# Title Slide – PERCEPT

Indoor Navigation System

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Logos: University of Massachusetts Amherst, PERCEPT, 5G Mobile Evolution Lab, National Institutes of Health, Massachusetts Department of Transportation, MBTA

## Slide 1 – Outline

* Introduction
* Demonstration
* System Overview
* Usability Study
* Conclusion

Image: Stick figure walking with cane for visually impaired

Logos: PERCEPT, University of Massachusetts Amherst, 5G Mobile Evolution Lab [note: these appear on all slides]

## Slide 2 – Outline

Slide is the same as Slide One with the word “Introduction” in bold text.

## Slide 3 – Introduction

* Enables blind users to independently navigate in unfamiliar indoor environments
* Percept is an orientation aidused in conjunction with mobility aids
* Co-Designed with Certified Orientation and Mobility Specialists (COMS) from Massachusetts Commission for the Blind
* Successful trials conducted at UMASS and MBTA subway station with over 60 blind and visually impaired human subjects
* Featured several times in The Boston Globe

Image: The Boston Globe Story “Independence in an App: Indoor Navigation System will open Doors for the Visually Impaired at Boston Area MBTA Stations.” To view the article on The Boston Globe website visit: <https://www.bostonglobe.com/lifestyle/health-wellness/2014/12/22/new-app-will-help-blind-navigate-mbta-stations/6OkbDsNGMYSJ928sok6GTK/story.html>.

## Slide 4 – National Federation of the Blind (NFB)

* Finalists at the National Federation for the Blind Indoor Navigation Summit (December 2015)
* Anil Lewis Executive Director NFB: “The PERCEPT System is the only indoor navigation system we have identified that provides detailed point-to-point descriptive navigation instructions within an indoor venue. “

Logo: National Federation of the Blind

## Slide 5 – Advantages

* Deployed and successfully tested
  + Building and subway stations with over 60 BVI trials
* True wayfinding
  + Using detailed automated navigation instructions, you are never lost
* Pre-journey navigation
  + Build mental map of environment before stepping foot in it

Images: City building; subway car entering an underground station; dashed line with arrow pointing to “You’re here” symbol; figure sitting in front of computer

## Slide 6 – Outline

* Introduction
* Demonstration (the word “Demonstration” is in bold text)
* System Overview
* Usability Study
* Conclusion

Image: Stick figure walking with cane for visually impaired

## Slide 7 – Demonstration: North Station Subway Overview

Underground Level 1: Causeway Street Entrance, Green Platform to Lechmere, Valenti Entrance

Image: Outline of the Underground Level 1 of North Station detailing the different entrances and platforms.

Underground Level 2: Orange Platform to Forest Hills, Green Platform to Copley and West, Orange Platform to Oak Grove

Image: Outline of the Underground Level 2 of North Station detailing the different entrances and platforms.

## Slide 8 – Demonstration

Image: Hallway with escalators. Diagrams of fare gates, escalators, and Green Line platform. Image of smartphone with Main Menu: Start Navigation, Travel Preferences, Stairs & Elevator, Help and About, Developer Config Menu

## Slide 9 – Demonstration

Image: Smartphone says “Start Journey in North Station Subway. Green & Orange Lines: You are located within Valenti St. Entrance region on Street Level.”

## Slide 10 – Demonstration

Image: Smartphone says: Causeway Street Stairs Entrance. Green Platform to Copley and West, Green Platform to Lechmere, Orange Platform to Forest Hills, Orange Platform to Oak Grove, Valenti Way Entrance

## Slide 11 – Demonstration

Image: Smartphone says: You are located within Valenti St. Entrance region on Street Level. Your current location is Valenti Way Entrance, With the Valenti Way Entrance to your back, Walk straight ahead, heading north, reach the escalator to your right side, 20 feet away, You will hear the escalator noise. Select next instructions button. Options: Next instruction, End journey

## Slide 12 – Demonstration

Image: Individual goes down the escalator

Image: Smartphone says: You are located within Valenti St. Entrance region on Street Level. Your current location is: Escalator, take the escalator down, select next instructions button. Options: next instruction, prior instruction, end journey

## Slide 13 – Demonstration

Image: individual goes straight ahead toward fare gates

Image: Smartphone says: You are located within Southern Unpaid Lobby region on Underground Level 1. With the escalator to your back, walk across the opening, heading north, until you reach the Fare Gates, 40 feet away, you will reach: Fare Gates. Select next instructions button. Options: next instruction, prior instruction, end journey

## Slide 14 – Demonstration

Image: individual is disoriented

Image: smartphone says: You are located within Southern Unpaid Lobby region on Underground Level 1. With the escalator to your back, walk across the opening, heading north, until you reach the Fare Gates, 40 feet away, you will reach: Fare Gates. Select next instructions button. PERCEPT help menu: Where am I? Display map, submit session bug, cancel

## Slide 15 – Demonstration

Image: smartphone says: You are located within Southern Paid Lobby region on Underground Level 1. You are currently located in Southern Unpaid Lobby region. You have been traveling north. The Fare Gates unpaid side is about 5 feet to your 12 o’clock in the northwest direction. Head towards Fare Gates unpaid side. Select next instructions button. Options: next instruction, prior instruction, end journey

## Slide 16 – Demonstration

Image: individual at fare gates

Image: smartphone says: You are located within Southern Paid Lobby region on Underground Level 1. Go through the Fare Gates, with the Fare Gates at your back, There is Green Platform to Lechmere to your 10 o’clock direction, Walk across to the Green Platform to Lechmere to your 10 o’clock direction, heading southwest, 30 feet away, You will face the track. Select next instructions button. Options: next instruction, prior instruction, end journey

## Slide 17 – Demonstration

Image: individual about to board Green Line

Image: smartphone says: You are located within Southern Green to Lechmere Platform region on Underground Level 1. You have reached your destination: Green Platform to Lechmere. Select End Journey Button to end this journey. Options: next instruction, prior instruction, end journey

## Slide 18 – Outline

* Introduction
* Demonstration
* System Overview (the word “System Overview” is in bold text)
* Usability Study
* Conclusion

Image: Stick figure walking with cane for visually impaired

## Slide 19 – Components

* PERCEPT Space
  + PERCEPT tags deployed in venue
  + Digital representation of venue
* PERCEPT Navigation Instructions
  + Wayfinding instructions generated through PERCEPT navigation instruction generation algorithm
  + Uses digital map
  + Uses O&M rule book
* PERCEPT Smartphone application
  + No Internet required when providing navigation instructions
  + Accessible vision free user interface

Images: PERCEPT tag which is 56mm wide and white with small black logo on top, IPhone with PERFECPT navigation instructions

## Slide 20 – North Station Deployment

Encompasses 2 Unique Environments

Images: North Station Commuter Rail Ground Floor with TD Garden Logo and Purple Commuter Rail Symbol; North Station Subway Station (3 floors) with Boston MBTA “T” Green and Orange line symbols

## Slide 21 – North Station Commuter Rail

Encompasses 2 Unique Environments

* Houses both the Commuter Rail and Amtrak Services located on the ground floor within the TD Garden
* This floor also is the location for
* TD Garden Box Office
  + Fast Food restaurants
  + Convenience store,
  + Restroom facilities,
  + Service Desk for Amtrak and Commuter rail
  + ATM

Image: North Station Commuter Rail Ground Floor with TD Garden Logo and Purple Commuter Rail Symbol

## Slide 22 – North Station Subway

* Houses Green and Orange subway lines
* Composed of three floors
  + Street Level Access
    - North & South Entrances
  + Underground Floor 1
    - Fare Machines
    - Fare Gateways
    - Information Desk
    - Outbound Green Line
  + Underground Floor 2
    - Inbound Green Line
    - Outbound Orange Line
    - Inbound Orange Line

Image: North Station Subway Station (3 floors) with Boston MBTA “T” Green and Orange line symbols

## Slide 23 – PERCEPT Tag Overview

* PERCEPT Tag is a Bluetooth tag, also known as an iBeacon
* Tag is needed for navigation instructions
  + In order to provide instructions to a destination, we need to know where the user is located

Image: Navigation instructions help user get from user’s location to destination

Logo: Bluetooth

## Slide 24 – PERCEPT Tag Overview

* Outdoor navigation we are accustomed to GPS
  + GPS does not work indoors
* PERCEPT tags provides GPS like capabilities indoors
* Tags are mounted up high on ceilings and walls

Images: GPS Symbol; stick figure walking with cane for visually impaired with a green check mark next to it; city building with a “no” symbol on top of it; representation of PERCEPT in action demonstrated by a stick figure walking with cane for visually impaired in subway station with PERCEPT tags located on pillars throughout the station

## Slide 25 – PERCEPT Space

* Digital representation of the venue
  + Contains the sensory roadmap for the venue
* Digital rulebook that adheres Orientation and Mobility best practices
* PERCEPT looks at the digital representation and refers to the rulebook to generate navigation instructions

Images: Digital representation of mock subway station with words describing what each of the symbols represents (stairway; elevator beeping; platform tactile strip; beeping, opening, and closing fare gates; escalator humming)

## Slide 26 – Components

* PERCEPT Space
  + PERCEPT tags deployed in venue
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Images: PERCEPT tag which is 56mm wide and white with small black logo on top; IPhone with PERFECPT navigation instructions

## Slide 27 – Navigation Instructions

North Station

Over 2,800 detailed instructions generated in 5 minutes

Infographic: Image of green Line MBTA “T” car arriving at the North Station platform. There are four different platforms at North Station. There are three floors at North Station that are accessibly by elevator, stairs, or escalator

## Slide 28 – Navigation Instructions

* Automated instruction generation provide a cost-effective and scalable means to provide detailed navigation instructions
* O&M specialist is not manually crafting each PERCEPT instructions
* This algorithm is continually being improved

## Slide 29 – Components

* PERCEPT Space
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Images: PERCEPT tag which is 56mm wide and white with small black logo on top; IPhone with PERFECPT navigation instructions

## Slide 30 – PERCEPT Application

* No Internet required
* User friendly design
* Accessible “Vision Free” interface for blind and visually impaired
  + Integrated with Voiceover and Large Font accessible services on iPhone
* Accessible visual user interface
  + In Development
* Available on iOS and Android platforms

Images: 2 iPhone with the PERCEPT application at different stages open on each

## Slide 31 – PERCEPT Application Flow

Open PERCEPT application

Select “Start Journey” from Main Menu

Select Your Desired Destination

Receive Detailed Instructions to Destination

Images: Home screen of an iPhone; Main menu of PERCEPT application in iPhone with various menu options listed; Select Destination screen on PERCEPT application in iPhone. All possible destinations are listed; Instructions

## Slide 32 – PERCEPT Application Flow

Reach Destination

Disoriented or Lost??

Shake Device to Open Help Menu

Select ‘Where am I?’

Images: iPhone with PERCEPT application open to the screen that is displayed once your destination is reached; iPhone with PERCEPT application open to the screen that that is displayed when you shake your device if disoriented or lost in order to open the help menu, the options that pop up include “Where am I?” and “Submit Bug”; iPhone with PERCEPT application open to screen that is displayed after you select “Where am I?”, the application provides you with specific instructions regarding your collection

## Slide 33 – Vision Free User Interface

Voiceover in iOS allow for Vision Free Use of Smart Device

* User navigates the application by performing touch gestures on the screen
  + **Touch:** Item touched is read to user
    - * **Swipe Right or Down**: Select Next Item
      * **Swipe Left or Up**: Select Prior Item
      * **Double Tap:** ‘*Clicks*’ selected item

Images: Finger point at an iPhone screen performing the touch gesture necessary to select directions that will be read aloud by the phone; Volume symbol with speech box that reads “You are located within Causeway Street Entrance…”

## Slide 34 – Large Font Integration

* User sets a preferred font size within their devices settings.
* This preference is inherited into PERCEPT.

Global Font Size Setting Default Font Size, Preferred Font Size

Images: Electronic device open to Accessibility settings of device that allows you to drag a slider to increase or decrease the “Global Font Size Setting” of Apps that support Dynamic Type; electronic device with PERCEPT application open to Main Menu which displays the “Default Font Size”; electronic device with PERCEPT application open to Main Menu which displays a larger “Preferred Font Size” that the default setting

## Slide 35 – PERCEPT Visual UI

* Provides a visual pathway to the selected destination
* Indicates surrounding landmarks
  + User can select landmark for further details
* User can select a preferred floor traversal preference.
  + Elevator, Stairs, Escalator, …

Image: Pointer finger on the screen of an iPhone and using the PERCEPT application to select the option for “Elevator” to the Valenti Street entrance of North Station.

## Slide 36 – Pre Journey Navigation

* PERCEPT provides pre-journey learning options
* Select destination and starting point in PERCEPT app
* Go through station instructions or visual path step by step
* Explore station from comfort of your own home

Image: Images: A black and white iPhone with the PERCEPT application at different stages open on each.

## Slide 37 – Outline

* Introduction
* Demonstration
* System Overview
* Usability Study (the word “Usability Study” is in bold text)
* Conclusion

Image: Stick figure walking with cane for visually impaired

## Slide 38 – Usability Study Overview

Two phases

* Phase A: blind or visually impaired subject use PERCEPT
* In between phases, improvements to PERCEPT based on trial feedback
* Phase B: Returning participants from Phase A and new participants use PERCEPT

## Slide 39 – Phase A Trials

Blind or Visually Impaired Participants navigate throughout North Station using PERCEPT

Images: Stick figures walking with canes for visually impaired; MBTA “T” symbol with green and orange lines; iPhone open to PERCEPT application

## Slide 40 – Trial Composition

Hands-on Orientation

* Sit-down & on-site

Percept Trial

* 4 Destinations
* Entering and exiting station from different entrances and platforms

Post-Trial Questionnaire

* Questionnaire to obtain:
  + Subjects feedback and experience
  + Qualitative evaluation of PERCEPT

Images: figures holding an iPhone; figure walking with cane for visually impaired in subway station; two figures with question marks over their heads

## Slide 41 – PERCEPT Trial

* PERCEPT trial is composed of four tasks
* Subject is asked to complete these tasks while only relying on their mobility skills and PERCEPT App
* Instructor is no longer able to answer any questions or assist subject during the trial
* Trial ends either when all tasks are complete or subject decides to stop

## Slide 42 – PERCEPT Usability Study Results

Subjects were asked to answer the following statements with a 7-point scale.

1(strongly disagree) to 7 (strongly agree)

a) Easy to learn how to use the system

b) Easy to use the system

c) Trial design was easy to complete

d) Easy to use User Interface

e) System provided sufficient re-orientation information when lost

f) I am confident I will reach destination using the system

Subjects were asked to give their impression on the following:

1) Likes/dislikes of the system?

2) Name the most difficult part of using the system

3) Name the most difficult part of the trial

4) Level of confidence in self – How confident were you when the trial started, that you could accomplish the task successfully?

5) Are there some improvements you’d suggest we make to the system?

6) Based on your experience using PERCEPT if you were to come to an PERCEPT enabled subway station in the future, would you use it?

## Slide 43 – PERCEPT Usability Study Results

* All participants were able to complete the 4 navigation tasks
* All participants thought PERCEPT was beneficial to them and said they would use it if available

Subjects were asked to answer the following statements with a 7-point scale:

1(strongly disagree) to 7(strongly agree)

*North Station scores that follow each question are averaged*

a) Easy to learn how to use the syste: 7

b) Easy to use the system: 7

c) Trial design was easy to complete: 6

d) Easy to use User Interface Score: 6.5

e) System provided sufficient re-orientation information when lost: Score: 6

f) I am confident I will reach destination using the system: 6.5

## Slide 44 – Outline

* Introduction
* Demonstration
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* Conclusion (the word “Conclusion” is in bold text)

Image: Stick figure walking with cane for visually impaired

## Slide 45 – Conclusions

* Conducted over 60 trials with blind and visually impaired participants in buildings and subway stations
* Trials demonstrated that PERCEPT is easy to learn and use
* All participants said they would use PERCEPT if available in transit venue
* Pre-journey learning option

## Slide 46 – Thank You

* PERCEPT is not exclusive to blind and visually impaired
* There is significant potential to aid others when it comes to wayfinding in a transit setting
* We are actively researching new methods to make PERCEPT inclusive and accessible to all
* We seek feedback from those present for how their patrons, clients, or they themselves may benefit from PERCEPT

## Slide 47 – Thank You

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