Interactive Tactile Maps
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INTRODUCTION

Tactile Graphics
- Accessible images that use raised surfaces so that a visually impaired person can feel them.
- Convey non-textual information.
- Tactile maps are a subset of tactile graphics.

Tactile Maps
- Provide visually impaired individuals with a practical knowledge of their environment, but their widespread adoption is limited by:
  1. The cost associated with manufacturing maps.
  2. The complexity of designing such maps, which generally required 3D modeling software.
  3. The static nature of the map's limit interactivity and in-the-field application.

Existing Alternatives
Braille displays:
- High resolution, refreshable displays, connected to a camera.
- Cheapest model: weighs 2.5 kg and costs $7,000. (Tactisplay Corp, June 2015)

TMAP and related services:
- Users enter an address on a website and are sent a printed version of the surrounding area.

Zoom maps methodology:
- Maps from a macro to a micro scale, with each new map more detailed than the previous.

Tactile tablets:
- Touch-sensitive tablets capable of holding a tactile graphic sheet motionless in place.
- Again cheapest model starting at $800. (Tactisplay Corp, August 2015)

IMPLEMENTATION

Our Implementation
- Cheap map fabrication by utilizing the increased availability and reduced costs of 3D printers.
- An accessible web tool designed to allow visually impaired users to generate customized 3D map models for fabrication.
- A companion Android application that provides helpful, location-aware cues.

Web Interface
- User registration and login in a secure manner.
- New map creation with points of interest and an investigative area - a region for which the user would like a second, more detailed map.
- Single-click download of 3D printable representations.
- REST endpoints accessible by the Android application.
- Voice commands to make all of this accessible.

Map Model
- Roads, waterways, parks, building footprints, or topographical data extruded and assigned adjustable tactile features.
- Layouts of touch-sensitive graphene points allow the user to interact with entered POIs or investigative area.
- All different features stitched together into a single .stl file

Map Case and NFC
- A 3D printed case keeps the map in place over the user’s phone, and also provides 3 – 6 tactile buttons.
- NFC tags encode map and user information - a user just taps a tagged map on his/her phone, and information is pulled from the server.

Android Application
- User locates his/her position on the map and identifies potential destinations through haptic and audio feedback.
- Source-destination routing with audio feedback.
- Geo-fencing to signal users when they are approaching bus stops.
- In-depth exploration of smaller, investigative areas.

WAY FORWARD

Current implementation: cheap, easy to learn.

Extensive user testing and surveying required!
- User experience and interaction can be enhanced in several ways:
  1. Dynamic routing which guides the user when he/she goes off-course.
  2. Incorporating public transport into the user navigation suite.
  3. On-the-fly point of interest mapping based on the user’s current preferences, in investigative areas.
  4. Multiple investigative areas per map.
  5. Improved prompts when the user moves from one map area to another.
  6. Utilizing accelerometer and gyroscope information to point the user in the correct direction at strategic points.
  7. Improved accessibility for the server interface.
  8. Incorporating automated NFC tag writing in the app.

Many open questions:
- Which map features should be included?
- How should we label these map features?
- How to best scale the maps?
- What information density is best?
- What audio feedback is most helpful?
- What other app interactions would be helpful?
- What else can be done?