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Interactive 3D Printed Campus Maps

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Accessing Higher Ground Nov. 16th 2018

Denver, CO

Logos of Portland State, NSF, and Cornell Tech

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Cornell Tech Collaborators

Lei Shi (Image of Lei)

Dr. Shiri Azenkot (Image of Shiri)

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Overview

Introduction to 3D printing in educational settings

Overview of past and current research related to interactive 3D models, including maps

Opportunity to field test 3D printer toolkit

Discussion and Q&A

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3D Printers Make

Models More Available

Image of 3D printer with red printed bunny

Buehler, E., Kane, S. K., & Hurst, A. (2015)

Kane, S. K., & Bigham, J. P. (2014)

Brown, C., & Hurst, A. (2012)

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3D Printed Models Are Useful to Students Who are Visually Impaired

Image of person exploring 3D printed model of father throwing son in the air

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When are 3D Printed Models Appropriate?

* When real object is not available to explore through touch (too small, large, fragile, dangerous, not in proximity
* When process, stages, progression are involved
* When moveable and/or removable parts are incorporated (e.g. model of the eye, electricity through a circuit
* Color variation helps learner with low vision distinguish the components of 3D object.

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Use of 3D Printed Materials - Additional Uses

* Learner with visual processing difficulties has hands-on opportunity to explore and manipulate object being taught more thoroughly.
* Learner with auditory processing difficulties can examine up close, ask questions, listen to directions/instructions while having the opportunity to manipulate object.
* Learner with physical disabilities can view 3D materials when actual object or parts of it are not accessible for viewing
* When using technology (e.g. microscope) is difficult for motor abilities, 3D printed materials provide access to critical content

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Commercial Globe Model (Image of commercial globe)- Shape, Texture, Color, Text VS

3D Printed Tactile Globe Model (Image of white printed globe) - Shape, Texture

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Markit - tagging application (Image of software application)

Talkit - sensing application (Image of person exploring 3D printed model)

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Augmented models that provide information to the user

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Previous Research

Video of recent research

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Process of Creating an Augmented Model

1. Find a 3D model online
2. Add annotations with the tagging application
3. Print the model
4. Learn from it with the sensing application

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Case Example: Portland State University Map

1. Map design was generated using Touch Mapper
2. Audio annotations were added for campus buildings
3. The maps were printed using high contrast colors
4. Two adults explored using the 3D printer toolkit

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[Touch Mapper](https://touch-mapper.org/en/))

* Easy to use
* Type in address and create 3D printer or tactile graphic file
* Pulls information from OpenStreetMap.org
* Design can be modified
* Does not generate key or legend for map
* Does not include braille

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Design Process

* After the initial model was generated, the model was edited in Tinkercad, a free modeling tool for beginners.
* The map orientation was adjusted and unnecessary sections were removed. The map was then scaled to a larger format to allow for braille labels.
* Because the Portland State University campus is within a dense urban area, the height of the PSU buildings was extended to make them more noticable. This also allowed for multi-color printing.
* An arrow pointing north was added to give the user context for orientation.

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3D Braille Font

* Available on Thingiverse
* Includes symbols for contracted braille
* [OpenSCAD grade2 braille font module](https://www.thingiverse.com/thing:74358)

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Printing of Braille with 3D printers - Guidelines

* Limit the amount of braille on a 3D print - less is more
* Include a key
* Use preferred braille code (UEB, Nemeth)
* Testing suggests that vertical printing results in optimal results
* “Vertical braille occurs when the surface on which the braille is printed is perpendicular to the build surface.”

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Annotation Process

* Key elements about each building were included, focusing on cross streets, access to building, and departments, offices or services found within structure.
* Annotations were added using Markit
* Refinements were made based on initial testing among research team
* The model was initially too complex to be properly tagged and annotated. A simplified model was used for the tagging process, and the information from this model is overlaid on the more complex final model.

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Image of 3D design within software. Each building is color coded and text information is added.

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Annotation Example: West Hemlock (Image of building)

The Western Hemlock Trailer Pod (WH) is a group of 5 single-level temporary trailers located within the Shattuck Parking Lot. The trailers must be accessed via the Shattuck Parking Lot along SW Broadway between College and Jackson Streets just south of Shattuck Hall itself. Western Hemlock are the southernmost group of trailers in the Shattuck Lot; a second, fenced-off group of trailers is for construction work related to Peter Stott Center.

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Beta Testing with Individuals Who are Blind

Participants

* Two female college graduates who are totally blind
* Both had limited experience using tactile graphics for wayfinding purposes
* One is a user of BlindSquare app for traveling; the other has limited experience using wayfinding apps

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What aspects were effective?

* Users gained relevant information about key buildings on campus.
* The application was easy to use.
* They envisioned using a similar map for orientation and mobility lessons.
* One reported that the system would be an effective way to pre-plan for travel to a specific destination.
* They liked the braille labels on the map.

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What aspects could be enhanced?

* One structure has two buildings and the app did not consistently distinguish between the two.
* Both participants wanted more specific information about the intersections on campus.
* Both participants wanted information about local resources (e.g. bank, post office).

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Future Directions

* Gather input from orientation and mobility instructors
* Explore use of maps for intersections (i.e. zoom views of specific areas)
* Expand upon research that took place in school settings
* Refine toolkit so that those with visual impairments can add their own annotations to 3D printed materials
* Share existing 3D prints with annotations with the community

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Comments or Suggestions from You (Image of Post-It Note with Light Bulb pinned to cork board)

* What are some ideas you have for using the 3D printer toolkit?
* How might you use it within your agency?

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Questions? (Image of 3D printed explanation point, question mark, and arrow point to words “Thank you!”)

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More information

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[Interactive 3D Printed Models Website](https://www.interactiveprintedmodels.com/)