Ticket Tap

Airport Concourse / Terminal Information Display

P4 - Evaluation

CS 6750

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Task Overview

Exploration of the design space past security in airports has led to several important considerations for information display systems. First, the system must be inviting. Apprehension of using unfamiliar technologies in a public space may discourage first-time users from engaging any new and novel forms of technology. In addition to approachability, the system must be relevant for users and indicate very clearly the service it provides.

Current information display systems serve a passive role in the airline traveler experience. Long lists of arriving/departing flights are often elevated above eye-level, with constant updates making it difficult to track a specific flight quickly. Concourse maps are primarily static, either physical printed maps or digital displays with no way to interact beyond passive observation. Customer service representatives can be a valuable source of information if they are available and helpful, though this is often not the case.

For the TicketTap prototype, we focused on two major sources of information:

- **Wayfinding:** Finding departure gates, airport amenities, retail, etc.
- **Destination Information**: Relevant information about traveler's destination city, including weather, events, currency exchange rates, etc.

The system is designed for quick access, ease of use, and approachability. Controls are gesture-based, utilizing up/down and left/right swipes to access content. Gesture-based systems can be problematic when it comes to learnability, but restricting the type and number of available gestures allows for direct manipulation of the content without breaking focus on the main display screen. Once the gestures are learned, navigation within the system should be quick and easy.

Evaluation Techniques

Environment and Equipment

The usability tests were held in a controlled environment where all of the participants were tested in the same conditions. A projector displayed a screen against a wall at an average eyelevel (about 5 ½ feet from the ground). A projector was chosen instead of a monitor because it is easier to transport and set up for testing. This projector was connected to a laptop on which our flash prototype was running. One of the evaluators controlled the prototype to show the appropriate screens using the Wizard of Oz technique. The evaluator and the laptop were out of the participant's view to simulate an actual environment. The participant stood a few feet away from the projected screen. In front of him/her, the solid model of the motion/gesture pad was placed on a stool so that the participant could easily place his/her hand over the pad (Figure 1). A second laptop displayed the flash prototype which showed the participant what he/she would actually be seeing on the final pad design. This was also controlled by an evaluator. The pad is meant to have dynamic displays with text and graphics. For the purposes of this usability test, we chose this technique for simulation.

Figure 1 – The set-up, including the projected screen and gesture pad model.

Figure 2 – The gesture pad flash prototype beside the physical model.

Usability Study

For user testing, our primary focus was evaluating user response to the gesture-based navigation system. Secondary foci include user responses to system aesthetics, appropriateness of system to user needs as specified in initial prototype planning, and system learnability.

Since the prototype lacks the depth necessary to evaluate relevant system use within an airport environment, we evaluated our system in another environment.

The test involved five participants who acknowledged that they are adults who utilize air travel through airports, and who consented to be in the research study. Each participant held separate 15-30 minute sessions in which they tested out the prototype. The first ten minutes involved introducing the participant to the study, obtaining the written consent, and answering any preliminary questions.

The introduction statement for all of the participants was as follows:

> "Thank you for taking time out of your day to help us. You have been invited here to give your opinion. There are no right nor wrong answers. This study is not meant to test your abilities, but instead to evaluate the effectiveness of the design and interface of a system. We would appreciate it if you could provide your honest feedback so that the system can be best analyzed.
>
> In today's session, you will be taking the role of an air traveler. You are traveling to Toronto Pearson International Airport from Dallas Fort Worth International Airport with a connecting flight at Hartsfield-Jackson International Airport. You are currently in Gate B-8 in Atlanta, and you need to get to Gate E-27 to catch your flight, as stated on your boarding pass.
>
> You are unsure of how to get to your gate from where you are, and you refer to TicketTap in order to help you navigate to your gate and find some more information about your destination.
>
> Do you have any questions before we get started?"

The next ten minutes involved the participant interacting with the system. The primary tasks that the participants were asked to perform were as follows:

- Confirm the boarding time and gate number on the boarding pass with the TicketTap system.
- Determine how to get to the departure gate from the current location.
- Obtain information about the destination, specifically the 3-day forecast.

The test comprised of one run, consisting of only two tasks, so that the user would not be asked to evaluate every part of the interface that was built into the prototype.

The usability test assessed the participants' abilities to:

- Tap their ticket against the gesture pad to access the first level of information.
- Understand the first level of information.
- Tap the pad once again to reach the second level of detailed information (menu screen).
- Be able to understand and utilize the gestures to navigate through the design.
- Remember the directions to the gate.
- Go back to the menu screen.

During the tests, participants were asked to talk about what they saw, what they thought, and what they planned on doing. If the participant did not actively contribute to the think-aloud process, they were asked certain questions like:

- What do you think the next appropriate steps will be?
- What kind of information are you seeing on the screen?
- Are you feeling any frustration with any part of the task?
- Are you seeing what you have expected to see on the screen?

Post-Test Interview

After the test, an oral interview was performed and the users' responses were noted through written notes. The interview questions are listed in the Results section.

Through this evaluation plan, sufficient feedback of the prototype was gathered to note the strengths and weaknesses of the important features of the design.

Evaluation Rationale

Our evaluation of the system through usability testing sought to determine if the user interface and the gesture-based input system were adequate for users to find out their flight information, navigate the airport (specifically finding their gates), and find more information about their destinations. We wanted to find out if the system developed would provide a faster way of accessing information.

Usability testing provided a way to take advantage of a controlled environment. It gave us power over variables and allowed us to focus on specific aspects of the system that we were concerned with. These were rapid access to flight, airport, and destination information. One of the most important aspects of a usability test is the identical environment in which all the participants will be testing the system. All the participants were given the same number and kinds of variables, information, tasks, and interview questions. Variables refer to elements of the testing such as the equipment layout.

The usability test involved two laptop computers, a projector, and a foamcore model of the gesture pad. We did not have access to a large monitor which could be carried around easily; therefore we used a projector to present the interface on the wall. One laptop computer was used to control the display of the projector and the other was used to show what the displays on the gesture pad would look like. The foamcore model was simply used as a physical representation of the pad, since it would have been too difficult at this stage to develop a fully-functional prototype that incorporated the displays. The participants were placed about 5 feet away from the screen with the foamcore model of the gesture pad placed in front of them. This emulated our ideal system.

The usability tests utilized the Wizard of Oz technique where the displays "responded" to the gesture movements made by the participants. For example, whenever s/he moved his/her hand to the left, one of the testers pressed the right button on the laptop controlling the projector

display to progress the screen to the right, emulating Apple iPhone's method of swiping screens. This required the tester to keep a close eye on the participant's hand movements. We selected to utilize the Wizard of Oz technique because it did not demand a fully-functional system, but allowed us to develop a prototype to the point where it was sufficient to be tested for its usability. It reduced the time required to build the prototype.

The participants were asked to perform a think aloud technique to present what is going through their minds as they are performing the tasks. We realize that think aloud techniques may impact the performance of the user, as the user may have to think about what to say while interacting with the system. However, despite its cons, this technique is beneficial because it allows testers to obtain a better understanding of the participants' thinking process. The think aloud technique is also often used in industry, especially in tasks with relatively low demand of cognitive processing. The post-interview provided additional information about the participant's opinions about the system through specific questions and whatever was not clear or answered during the think aloud process.

In the IRB report, we suggested that we would invite ten participants in the study. However, our usability testing involved five participants. This was because all five participants were providing consistent feedback regarding the system during the tests, and we felt that we would continue receiving similar feedback from other people.

Also on the IRB, we mentioned that we would be video recording the sessions, but this was not possible as we had technical difficulties with the camera. Therefore, we relied heavily on observations, notes, and answers from the interview questions to assess the usability of the system. Our original intent of utilizing a camera to video record the session would have required us to review each recording, but it would have provided us the ability to play back the sessions at leisure in order to extract as much information as possible. However, due to the consistency in feedback from the participants, our own notes proved to be sufficient in analyzing the usability of the prototype.

Results

Participants did not utilize the pad screen much or at all. Only one participant used the help button and that was after much searching. This is most likely due to the gesture pad and simulated display being separated for the experiment. Most of the participants seemed confused by the disconnect and did not quite understand how the laptop screen and the model connected.

All of the users first tried tapping or double tapping to select a menu option, when this produced no results all participants tried to swipe right. Only after this did they figure out they needed to swipe left to enter the menu. Once the participant figured out that swiping left was used to enter a menu they were very quick in navigating and had had minimal errors. This suggests that for a system with a screen and a separate touch pad, such as the one used in the experiment, gestures that correlate to direction of movement are more intuitive. A set up that just had one screen and the participant touched the display directly might work better for a direct correlation between virtual object movement and gesture (user swipes left and the object on screen moves left as opposed to the view moving left).

After the learning curve of understanding the gestures navigation became exceptionally quicker. The learning curve primarily entailed figuring out the swiping left was to enter a menu. Allowing tapping to enter a menu or switching the gesture to swipe right would probably significantly cut down on the learning curve.

When asked to recall the directions after viewing the fly through participants expressed trouble with the speed of the animation as well as having to focus on the animation plus the text directions. Also recalling two to three landmarks was the average number recalled from the participants sampled.

The lighting conditions in the room were not ideal for a projection based system which resulted in less clarity and readability. This sometimes caused participants to learn in and stare at the screen longer to make out some of the text. Better testing conditions would ameliorate this however airport terminal viewing conditions might not be ideal either so larger text might be needed to increase readability.

When given the task to find the three day weather forecast many participants became confused and it took some searching and experimentation to find it. Participants stated that there was no visual indication that there was another layer of depth after the fist menu selection.

There was some human error involved in using a wizard-of-oz test setup mostly in the form of lag which caused participants to get inaccurate feedback. Also the test set-up used only the arrow keys which were tapped and resulted in an set change, this is in contrast to what the actual system which would have a gradient of changes to the interface that were based on the specifics of the participants gesture. The system will also provide more robust feedback according to the gesture input. Currently, the system provides a 'snap' when the user gestures beyond the bounds of the displays. Future iterations would allow for more appropriate snapping according to direction and speed of the swipe gesture.

The data we collected is below:

Post-Study Interview Questions

1. Can you recall the directions to your gate?

2. From 1-5 scale, how easy did you find the system easy to use, with 1 being the most difficult and 5 being the easiest? (Why?)
3. From 1-5 scale, how user-friendly did you find the gesture / motion interface, with 1 being least user-friendly and 5 being the most user-friendly? (Why?)
4. Did the screen change the way you expected it to according to your movement? (Explain?)
5. From 1-5 scale, how easy did you find the layout of the display, such as the menu, to comprehend? (Why?)
6. What frustrations did you experience with the system?
7. What about the design most or least facilitated your task description?
8. What are some improvements to the system that you recommend?

Participant 1

Observations

- First tried to double tap to enter the menu, then swiping right
- Took a lot of time to search the information on the screen even leaning in at times to get a better look
- Took awhile to get from the first screen to the home screen
- Did not notice the hand gesture overlay tutorial(displayed when the home screen is loaded for the first time) on the home screen

Participant's Remarks

- Should use tap to select menus

- Should reverse left right swipe direction
- For the fly through
    - Should show sign and landmarks in the visual animation
    - test directions are too wordy
- Secondary level should look similar to the home screen because the user has already learned the layout
- Separation between the laptop screen and the pad model was confusing

Questions

1. Recalled passing a bathroom, and the gate is E27
2. (3)
3. (1)
4. No
5. (4)
6.
7. MOST - The help system
   LEAST - Not obvious navigation, no clicking

Participant 2

Observations

- Tried to tap the pad at first to enter a menu, then swiping right
- Touched the pad at the bottom to enter the home screen because the directions/icons on the first screen were located at the bottom. Suggesting the participant though the screen was mapped to the pad and location mattered
- Tried to scroll up/down on the secondary menus

Participant's Remarks

- The outline/highlight makes the menu look like it is clickable or you can tap to select. If you highlight something it looks like you can click it.
- Arrow all look the same. The direction/airport navigation arrows should look different than the gesture help arrows.
- For the fly through
    - use arrows instead of bullet points
    - Tried to remembered text but it disappeared when the animation reset
    - The directions should be simplified

Questions

1. Go past the bathrooms, left at Lacoste, left at elevator...remembered a pause but could not recall what it was for.
2. (4)
3. (3)
4. (5)
5. (5)
6.
7. MOST - Design scheme, and consistency
   LEAST- Figuring out the left right swipe direction

Participant 3

Observations

- Tried clicking at first to enter the menu, then swiping right
- Looked at pad model for information after tapping the ticket. Seemed confused about the experimental setup.
- Got much quicker in navigation after the first task

Participant's Remarks

- Did not realize the main (projected) screen was where all the information was at first. Kept looking at the pad for information.
- Thought at first you could tap to enter the menus, however once I figured it out it was easy
- Thought you could scroll down further on the home screen to show more items.

Questions

1. Lacoste, some restrooms, and a train....kind of zoned out at the end
2. (3)
3. (2) at the beginning and (4) at the end
4. Not at first
5. (5)
6.
7. MOST - 3d flythough was helpful for directions and big buttons/menus
   LEAST - Thought the home screen were buttons and clickable so tried tapping.

Participant 4

Observations

- Tried to tap at first then swiping right
- became much quicker after doing the first task
- Was satisfied with the first screen (right after tapping ticket) as far as determining what direction to go. Seemed confused as if s/he should proceed further. This might be partly due to how the task issued to the user was worded.

Participant's Remarks

- Navigation issues, though gesturing right should be deeper.
- Breadcrumb issue, did not know where he was in the system after he went past the first screen
- Some visibility issues, there was no indication that there was further information to get the 3 day forecast.
- Related to the flythough
    - Was useful but was way too fast to pick up the details in the animation
    - having both text and video was confusing, had to keep switching focus
- The first task (find directions to your gate) was a little difficult to understand, once I say the first screen (after the tap) I knew my gate and the direction and that was enough. usually just likes a direction to head in and then if he gets lost later would hope there is another system like this.

Questions

1. Lascoste, take an elevator to the tram, maybe something about passing British airways?
2. (3) at first then later became a (4) or (5)
    - Tapping the ticket at first was very easy to understand, but there was some visibility issues on the first screen.

3. (5)
4. Yes...there was good feedback. There were some visibility issues that you could expand to the right, would be nice if there was something hinting that there were further sub menus. Liked the fact s/he felt that that any action s/he did would not screw up the system state.
5. (5)
6.
7. MOST - Simple interaction, no typing, super constrained and simple up down left right navigation.
   LEAST - Visibility of where you could go.

Participant 5

Observations

- Tapped at first to enter the menu, then swiping right, then pinching gesture
- Watched the animation for awhile trying to memorize the it
- Became much quicker after doing the first task.

Participant's Remarks

- Said he felt lost in the system at points and did not know were s/he was, breadcrumbs might help
- Did not know there was another layer of depth to see the three day forecast
- Expressed that the map animation was too fast

Questions

1. Bathroom, and elevator

- Can be hard for non English users, should focus on the animation and show landmarks/snap shots. Including the text and visuals together was confusing, the system could do with out the text all together.

2. (4)
3. (3) before the learning curve, 4(after)
4. yes
5. (4)
    - hard to tell there was further information
6.
7. MOST - Information architecture and design...the system was simple
   LEAST - Left right gesture was confusing and did not know there was more information to reach.

Implications

Design of user evaluation for our initial prototype proved problematic. Since there is no current analogue to our system in airports, determining an appropriate control experiment is tricky. For the tasks assigned to users, we can perform a steps analysis using legacy airport information displays as a basis of comparison. Using these legacy systems as a control, although interesting from a 'time-saved' perspective, is not an adequate measure of our prototype's efficiency. Since this system incorporates previously segregated forms of information display, even an inefficient design would still show improvement over legacy systems. The important steps for our initial evaluation are making sure that the system is as efficient and simple to use as possible, since there is no adequate precedent to use as a control.

Our usability test evaluated the gesture-based navigation, system layout, and system aesthetic. User response to the gesture navigation is very important; ultimately, this will determine the system's effectiveness. If the layouts are optimized, the data is optimized, but if the gestures prove difficult or counter-intuitive, then the system fails to achieve its primary usability criteria. As a basis of comparison, we look at the steps analysis of the first task given to users:

Task: Find the way from current location to departure gate

Legacy Displays: User is in front of a flight departures display screen
TicketTap System: User is in front of the TicketTap system

Structured Task Analysis using Legacy Airport Displays:

0. Find departure gate

1. Locate flight on Departing Flights Screen

1.1. Locate Departing Flights Screen

1.2. Scan List of Departing Flights

1.3. Find Flight number

1.4. Scan listing for Departure gate

2. Locate Departure Gate

2.1. Determine method of finding Gate

2.1.1. If gate is close to display, task completed

2.1.2. Find concourse map display

2.1.2.1. Locate current position on map display

2.1.2.2. Locate departure gate on map display

2.1.2.2. Determine route from current position to departure gate

2.1.3. Find customer service representative

2.1.3.1. Ask representative for directions

Structured Task Analysis using TicketTap System:

0. Find departure gate

1. Engage TicketTap system

1.1. Tap ticket to gesture pad

1.2. Find departure gate on main information screen

1.3. If gate is in current concourse, follow directional arrow to gate

2. Find departing gate location

2.1. Find departure gate on main information screen

2.1.1. If gate is in current concourse, go in direction of green arrow

2.1.2. If gate is in separate concourse, engage menu system

2.1.2.1. Tap gesture pad

2.1.2.2. Swipe right on gesture pad to access flythrough instructions to gate

From this task analysis, a distinct advantage can be seen for users engaging TicketTap. The best-case scenario for using existing airport displays relies heavily on separate systems located in close proximity to one another. Separating the flight information screen and map displays makes it difficult to contextualize flight information and the spatial relationship of departure gates, and requires physical relocation between these information sources. Note that transitioning from steps 1 to 2 in legacy systems involves a physical change of location in the airport. These forms of information are inclusive in the TicketTap system.

We had the opportunity to measure the time it took to search for flight information at the Hartsfield-Jackson Atlanta International Airport and compare it to the time it took for the usability participant to interact with the prototype. After the security gate, it took about 10-15 seconds to find a specific flight on the flight information display board that had scores of departures at the airport. On the TicketTap, a user would only need 2-3 seconds to tap their ticket to access their flight information. After looking at the flight information display board, it took another 2 minutes and 10 seconds until an airport map was discovered to find out the location of the gate. On the TicketTap, the participant would only need to provide a few gestures to access both the terminal map and a video flythrough of the terminal showing how to get to their gate, all which can be accessed in less than 10 seconds.

If a passenger has no means of -nternet access, information about the destination city is largely unavailable. There is no appropriate analogue to this segment of our system, which offers a unique advantage to TicketTap. Similarly, the concourse fly-through offers a new form of wayfinding, combining spatial cues with textual directions. Usability testing showed that heavy use of text combined with video did not aid in user's commitment of path to memory. Future iterations will address this deficiency, simplifying textual directions and slowing down the video.

The prototype developed for initial usability tests was relatively shallow. It provides one user with fixed information and several scripted information responses (weather and events do not auto-update). It also assumes a fixed position for the user each time the system is engaged. For these reasons, the implications we can make from these initial tests are relevant to system structure and the gesture-based controls. This evaluation provides a solid base to further elaborate our prototype.

The next round of usability tests would evaluate a more completely functioning prototype within an airport. We would expand on the prototype to include a fixed number of flights, build a fully functioning gesture pad and screen display, and create several variations of airport fly-throughs relevant to the flight data we selected. This would allow users to achieve relevant real-time data in a circumstance very closely matching real use of a functioning TicketTap system.

At that stage, it will be more relevant to compare passengers using traditional flight displays/concourse maps and users engaging the TicketTap system. The key difference between our current prototype and the aforementioned prototype would be consistency in information sources. It would be advantageous to investigate the forms and sources airports currently use to populate their flight listings, and use a relevant methodology to propagate TicketTap.

Testing a more elaborate prototype in an airport environment will provide further insight into the system's shortcomings. Our usability test, although adequate for simulating the system setup, lacks certain aspects crucial to the airline travel experience. Firstly, users will be under variable time constraints in an airport. The urgency of the required information will affect how the user engages the system, or if they engage the system at all. An unknown system may be avoided in light of known and standardized forms of information access, despite any advertised advantages. Making the system approachable and simple to use is of utmost importance. Also providing a clear call to action and comprehensive but simple help system is essential.

Prototype Improvements

Observations from our usability testing have led to several direct changes necessary in future iterations of TicketTap:

1. Allow users to tap gesture pad to access more information.
2. Provide consistent gesture to action mapping
3. Provide indications about levels of depth for each menu item
4. Although menu system was simple and clear, further content levels should be more consistent with themselves and with the main menu level
5. Elaborate help system and indications of appropriate gestures
6. Slow down the fly-through and simplify text directions, and possibly make the text directions static

For this prototype, menu items are selected using an up/down swipe on the gesture pad. Using the Apple iPhone precedent, we implemented a left swipe to access more content to the right. Although appropriate for certain applications, the direct manipulation of menu highlight (up is up, down is down) created a disconnect between gestures and expected system response. We will extend the selection box metaphor to handle all content navigation (sliding right will move the selection box and system focus to the right, and vice versa for left swipe).

When the user first reaches the menu selection screen, an overlay with a hand swiping down shows the user that a downward gesture will change the menu selection. There was no such overlay for left/right swipes to access further content. Including this in the animated overlay may help alleviate some confusion about how to access further levels of information. Also providing visual cues for where more content is available will help the user achieve a cognitive context for where they are within the system. After a user has engaged a menu item, there is a small tab on the top left of the display with a home icon, indicating that 'home' is to the left.

There is also a quick 'home' button on the top portion of the gesture pad. Adding a tab to the top right indicating further levels of depth would be consistent with our current design.

The fly-through paired with the text directions did not prove to be useful enough for helping users remember directions. The fly-through was too fast and did not highlight landmarks enough. Additionally, the text directions were too long. In the future we would simplify these to show arrow icons and only important words. Because users kept glancing between the two modes of information, they got confused and did not retain the directions well. This could be solved by either slowing down the directions or by making the text directions static. The latter would allow users to look at the text either after or instead of looking at the video.

Conclusion

In summation, our initial usability test provided some relevant insight for improving our interface. The gesture system provides a powerful form of direct manipulation over system content, but consistency in gestures and feedback is of crucial importance in development of this type of system.

Investigation into existing flight information sources and robust forms of 3d modeling will need to be performed in order to elaborate on this initial prototype. Cost analysis is also necessary to determine which essential features are cost-effective for full-scale implementation in an airport environment. Further user testing is required with dedicated control groups assigned to achieve parallel tasks using existing information displays. Tests within an airport with travelers will provide invaluable data illustrating the effectiveness of the TicketTap system. Steps analyses show a distinct advantage to incorporating information sources in one system, but quantitative data needs to be collected to determine the scale of the effective difference.