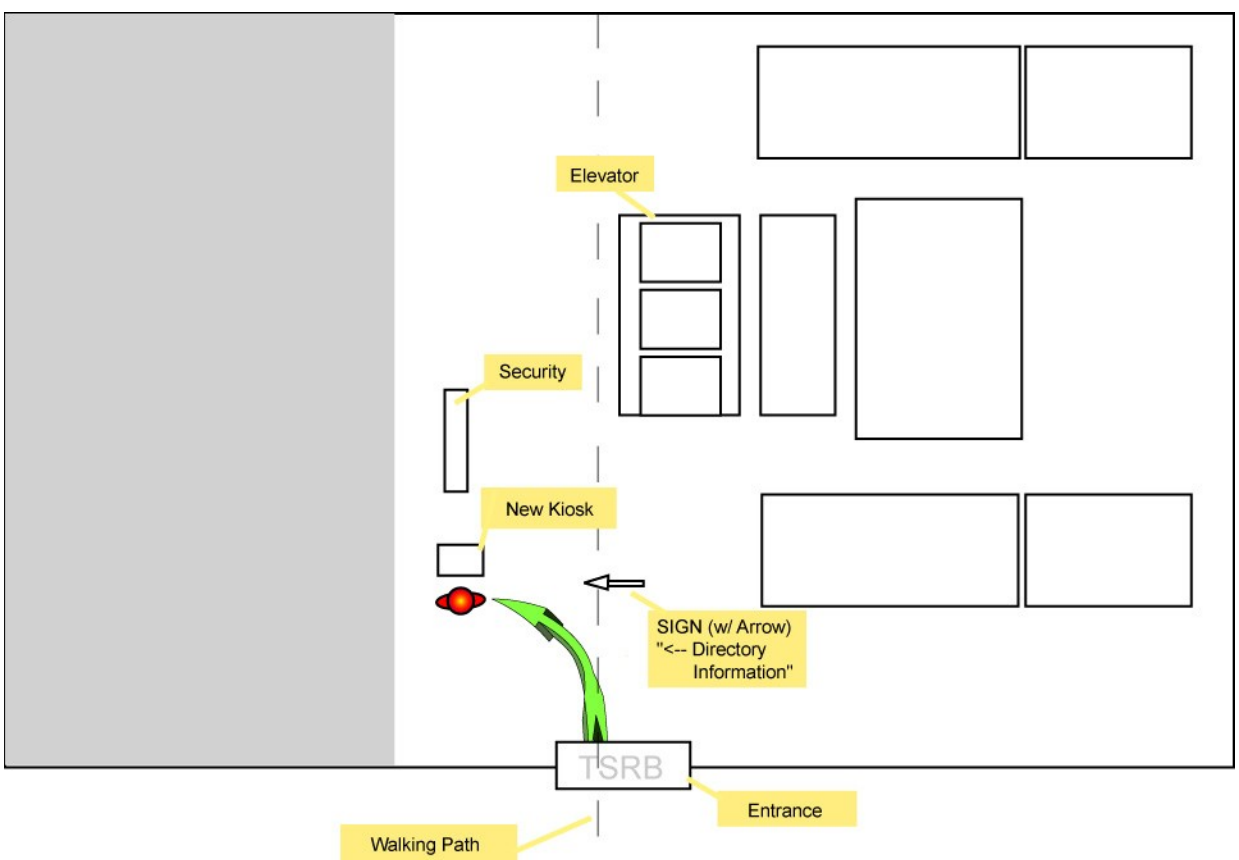
Prototype

Overview

We built a static prototype using computer drawing tools. Below is a list of interfaces we prototyped for our improved navigation system for TSRB.

- Physical Placement / Layout: how machines are placed in the working environment;
- Kiosk Hardware Interface: the modification of Kiosk hardware;
- Kiosk Software Interface: the modification of Kiosk software to help user get information/direction;
- Digital Compass Interface: the added machine/interface to help user executes direction.
- Physical Placement / Layout

Below is a rough plan for the lobby level in TSRB. We focus on the Kiosk area here.

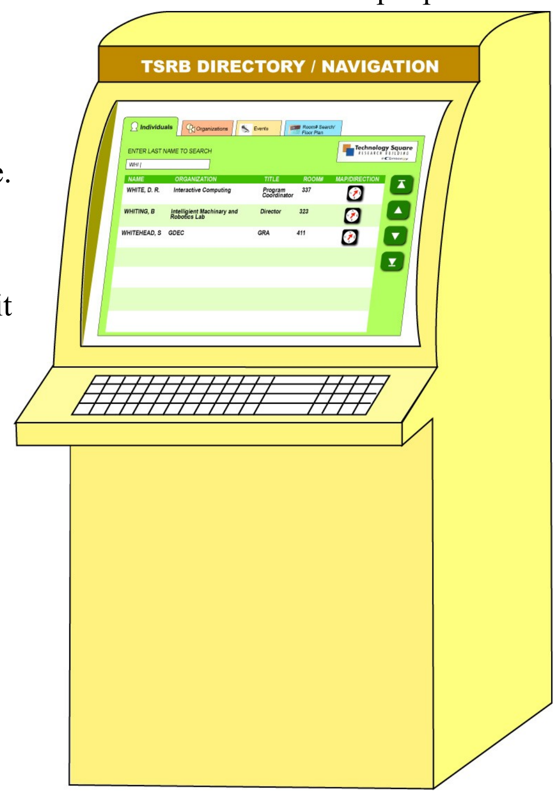


[Overhead view of the kiosk in the TSRB lobby]

Physical Placement

The standing position of user and location of kiosk in the diagram show that the new kiosk is turned 90 degree clockwise to face toward outside the building so that when users are looking at the map, they could get the natural mapping (up -> forward, down -> backword, etc.).

There are two signs set up for the kiosk. One is next to kiosk to show the purpose of kiosk. Another sign is placed in the visitors' natural walking path so when people get in the building, they will notice the sign and follow the arrow to turn left for kiosk. The reason we place a sign there instead of kiosk itself is people would block the entrance if they to stop and operate the kiosk in the middle of walking path. The situation would be even worse if there are other people in the line waiting to use the kiosk.



Kiosk Hardware Interface

We modified the kiosk hardware to make it easier to operate.

A bigger display is used in order to reduce user's burden of zooming in the map. They can see maps/floorplans in one screen clearly without zooming. Bigger displays also make it possible to have bigger buttons and more contents at the same screen. So the user interface can be much easier to operate and user can save time from navigating through different pages.

While the on-screen keyboard looks fancy it actually occupied a lot of screen space and is a lot slower than regular keyboard. We added a physical keyboard to the kiosk so that user's performance can be improved and more information can be displayed at one screen.

Kiosk Software Interface

The kiosk software interface is also redesigned to make the system easier to use, easier to understand, handle more user scenarios and to improve user performance.

Main Interface

[The kiosk's redesigned main interface]

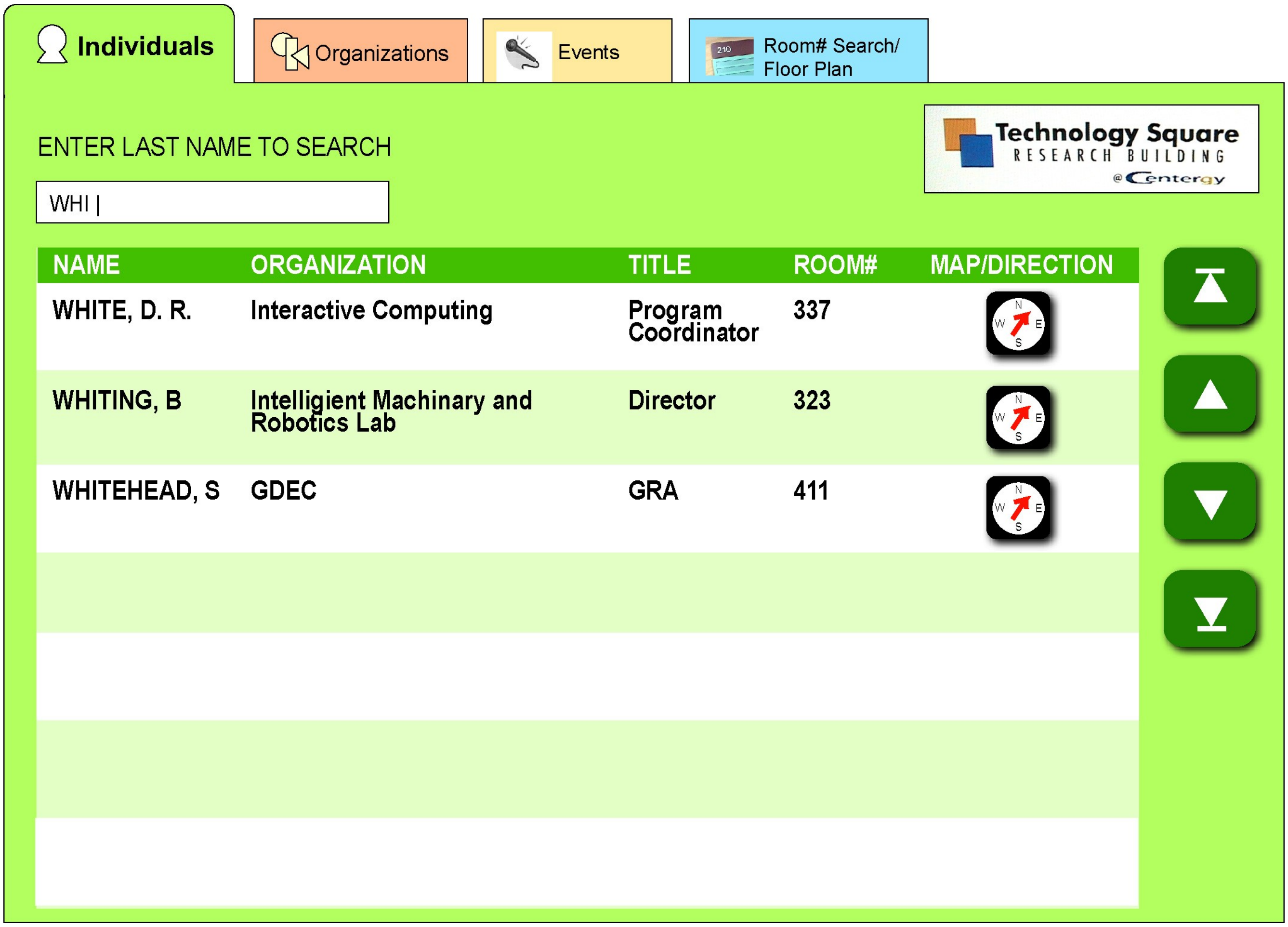
We redesigned the main interface get rid of all decoration thing to let user start to use it immediately. We have the original features as well as some additional features.

As most people would be interested in some destination like a special event held today or other popular places, we added those options and put them on the first screen so users can get information without going through the menu and searching system.

The original menu in TSRB kiosk is relatively small and buttons are sometimes hard to locate and to press on. We redesigned them with bright background and large size, so that user can easily operate and prevent errors.

Individual Search

The individual search function is completely redesigned. The on-screen keyboard is now removed to save space for people listing. Users can use a physical keyboard instead to enter names.

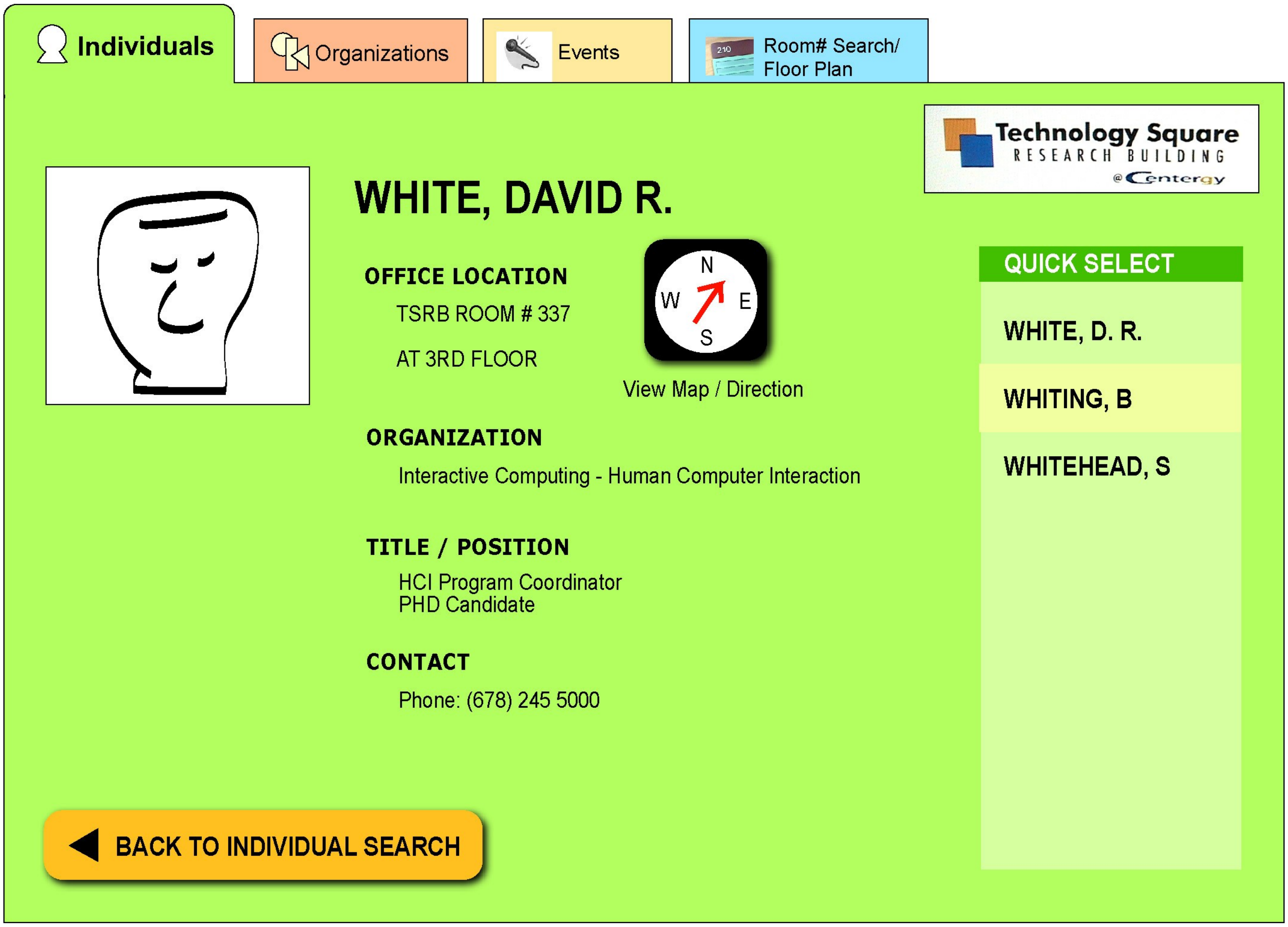


[The redesigned search screen]

Search results come up while users are spelling the names of people to visit. Users don't need to complete the names or hit "search" before they can see any result. It could greatly improve the searching performance and also help users who don't quite know how the name is spelled.

Most users are familiar with computer keyboards. The downside of on-screen keyboards are the spaces they occupy on the screen, the lack of touch/texture feedback and sometimes lag. So use of a physical keyboard instead of an on-screen one can greatly improve user performance in entering searching criteria. It also save precious space for display of more important information.

Individual Profile



[Modified profile page]

There are three major modifications in personal profile interface. The first is data rearrangement. We believe most important/desired data should appear earlier to user. Because most users scan data left-to-right and top-down, we placed the office location and button to map/directions before all other information. User can get desired information quickly. Another improvement is the destination floor number is now displayed below room number. This can help people determine destination floor if no easy mapping is available.

We have also improved the button that leads to the map and directions. The new button is much more meaningful and visible. Most users will be able to identify it to be a button and easily figure out the purpose.

The quick select pane on the right is also newly added. It is provided because sometimes users might not be able to identify destination at the personal search interface. They know it might be one of the search results listed but just not sure which. So they click on each of them to find out the detail description. We provided the quick select to help people switch among search results without going back to previous interface, which improves performance.

Map and Direction

[The improved map interface]

In the new map interface, the following improvements have been added to help user to collect navigation information. The first is map orientation. We fixed the problem of map orientation so that the map is now oriented at the same way as the building. The mapping is now more natural: top – front, bottom – back, left – left, right – right. It improves user performance and prevents some errors.

By using a larger display we get rid of the need for a zooming function to make map reading easier.

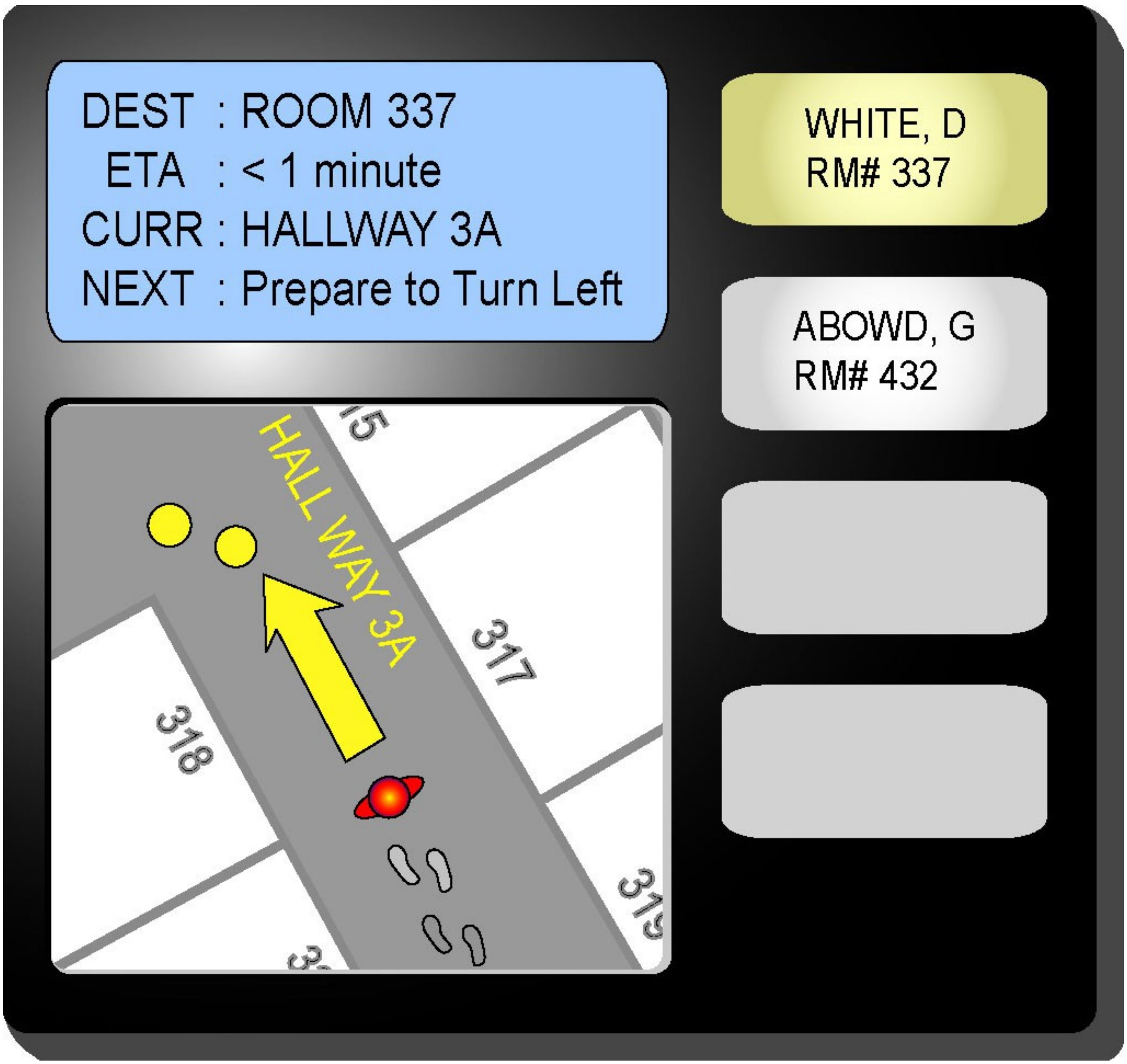
Locations like the elevators, destination, and the user's current position is now marked on the map to help user determine situation. Direction is now given in two different ways: the track on the map and the text direction to the right. Users can combine them to understand how to get to their destination.

We added functionality to help user switch between maps of the entrance level and destination floor quickly so that users can get a global picture of the complete journey.

If user wants to visit more than one destination, he/she can simply press “save to destination list” to save current destination and look up another one. All destinations will be saved for user's future reference.

Users now can borrow a “digital compass” (or PDA with a map and directions) from the kiosk. The device will be dispensed after selecting “borrow a digital compass” function. The digital compass will help user to get to destination without effort under all kinds of situations.

Digital Compass Interface



[The digital compass interface prototype]

There're three separate part of displays/controls on digital compass. Left top is the text navigation to tell user what current destination is, where he/she is, estimated time to destination and next action (get prepared).

Left bottom is a map with an arrow guiding user their walking direction. The map will automatically synchronize to user's current location and current facing so the device can be held in any way. Map also includes environmental information and passed and future path.

On the right is the destination selection. The yellow-lighted button indicates the current destination. User can press on one of them to switch destination. To prevent accidental activation without user's awareness, the switching destination action must be confirmed.

Improvements

For the navigational part of our project we chose to evaluate the PDA design in a creative way. One of us played the role of the PDA device. However, this prototype is different from our original design because it works with an audio interface; the "pda-human" gives auditory instructions to the participant based on her/his location. But for this evaluation those changes will not affect the analysis because we want to gather information about the time it takes to end the inquiry and navigational process between different situations.

The different situations with their measured times are the following:

1- Person bypassing the Kiosk (what normally happens) and looking for the GVU office by wondering around the floor in which she thinks the office is located and asking questions to get to the destination. –(3:58)

2- Person using the Kiosk and remembering the location of the GVU office is order to get there. –(2:30)

3- Person using the Kiosk and after that following the instructions to get to his destination from the "pda-human" that is standing behind him. –(1:33)

After doing this evaluation the data gave us an idea of how the PDA device will improve the quickness of the process. Clearly the person using the "pda-human" did faster (1:33) than the other people who used only the kiosk (2:30) or just bypassed it (3:58). We can infer that this improvement is related to the reduced workload when using the PDA. The PDA remembers and leads the user to their destination, so that the users don't have to. The only thing that they have to do is follow directions.

Conclusion

In this project, we examined the current navigation system in Tech Square Research Building (TSRB), and found two main problems- poor Kiosk system interface and high mental workload. To identify problems further, we applied some analysis techniques learned from class. Our results indicate that users may not use the kiosk to help them navigate because they don't even notice it. The kiosk is also hard to use so people may spend much unnecessary time dealing with the system. Furthermore, once the users get information from the system it is not easy for them to figure out the route on their own and memorize the directions to where they are going.

We propose some solutions to solve these problems. Absolutely, changing Kiosk interface is necessary. As for reducing human workload and transferring it to machine work, there are three possible ways that we have come up with: arrow light projected onto floor, robot that guides user to the room, and a PDA that user can carry along. We evaluated them by multiple criteria; the most feasible one was the PDA equipment. So we redesigned the kiosk interface and reallocated the tasks that user performs poorly to machine by storing map information and directions in a PDA device. We anticipate users can get to their destination more reliably, more easily, and in less time.

Although we try to make our resign meet users' expectation, there are still some things we didn't mention here, such as multiple destination route planning. Future works focusing on it may be useful.

1- http://www.tsrb.gatech.edu/

2 - http://www.gatech.edu/technology-square/overview.php

3 - Georgia Electronic Design Center - http://www.gedcenter.org/

5 - Center for Research on Embedded Systems and Technologies

4- Graphics, Visualization, and Usability Center