

Change Tracker for Algorithmically Generated Navigation Instructions

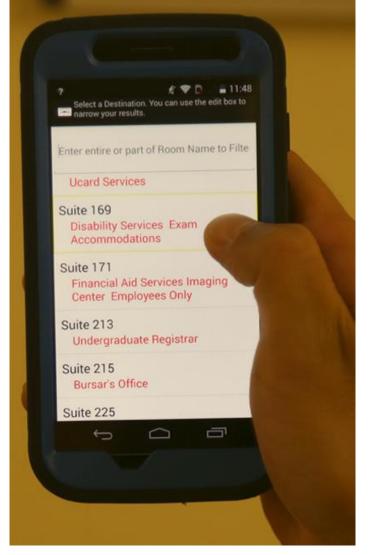


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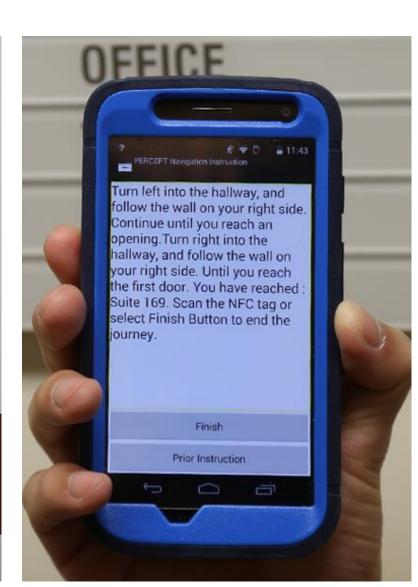
Background

- PERCEPT is an indoor navigation system for the visually impaired.
- Navigation instructions are algorithmically generated, making the app scalable to different types of indoor environments.

How PERCEPT Works







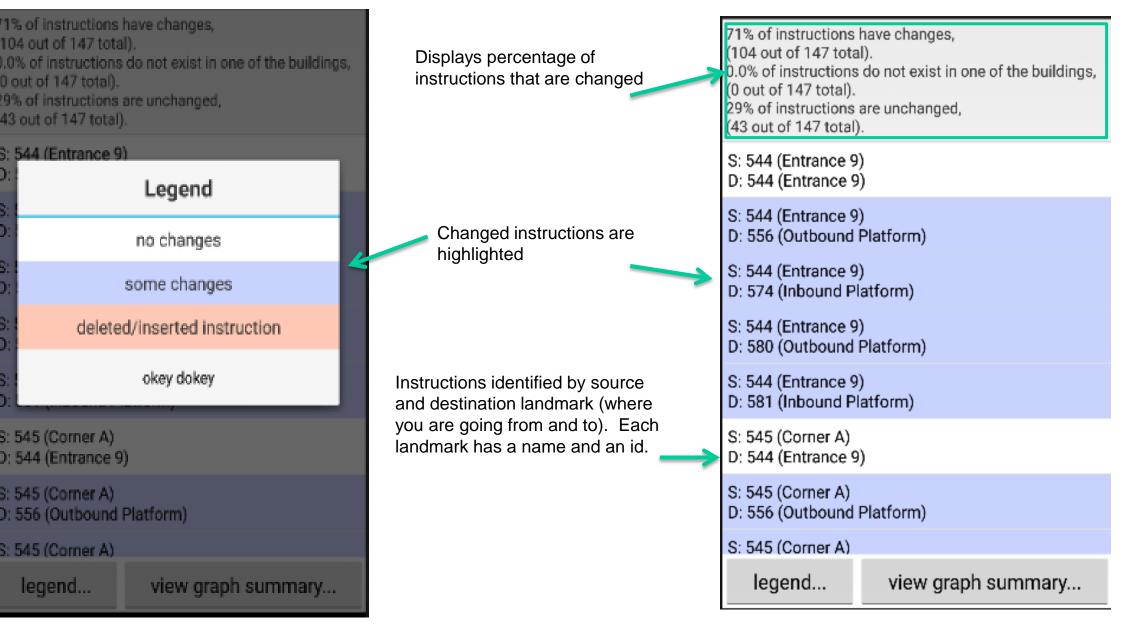
- 1. Select destination using vision-free user interface
- Scan tag at your current location
- 3. Follow instructions to reach your destination
- When deploying PERCEPT to a new environment, some changes in the algorithm must be made to account for new environment factors
 - For example, when installing PERCEPT in an MBTA station in Boston, we had to add instructions dealing with sloping floors, hallways that intersected at non-right angles, and ticket machines.
- We need a way to confirm that the changes we make have the desired effect on the instructions generated by the algorithm.
- Since there are so many instructions, doing this manually is time-consuming and it is easy to miss something.
 - Whitmore administrative building, the first location where PERCEPT was installed, has 16000 different instructions.



Objective

- Create a program, Change Tracker, to assist in debugging instruction generation for PERCEPT.
- Functionalities:
 - Automatically find the differences between two versions of an instruction set.
 - Display the new and old version of any instruction side-by-side and highlight the changes in a way that is easy to see and understand.
- Provide other information that is helpful in debugging, such as information about which types of instructions have changes.

Change Tracker UI: Summary of Changes and List of Instructions



Change Tracker UI: Marked changes

D: 556 (Outbound Platform)

(instruction 44 out of 147)

S: 553 (Corner B)

"~" symbol is placeholder to mark the space where a phrase was deleted (or where it would be inserted)

"*" symbol is placeholder for a deleted or inserted word

Building 70 (MBTA Instructions) With the tag to your back, Cross the hallway until you reach the wall.@Turn left and trail the Wall on your right side, until you reach an intersecting hallway. You will find the next tag on our right side wall.\$@Turn right and trail the Wall on your right side, until you reach Metal Gate. You will pass by Glass Window. This is a long hallway that will lead into Main Lobby. The floor slopes down. You will find the next tag on your right side wall before the metal gate. @Turn right and trail the Metal Gate on your right side, until it ends. You will enter the Lobby. You will find the next tag on the side of Charlie Card ticket machines. \$@Turn right and keeping the Charlie Card ticket machines on your right side. Continue until you reach the Fare Gate. ~~ You may hear the beeping, opening and closing of the Fare Gate. You will find and turn right. Go down two flights of stairs to the platform below * * * * * * * . At the bottom of the stairs, you will reach an opening. Walk past the opening. You will find the next tag on the beginning of the wall on your right side just past the opening.\$@On this platform the bway train arrives on your left side with a tactile strip, there is a wall on your right side. ontinge and trail the Wall on your right side until you reach another opening. You will pass y trash case and a bench. The floor slopes down. Walk past the opening. You will find the ext tag on the beginning of the wall on your right side just past the opening S@On this atform the subway wein arrives on your left side with a tactile strip. Building 96 (MBTA Instructions)

Legend...

next->

with the character of t

Legend

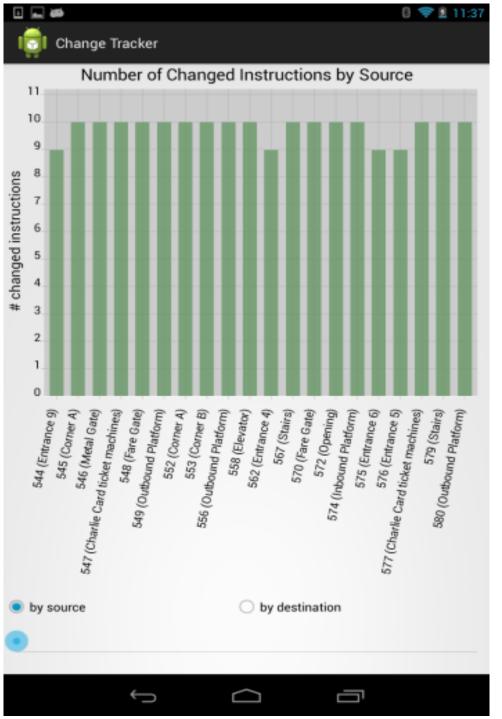
Building 96 (MBTA Instructions)
With the tag to your back, Cross the hallow until you reach the wall.@Turn left and trail the Wall on your right side, until you reach an intersecting hallway. You will find the next tag on your right side wall.\$@Turn right and trail the Wall on your right side, You will pass by Glass Window, until you reach Metal Gate. This is a long hallway that will lead into Main Lobby. The floor slopes down. You will find the next tag on your right side wall before the metal gate.\$@Turn right and trail the Metal Gate on your right side, until nends. You will enter *Lobby You will find the next tag on the side of Charlie Card ticket machine \$@Turn right and trail the Charlie Card ticket machine on your right side, *until you reach Meta* *Gate, Turn eft and trail the Metal Gate on your right side, until you reach Fare Gate. You may hear the beeping, opening and closing of the Fare Gate. You will find the next tag on the Fare Gate * * * * .\$@Go through the Fare Gate and turn right. Go down two flights of stairs to the platform below and trail the Wall on your right side. At the bottom of the stairs, you will reach an opening. Walk past the opening. You will find the next tag on the beginning of the wall on your right side * * * .\$@On this platform the subway train arrives on your left side with a tactile strip, there is a wall on your right side.

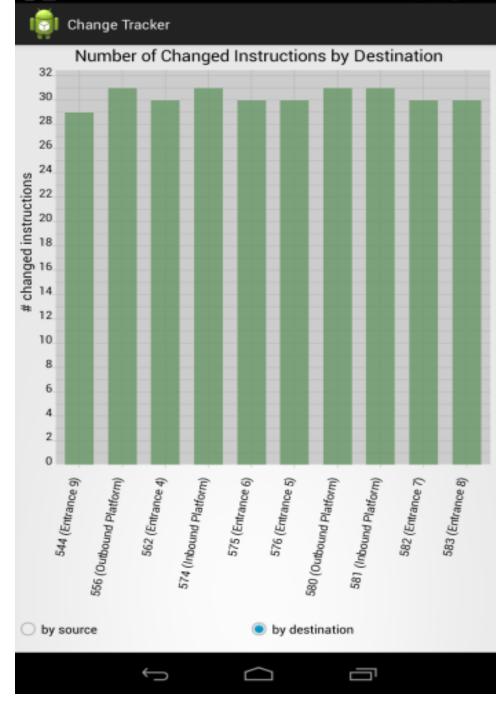
There are trash cans and bench along the wall on your right side.

Go to instruction...

Change Tracker UI: Graph Display

<-prev





- For each source landmark, displays bar representing number of changed instructions that give directions starting from that landmark
- For each destination landmark, bar represents num. changed instructions the give directions to that landmark
- Provide macro view of changes
- If you make a change to the algorithm that you only expect to affect directions from on landmark, for example, you can see immediately whether your expectation was correct.

Challenges

- Determining whether two phrases are changed versions of each other, or completely different phrases
- Detecting correctly when multiple consecutive phrases are inserted/deleted

Future Work

Improve change-marking algorithm in order to represent large changes more intuitively

References

- A. Ganz, J. Schafer, Y. Tao, L. Haile, C Sanderson, C. Wilson, M. Robertson, "PERCEPT based Interactive Wayfinding for Visually Impaired Users in Subways", International Technology and Persons with Disabilities Conference, San Diego, CA, (To Be Presented March 2015)
- A. Ganz, J. Schafer, Y. Tao, C. Wilson, M. Robertson, "PERCEPT-II: Smartphone based Indoor Navigation System for the Blind", IEEE Engineering in Medicine and Biology Society, Chicago, IL, August 2014.
- H. Dong, A. Ganz, "Automatic Generation of Indoor Navigation Instructions for Blind Users using a User-centric Graph", IEEE Engineering in Medicine and Biology Society, Chicago, IL, August 2014..

