

A11yBoard: Using Multimodal Input and Output to Make Digital Artboards Accessible to Blind Users

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The Problem:

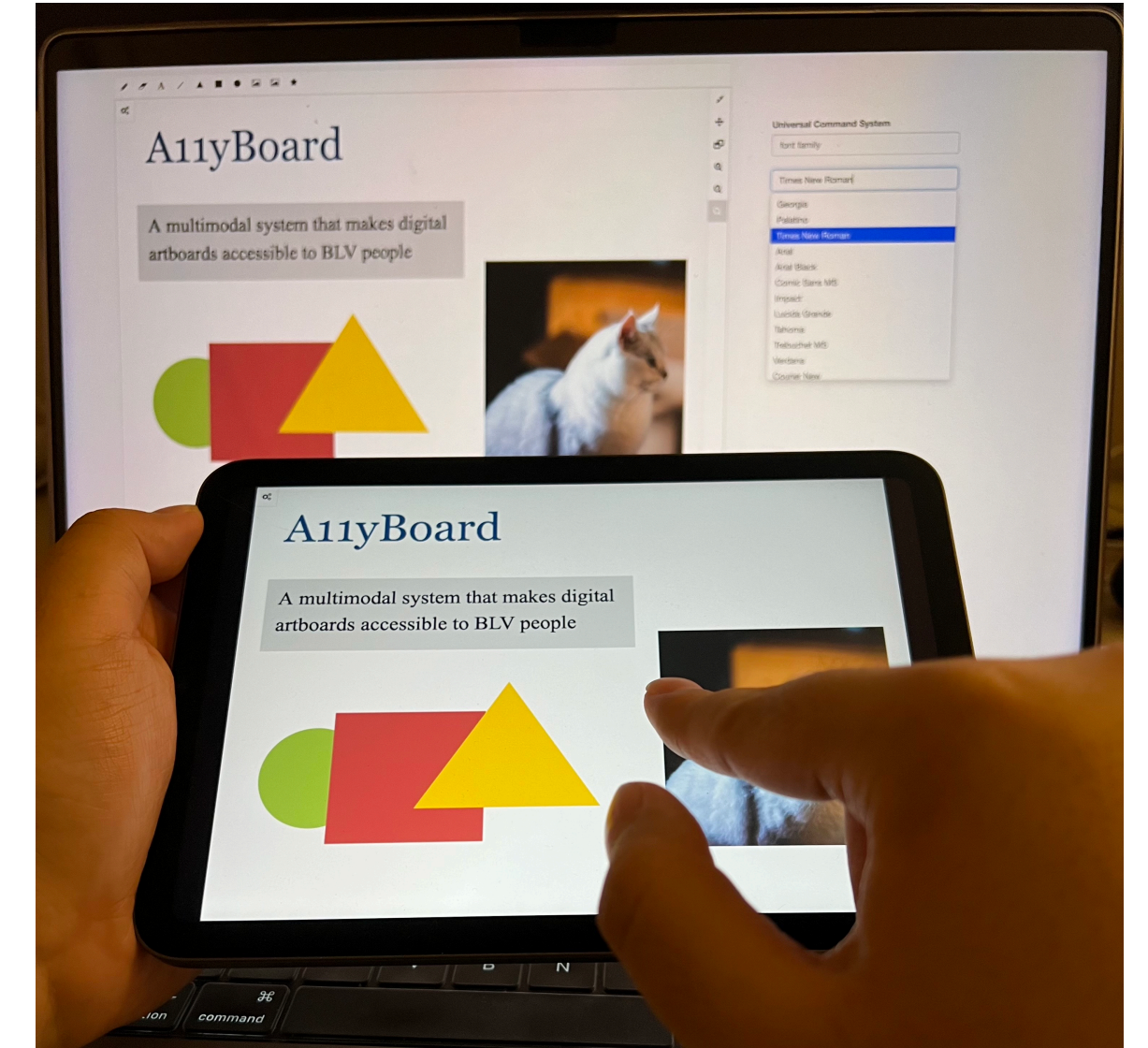
Prior work has shown challenges for blind and low-vision (BLV) users of object-based 2-D digital artboards, like those found in Microsoft PowerPoint and Google Slides: (1) High cognitive load; (2) Difficulty determining object relationships; (3) Uncertainty of operation success.

The Fundamental Challenge for Screen Readers:

2-D rich information spaces vs. **1-D** textual information stream.

The Solution: an interactive multimodal system:

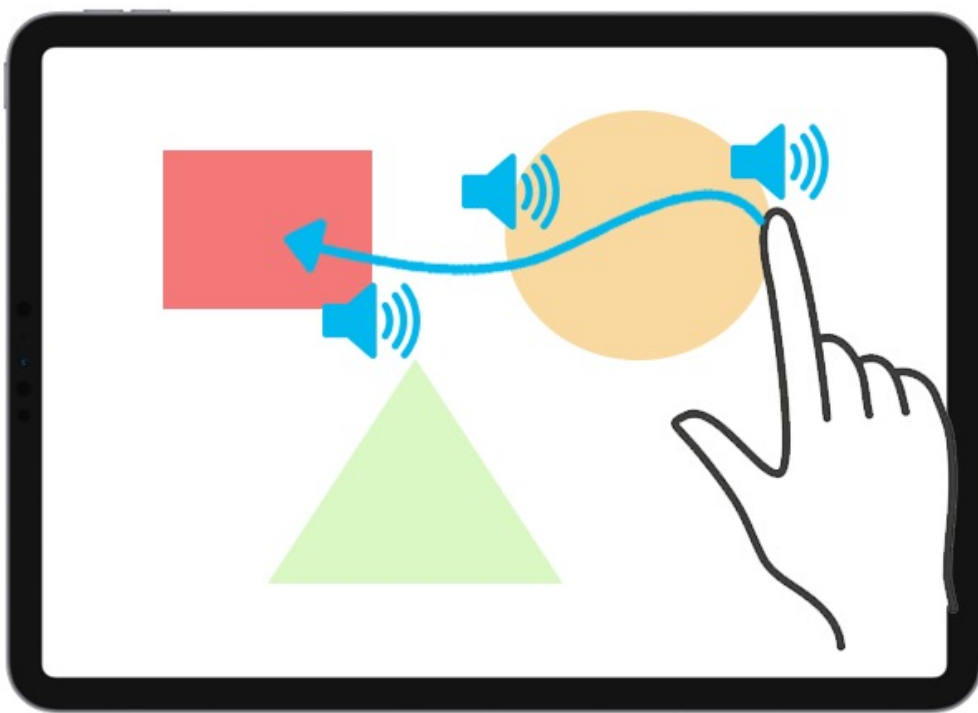
A11yBoard, an interactive multimodal system that combines **touch**, **gesture**, **speech**, **audio**, and **keyboard search** to create a feature-rich and accessible system for interpreting and authoring digital artboards.



Using A11yBoard, which consists of a web-based drawing tool and a mirrored touch screen enabling risk-free exploration and speech/audio interactions.

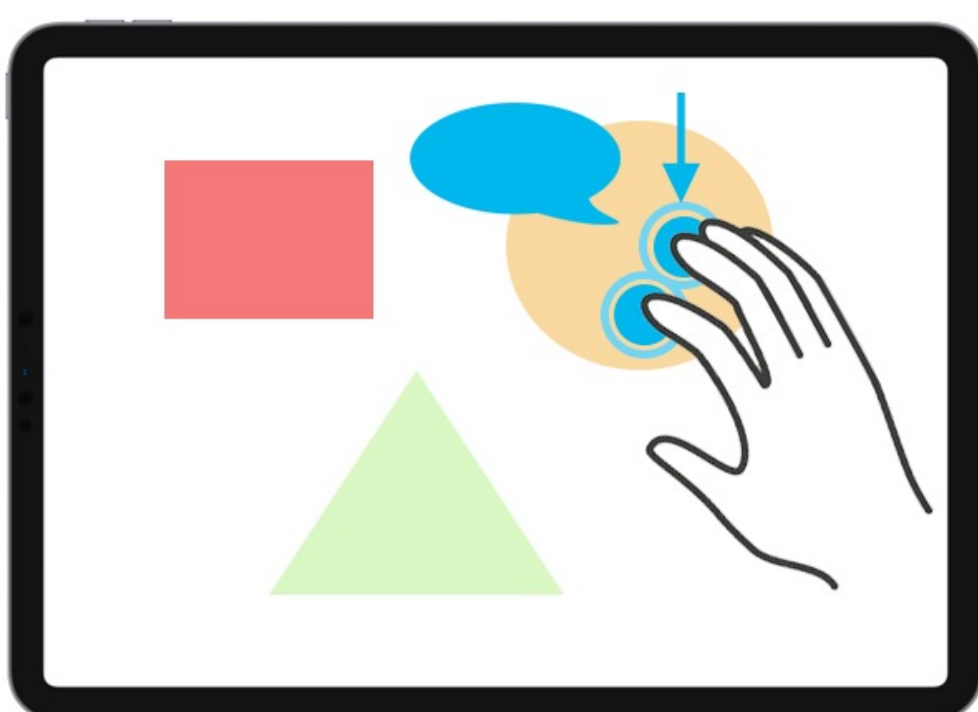
Risk-Free Exploration via Touch and Gesture

> Single-finger exploration:



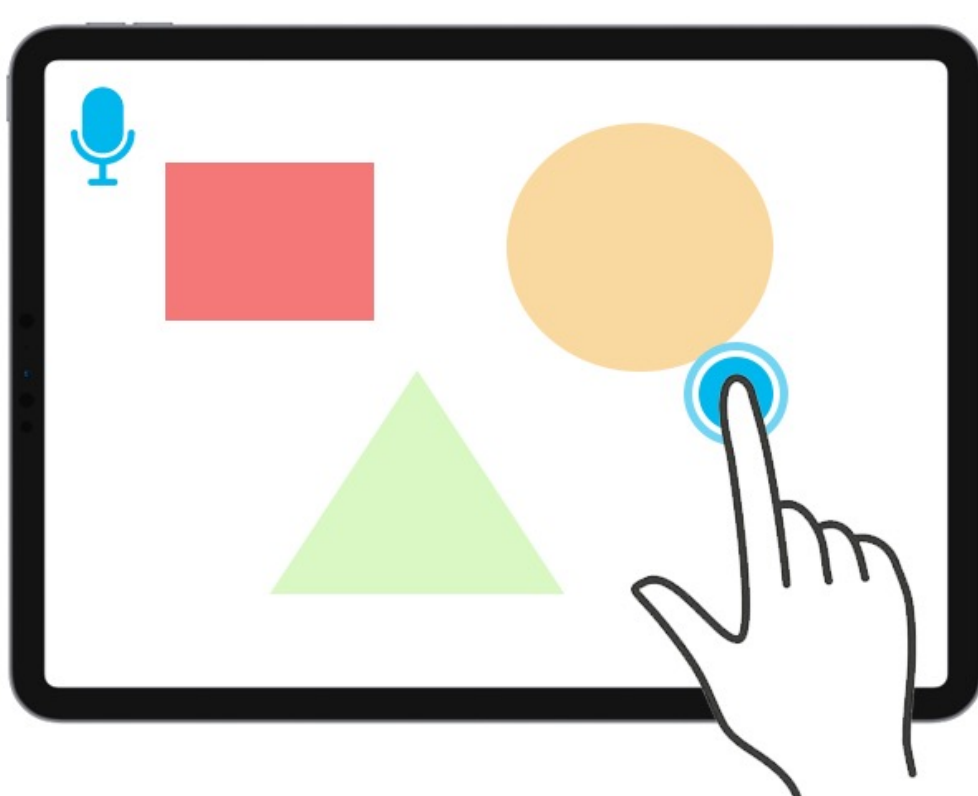
A single "reading finger" scans to freely explore objects. A "step-in" and "step-out" non-speech audio tone is played when going over an object's borders.

> Split-tap drill-down:



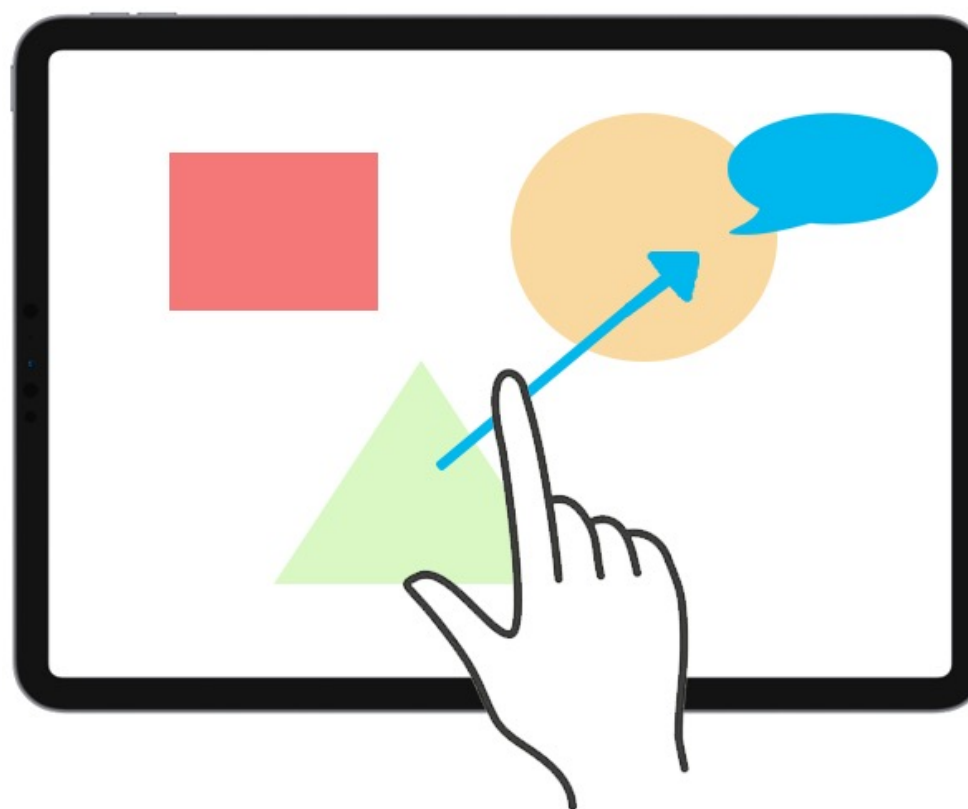
A11yBoard supports split tap (a second-finger tap on the screen) to select an object and hear detailed information about its size and location.

> Single-finger dwelling:



To further interact with a selected object, speech commands can be uttered so long as one finger actively dwells on the screen.

> Quick directional flick:



To support learning of surrounding objects, A11yBoard offers a two-finger quick directional flick gesture, which reads out information about the closest object in that direction.

Speech-Based Interaction

In "Single-finger dwelling," A11yBoard supports a series of speech commands to access information and manipulate objects. See below:

Speech Commands for Interpreting an Artboard

- > "Position" (or "left"/"top"/"bottom"/"right")
- > "Size" (or "width"/"height")
- > "Color"
- > "Closest"/"Farthest" (optional: add a number of how many objects requested)

> Any interpretive speech command can be added with word "exact" to learn about exact pixel or RGB values

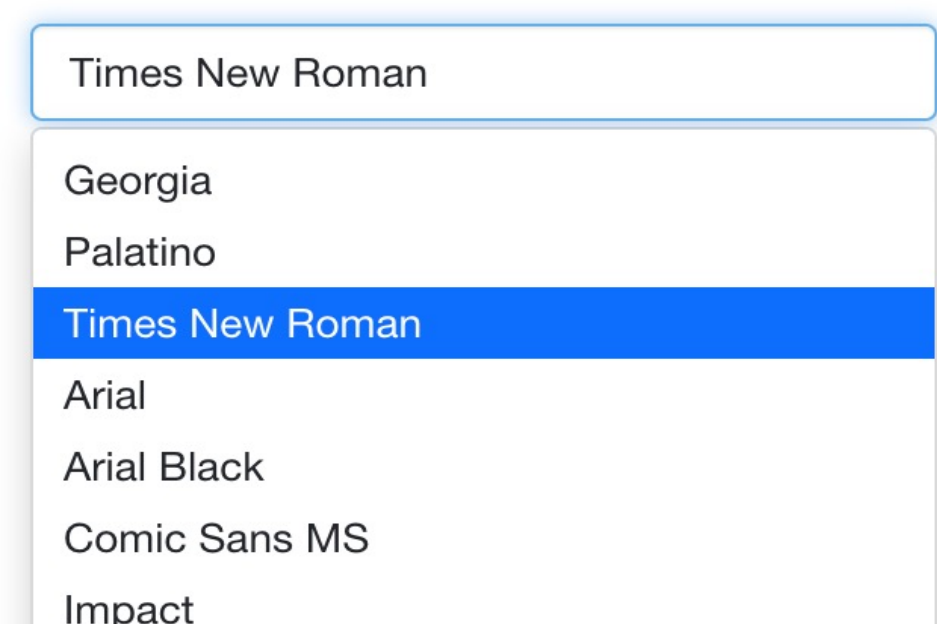
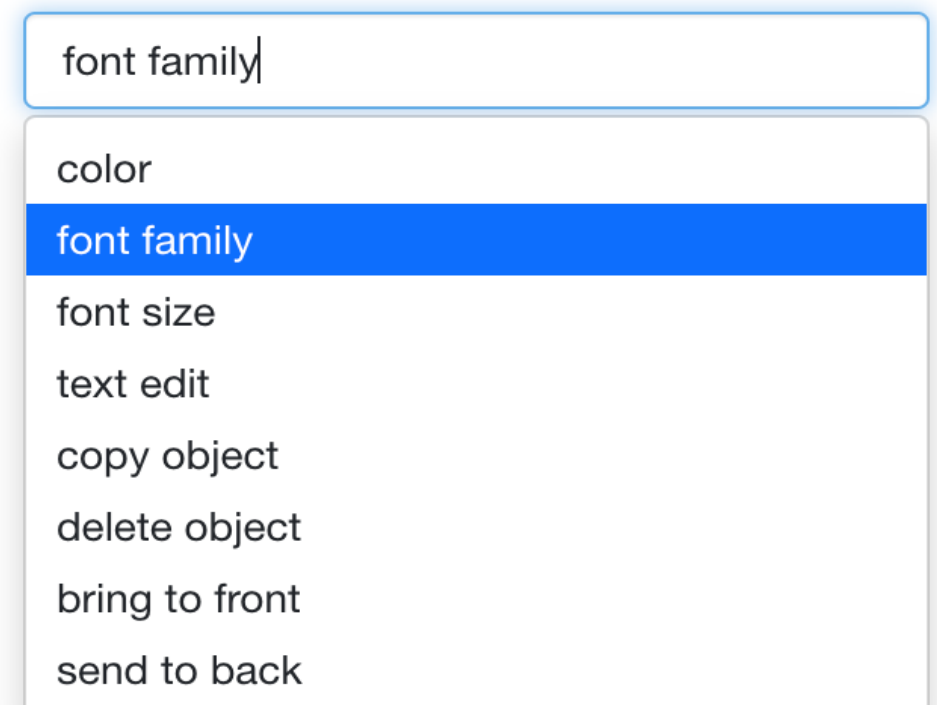
Speech Commands for Authoring an Artboard

- > "Create" (with an object type)
- > "Move"
- > "Resize" (with a corner, e.g., "top-left")
- > "Align" (execute moving/resizing to align with another object, e.g., align left to right)
- > "Here" (execute moving/resizing to a specific location explored by users)

Universal Command Line

To support more actions like changing colors and fonts, which can not be easily achieved by using touch, gesture, and speech commands, A11yBoard uses a custom search-driven command line interface to access commands and properties.

Universal Command System



Pilot Study and Future Work

We conducted three pilot studies with BLV users, who experienced A11yBoard's features and used them to complete tasks.

Participants were able to complete most tasks and liked the interactions. They also brought up suggestions like having a "help" speech command and an "overview" feature to have a basic sense of existing boards.

In future work, we will improve the design of A11yBoard further, and perform a larger usability test with more BLV people.

Acknowledgement

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