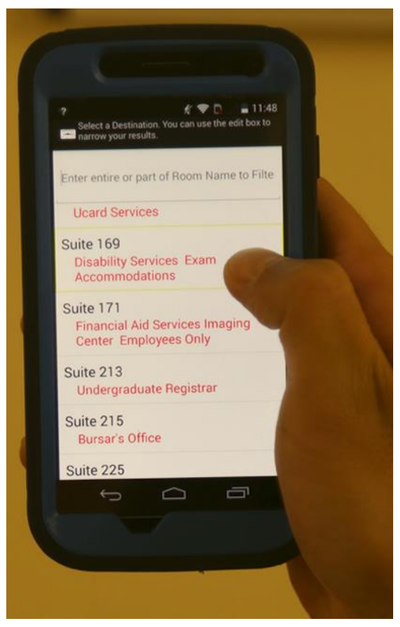
Change Tracker for Algorithmically Generated Navigation Instructions

Matthew Kowaleski | Professor Aura Ganz | Mentor: James Schafer
University of Massachusetts Amherst ECE Department

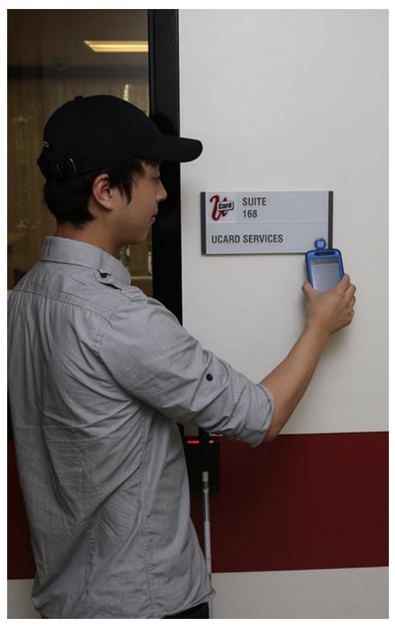
Background

- 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.

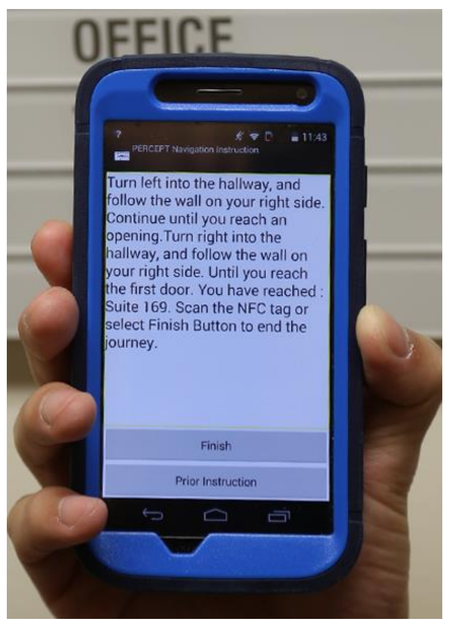
How PERCEPT Works



1. **Select destination using vision-free user interface**

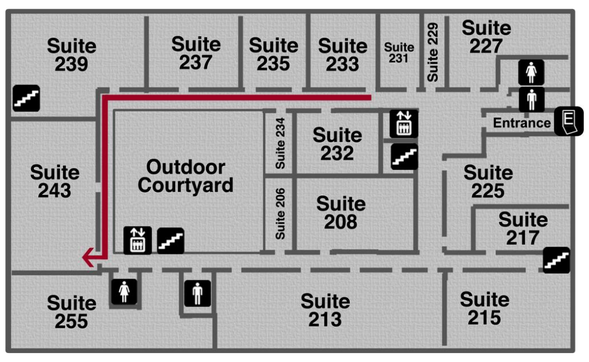


2. **Scan tag at your current location**



3. **Follow instructions to reach your destination**

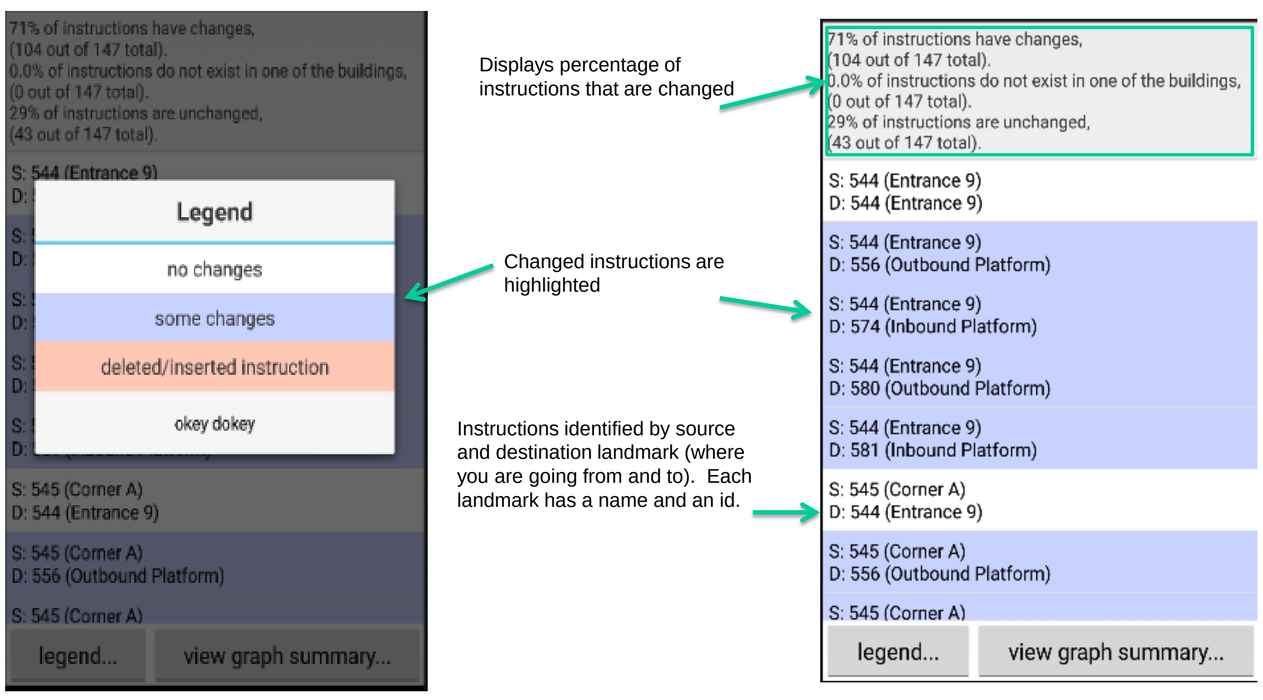
- When deploying PERCEPT to a new environment, some changes in the algorithm must be made to account for new environment factors
  - For example, when installing PERCEPT in an MBTA station in Boston, we had to add instructions dealing with sloping floors, hallways that intersected at non-right angles, 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.

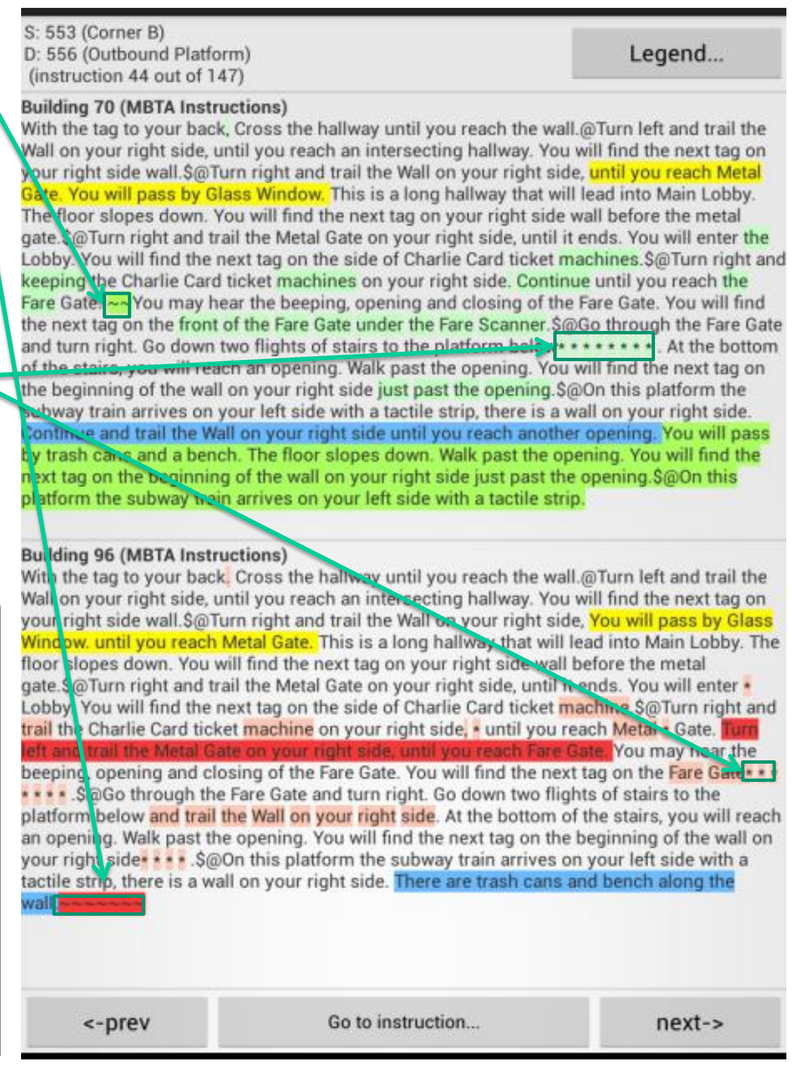
Change Tracker UI: Summary of Changes and List of Instructions



Change Tracker UI: Marked changes

"~" 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



Change Tracker UI: Graph Display

- 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..

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