

Designing an Accessible iPad Voting Case



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Thank you to Whitney Quesenbery and Daniel Castro of ITIF, without whom this project would not have been possible.

Jorge Silva, of Komodo OpenLab, also deserves much thanks for his immense help with the Tecla Shield.

Thank you, finally, to my coworkers at GTRI: Brad Fain, Linda Harley, Carrie Bell, Cara Fausset, Christina Harrington and Patrick Lambert. You guys are awesome!

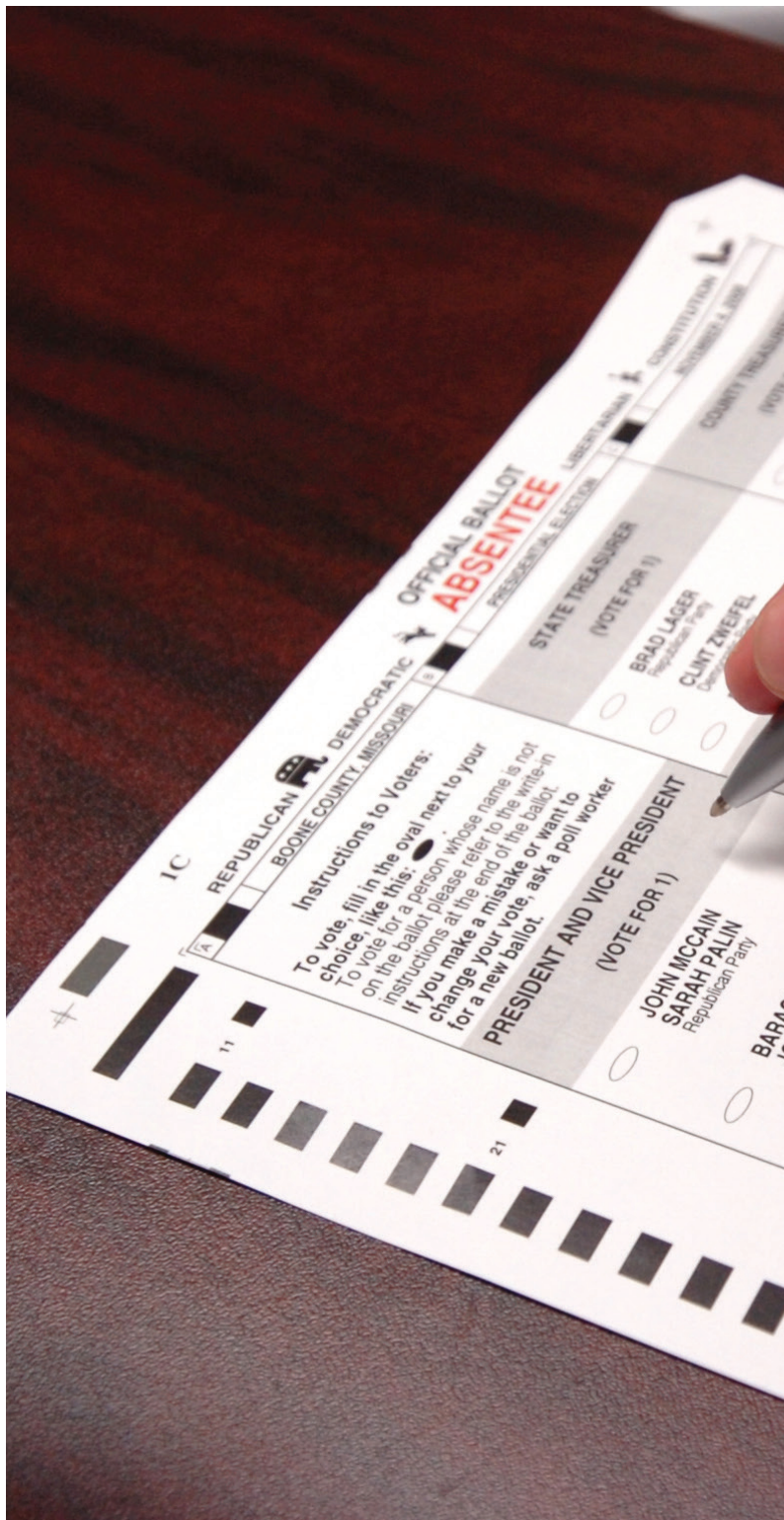


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How can voting be made more **accessible**, more **approachable**, and more **convenient** for those who cannot easily access a polling place?





For individuals with disabilities, voting at a polling place can be a **self-conscious, anxiety-ridden, and frustrating** experience. Sometimes, even getting to a polling location can be a physical impossibility.

For these reasons and others, over **26% of Americans** chose to participate in early or absentee voting in 2012.

But what happens when one's condition is such that even the absentee and early voting **alternatives** are **not a viable option**? How can we **ensure** that **all** voters have **equal access** to this fundamental right?

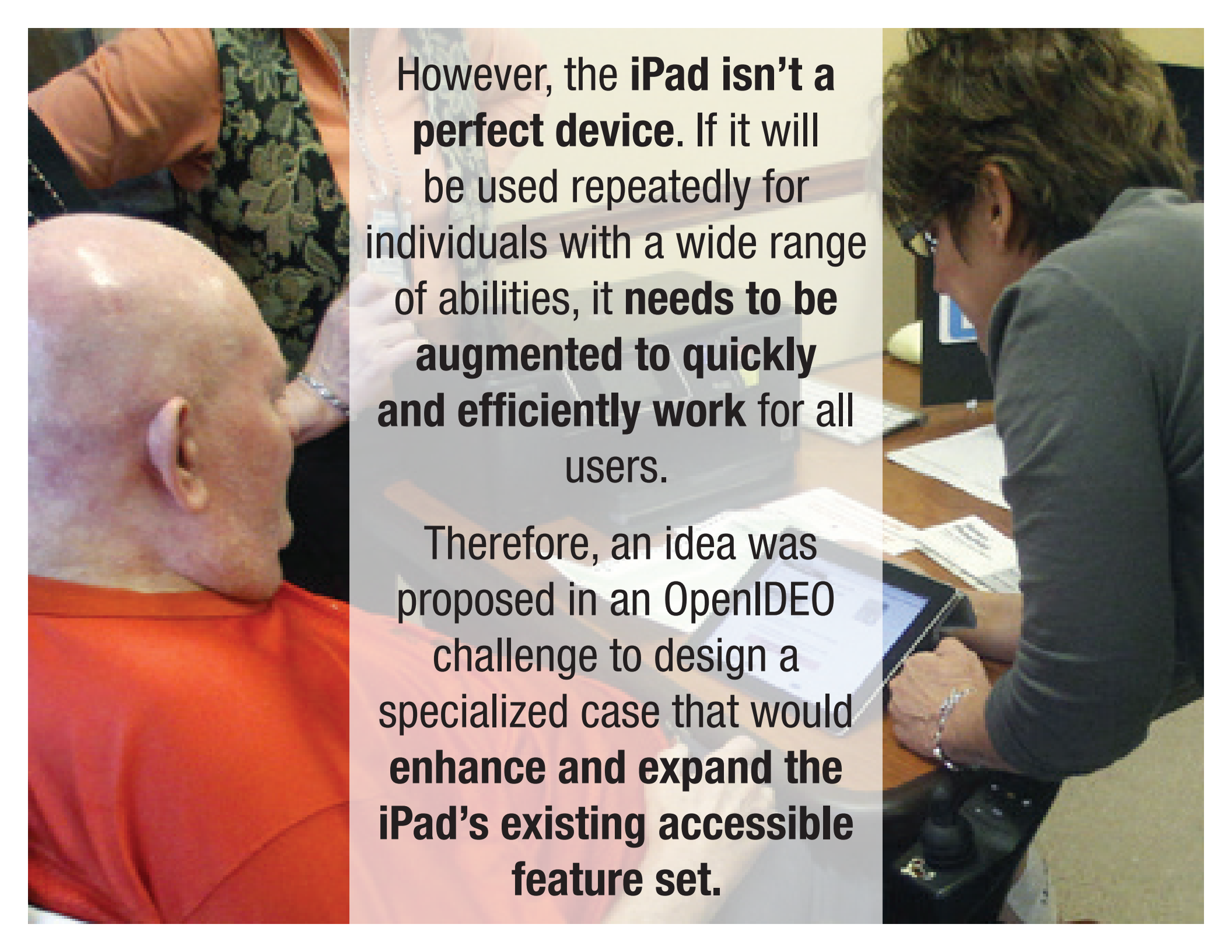


The answer may lie with Apple's iPad



The iPad has already been adopted as a **key tool** for many individuals with **sensory, mobility, and cognitive impairments.**

The built in accessibility options, such as VoiceOver and screen magnification, are **well-proven.** In 2011, **iPads were even used** in Oregon for a **special primary election** for elderly and disabled voters.



However, the **iPad isn't a perfect device**. If it will be used repeatedly for individuals with a wide range of abilities, it **needs to be augmented to quickly and efficiently work** for all users.

Therefore, an idea was proposed in an OpenIDEO challenge to design a specialized case that would **enhance and expand the iPad's existing accessible feature set**.

iPad Voting

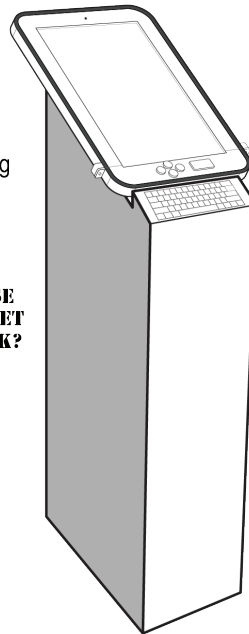
Web-based voting applications are currently being developed and can easily be implemented on an iPad... but how can we ensure effective voter interaction?

1: iPads are placed into custom cases that cover the Home Button, thereby disabling the ability to exit the voting application



2: iPads are mounted in kiosks for absentee voting use in places such as hospitals and elder care facilities.

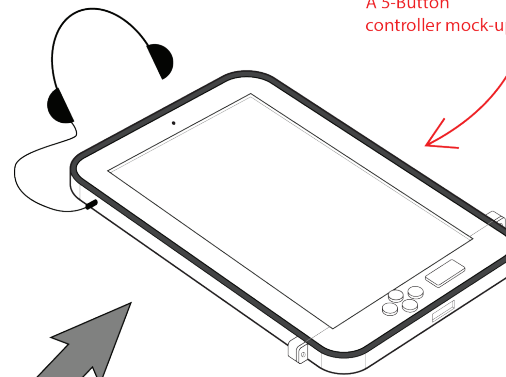
BUT WHAT ABOUT THOSE THAT ARE UNABLE TO GET UP AND UTILIZE A KIOSK?



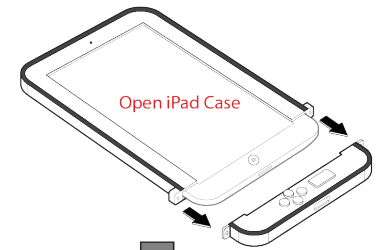
3: The custom cases that the iPads are fitted with are unique in another way too: they have a bluetooth connected 5-button controller built into them.

This bluetooth enabled tactile controller allows users with limitations such as low vision or poor motor control to interact with the iPad... without leaving their own bed!

A 5-Button controller mock-up



4: These cases are tamper-proof and can only be opened by an authorized technician - so nothing but the voting application is accessible to the user.



5: Using either the touchscreen or tactile button controller, the voter navigates through the voting application where they make their choices, edit if needed, and then cast their ballot.



* The case and kiosk design are meant for illustrative purposes only and are not meant to be a final design. Control sizing, orientation, and configuration still need to be optimized for use by the intended population. Furthermore, extra security measures will need to be incorporated into the kiosk and iPad case and a set of larger, more complex bank of controls may be added into the kiosk itself

The image on this page is the original idea that was submitted to OpenIDEO in early 2012. It was one of 11 winning concepts chosen.

the OpenIDEO winning concept

The OpenIDEO challenge was sponsored by the Information Technology & Innovation Foundation (ITIF) who released a call for proposals for their Accessible Voting Technology Initiative soon after. GTRI proposed and was awarded a grant to continue work on the iPad voting case concept.

Goal:

Design a case that extends the Apple iPad's integrated accessibility features, enabling it to serve as a universal absentee ballot marking device.

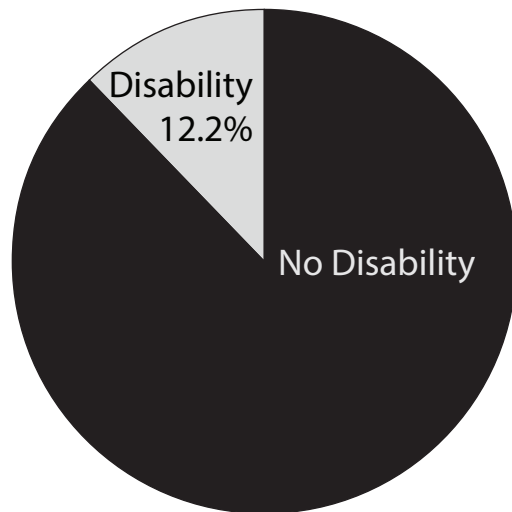
- Portable design allows the case to be brought to voters, rather than the other way around.
- Ballot marking device can be deployed to hospitals, rehab clinics, and assisted living facilities, among other locations.

the project goal

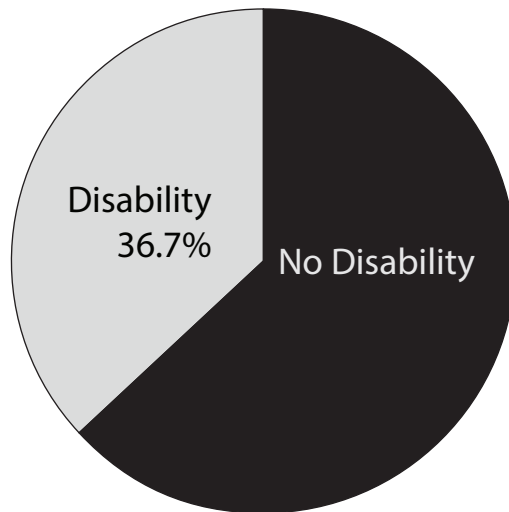
THE PROBLEM

the state of disability today

U.S. Population

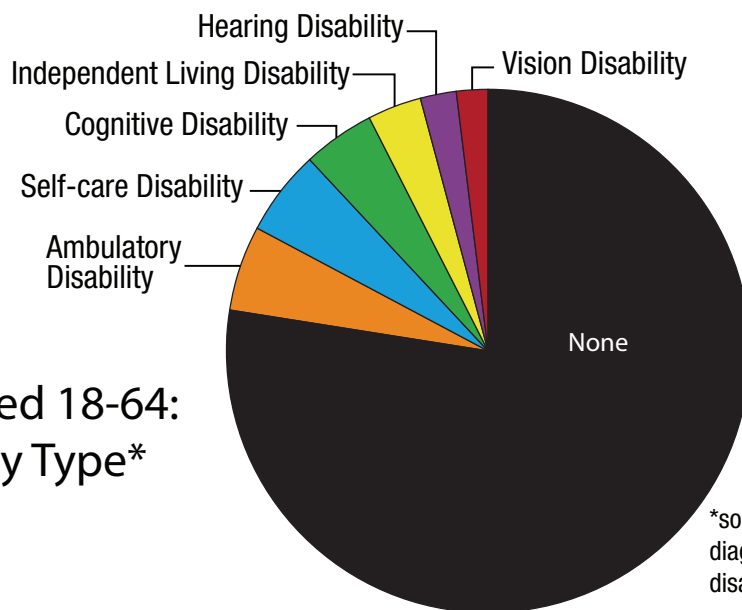


Adults aged 65+



Of the entire U.S. population, 12.2% (~38 million) are living with a disability, whereas 36.7% (~14 million) of the 65+ population are living with a disability.

Adults aged 18-64:
Disability Type*

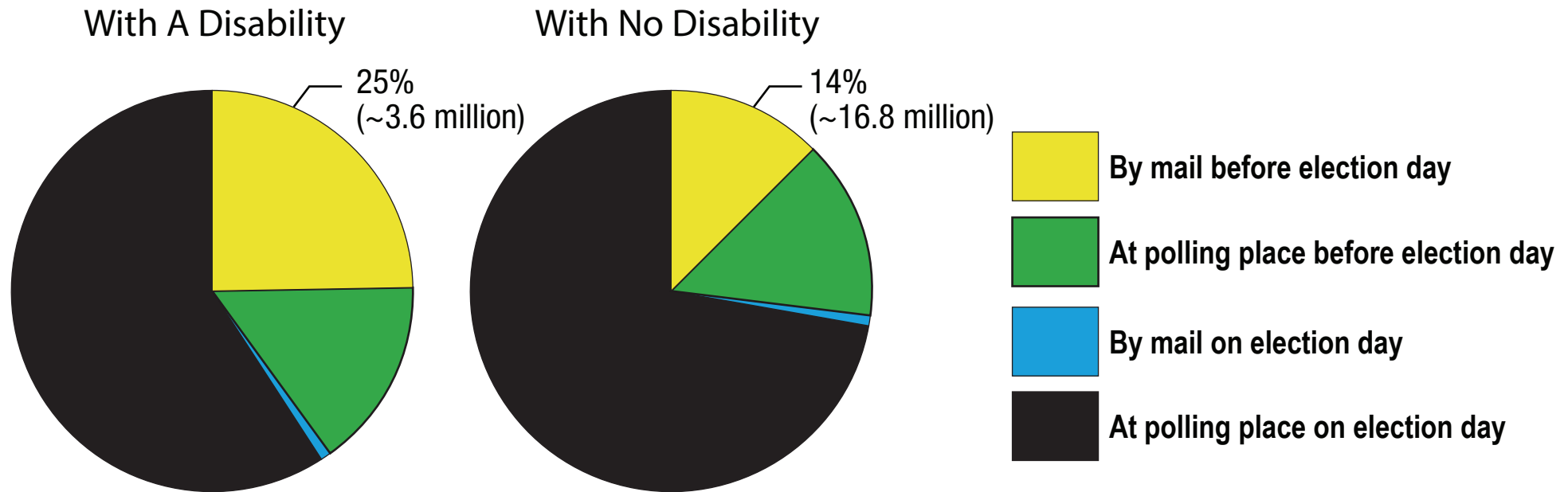


*some individuals may be diagnosed with multiple disabilities

how individuals voted, 2008 election

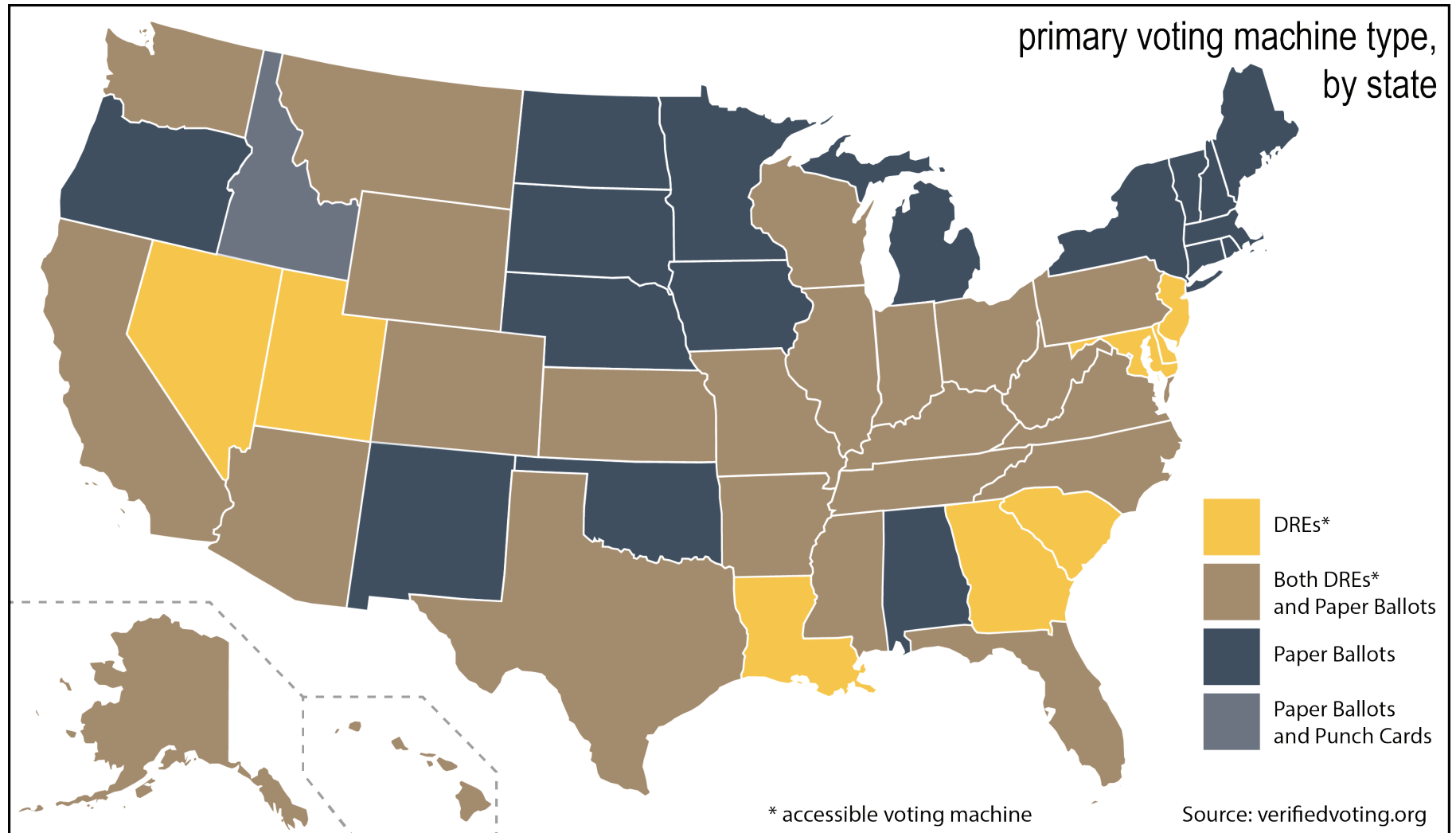
Sidelined or Mainstreamed? Political Participation and Attitudes of People with Disabilities in the United States, Lisa Schur and Meera Adya, 2012

57.3% of the eligible disabled voting population voted (14.7 million people), while 64% of people without disability voted (116.4 million people), a 7% disparity, though there was only a 3% gap in the voter registration rate.



Almost 25% of the disabled voting community voted by mail/absentee (~3.6 million people), compared to only 14.4% of the non-disabled population (~16.8 million people). Many of the individuals with disabilities cited transportation problems as their reason for not voting or for voting absentee.

voting equipment type by state



The Help America Vote Act (HAVA) requires every polling location to have at least one voting system that is accessible to people with disabilities. However, this requirement does not guarantee that these machines are ready for use or that the poll workers are familiar with these machines. Direct Recording Electronic (DRE) systems are the most accessible option, but there are still 18 states where these systems are unavailable.

DESIGNING FOR ACCESSIBILITY

target populations for iPad voting case

mobility impaired

examples: para-, tetra-, or hemiplegia, amputation, CP, MS, dexterity issues etc.

- switch access (including sip + puff)
- large target sizes (touchscreen)
- low physical effort

cognitively impaired

examples: learning disabilities, head injury, etc.

- highly intuitive interface
- low reliance on memory

older adults

examples: 65+ individuals, arthritis, etc.

- approachable technology
- simple interface

visually impaired

examples: blindness, glaucoma, cataracts

- audio interface
- tactile controls
- high contrast display
- large font
- braille display support

hearing impaired

examples: deafness

- easy to read screen

needs analysis: visual impairment focus group

With a very visual and non-tactile device like an iPad, designing for the visually impaired population is one of the most difficult challenges. Because of this, a focus group was run with 10 individuals with varied visual impairments to better understand the inherent barriers and difficulties that they face while using iOS devices and while voting.

participant quotes

On the benefits of the iPad's screen size:

"The iPad – because of the size of the screen – gives me with my limited vision a sense of the shape or layout of something that I'm not able to do with magnification."

On using a touchscreen and VoiceOver:

"I was very skeptical about the touchscreen because of the lack of tactile stimulation, but once I began to play with it I realized that having this software so well integrated into the system was something that was an improvement."

On bringing someone to help at the voting polls:

"Who's to say everyone has someone to help them?"

On not wanting to feel different or disabled:

"And that's another beauty – that we're not using a different device than sighted people."

On making the non-visual voting process easier:

"What about just a forward and back button – you know because you're just going down box for box for box... That would make it very simple and not reinvent the whole wheel."

On the benefits of the iPad's screen size:

"There's just a little more room for error; you can be touching in a bigger quadrant and still be touching a letter."

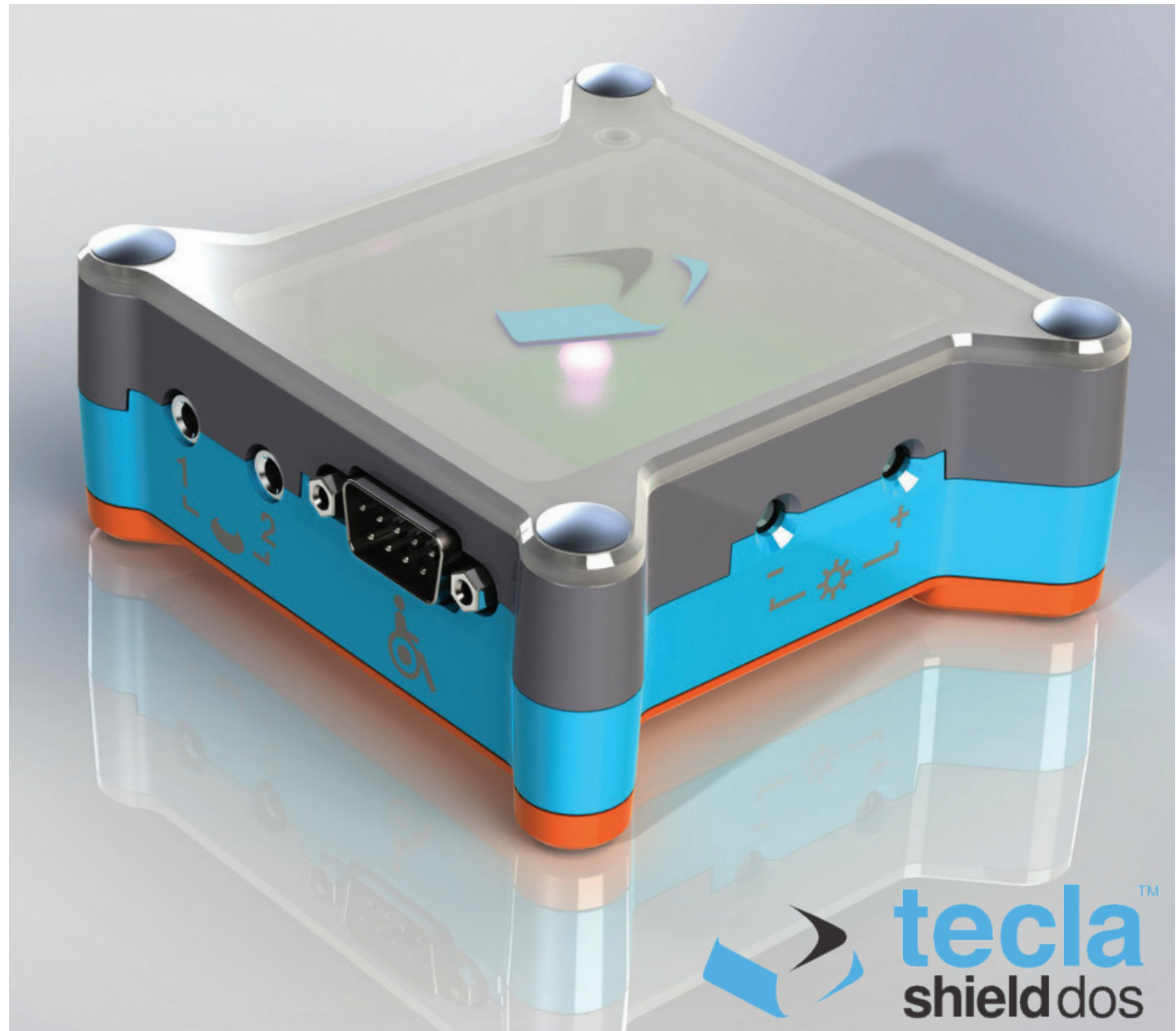
functional requirements of iPad voting case

	Functional Requirements	Current iPad Accessibility Features	Functional Improvements via voting case	How to address technology gaps?
Navigation	touchscreen	•		
	switch access		•	???
	tactile controls		•	hardware controls built in to navigate ballot
	stylus interaction	•		
Audio	screen reading/audio interface	•		via Apple VoiceOver
	hardware volume controls	•	•	case enlarges volume controls and makes them more accessible
	mono audio	•		
	braille support	•		
Visual	angle screen (reduce glare)		•	included stand to achieve optimal viewing angle
	high contrast display	•		
	screen zooming	•		
Other	lightweight	•		
	easy to grasp		•	added thickness and contouring of case will aid in holding
	drop protection		•	robust plastic construction
	disable home key	•		prevents accidental presses

switch access: partnering with Komodo OpenLab

Komodo OpenLab currently makes a device called the Tecla Shield, which provides reliable bluetooth switch access to iOS devices.

Komodo provided GTRI with a prototype of the circuit board that powers the Tecla Shield. Having this makes both switch access and tactile controls possible.



iPad + Komodo functionality



audio output



switch access



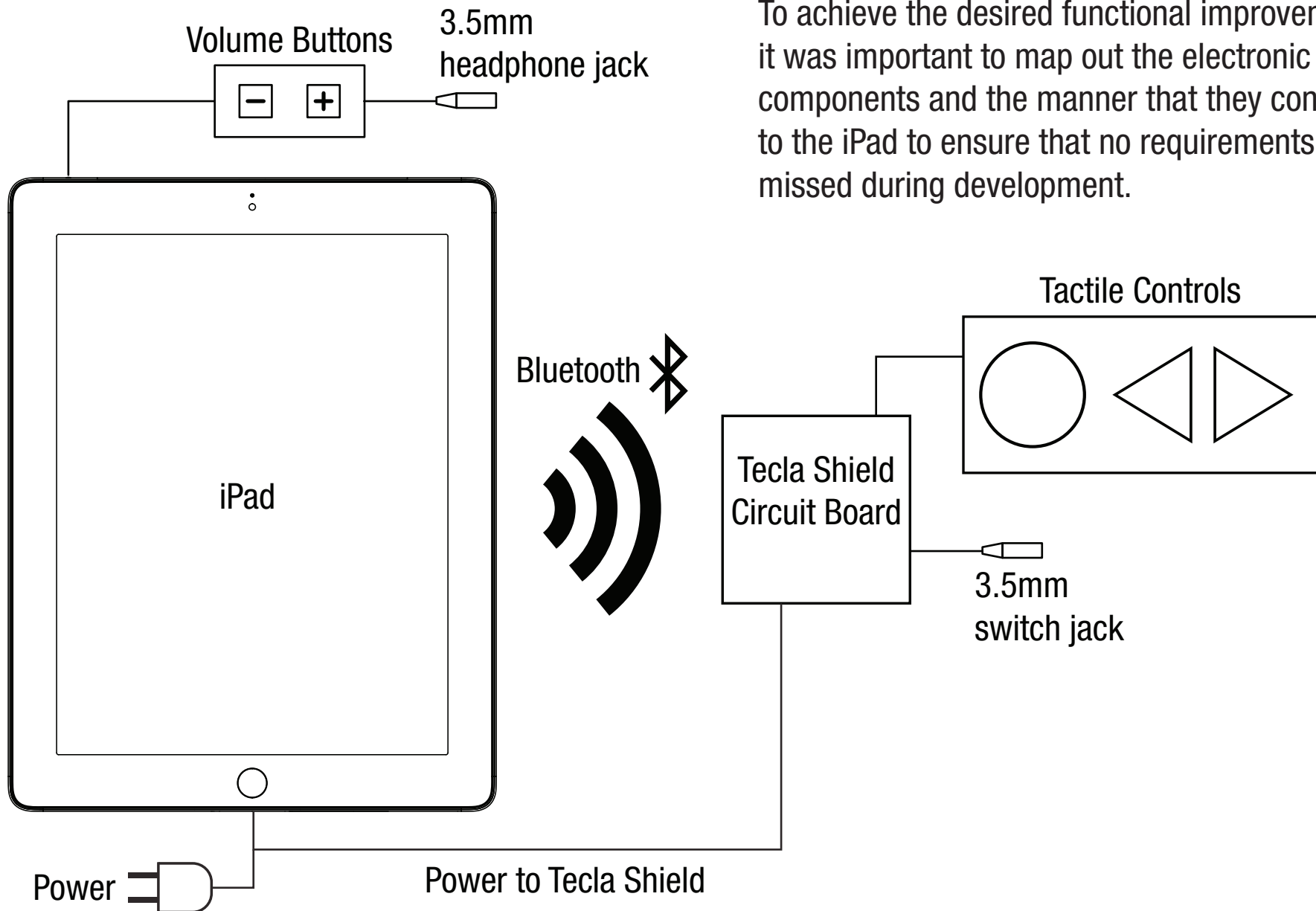
sip and puff access



voiceover screen reading

ELECTRONICS

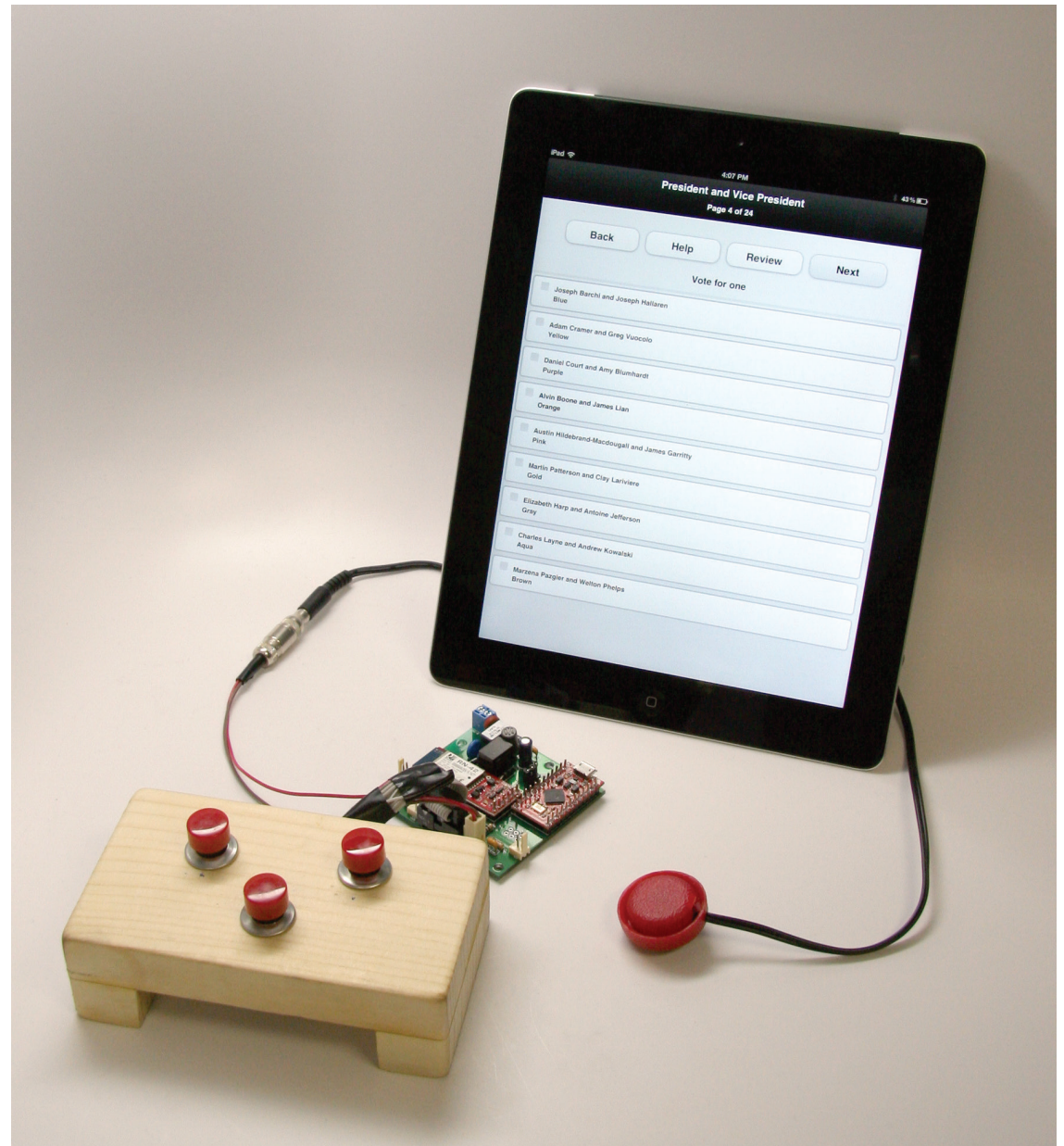
notional electronics diagram



To achieve the desired functional improvements, it was important to map out the electronic components and the manner that they connect to the iPad to ensure that no requirements are missed during development.

After mapping the electronics, a rudimentary assembly was constructed using the Tecla Shield board to test its functionality. The switch access technology was leveraged to connect a small accessibility switch.

A secondary function of the Tecla Shield allowed for 3 additional controls to be connected that can control the forward, backward, and select operations in the voting ballot application.



prototyping the electronics

3.5mm
switch jack

Tactile Controls

Tecla Shield
Circuit Board

Power to Tecla Shield

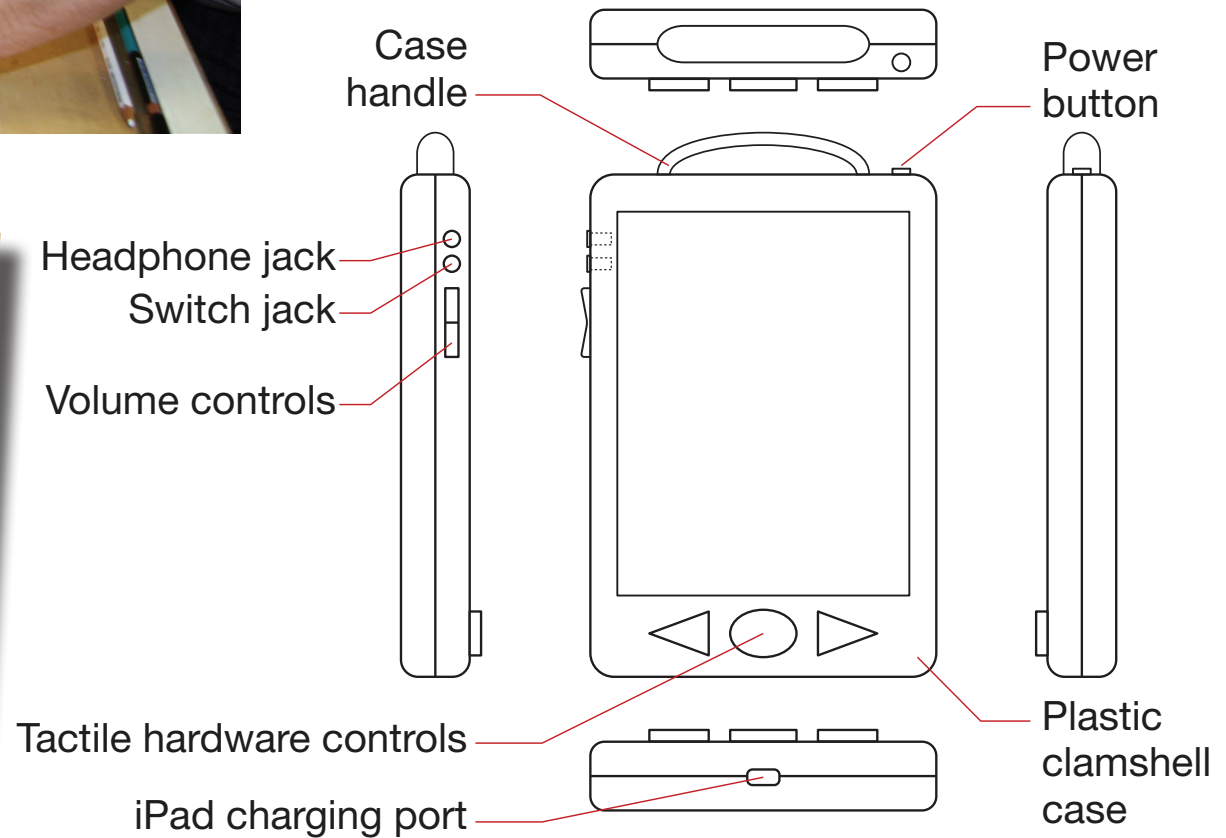
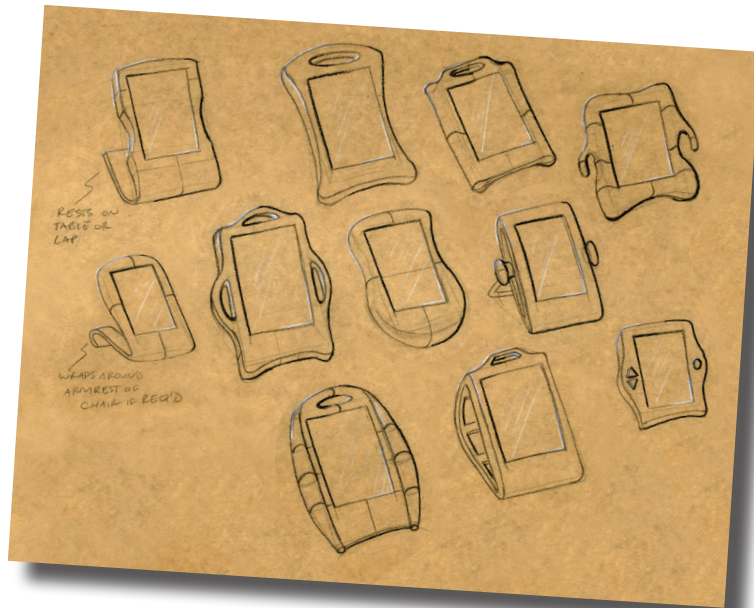


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FORM DESIGN + PROTOTYPING



With the electronics plan validated, the next step is to package those components into a final case design.



notional voting case design

tactile control concepts

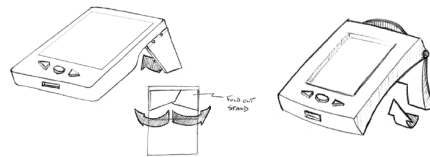
Built-In Tactile Controls

PROS

- Simple case design reduces chance of breakage
- No chance of lost components
- Controls fairly easy to wire
- Easy to implement with a kiosk

CONS

- Tactile controls may be awkwardly placed when set on lap
- When set on surface or lap, screen angle may not be optimal
- If controls break, service is difficult



Fold-out stand concepts mitigate viewing angle issues

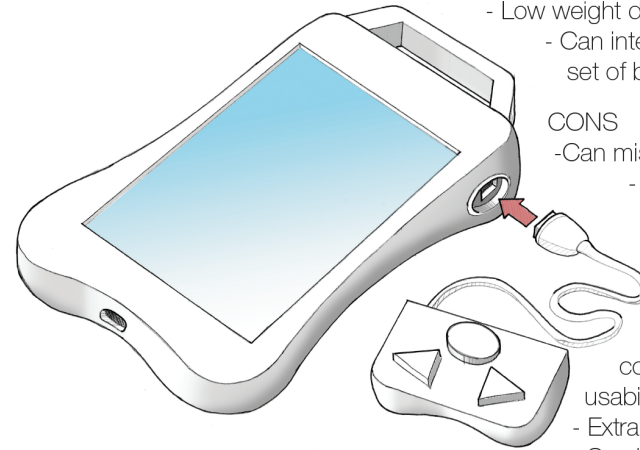
Detachable Tactile Controls

PROS

- Wired tactile control provides high flexibility
- Easy to service control module
- Low weight due to optional control module
- Can interface to a kiosk with a larger set of built-in controls

CONS

- Can misplace tactile controls
- Control may be hard to handle/interact with because of small base size
- Wire/connector subject to damage
- Location of control connection port can affect usability and cord length
- Extra piece to manufacture
- Small control module can be dropped



Pivoting Control Base

PROS

- Optimized for lap/surface use
- Can sit on lap with an optimal screen angle
- Tactile controls less awkward to use than those of the Built-in concept
- Allows for room at the top of the case for electronics with additional thickness

CONS

- Complicates and stresses wiring
- Complicates iPad charging
- Hinge can break or be subject to wear and fatigue
- Holding from handle may encourage hinge movement or damage
- Hinge breakage makes case useless
- Hinge feel is important



Hard Mounted Tactile Controls

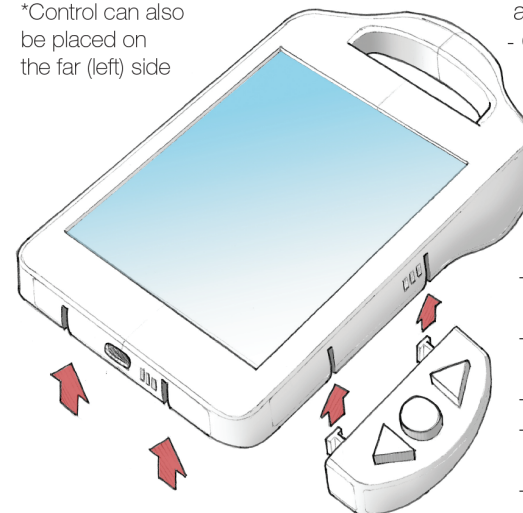
PROS

- Hard mounted control is easy to handle and interact with
- Cannot drop control module
- No cord to tangle
- Easy to service
- Varied mounting locations increase user accommodation

CONS

- Reliability issues with contact points
- Attachment features may be subject to damage or breakage
- Method of attachment for module poses some engineering challenges
- Controls need to "lock" in place
- Control placed in bottom position blocks charging port
- Control orientation varies based on installation position

*Control can also be placed on the far (left) side



pros and cons comparison

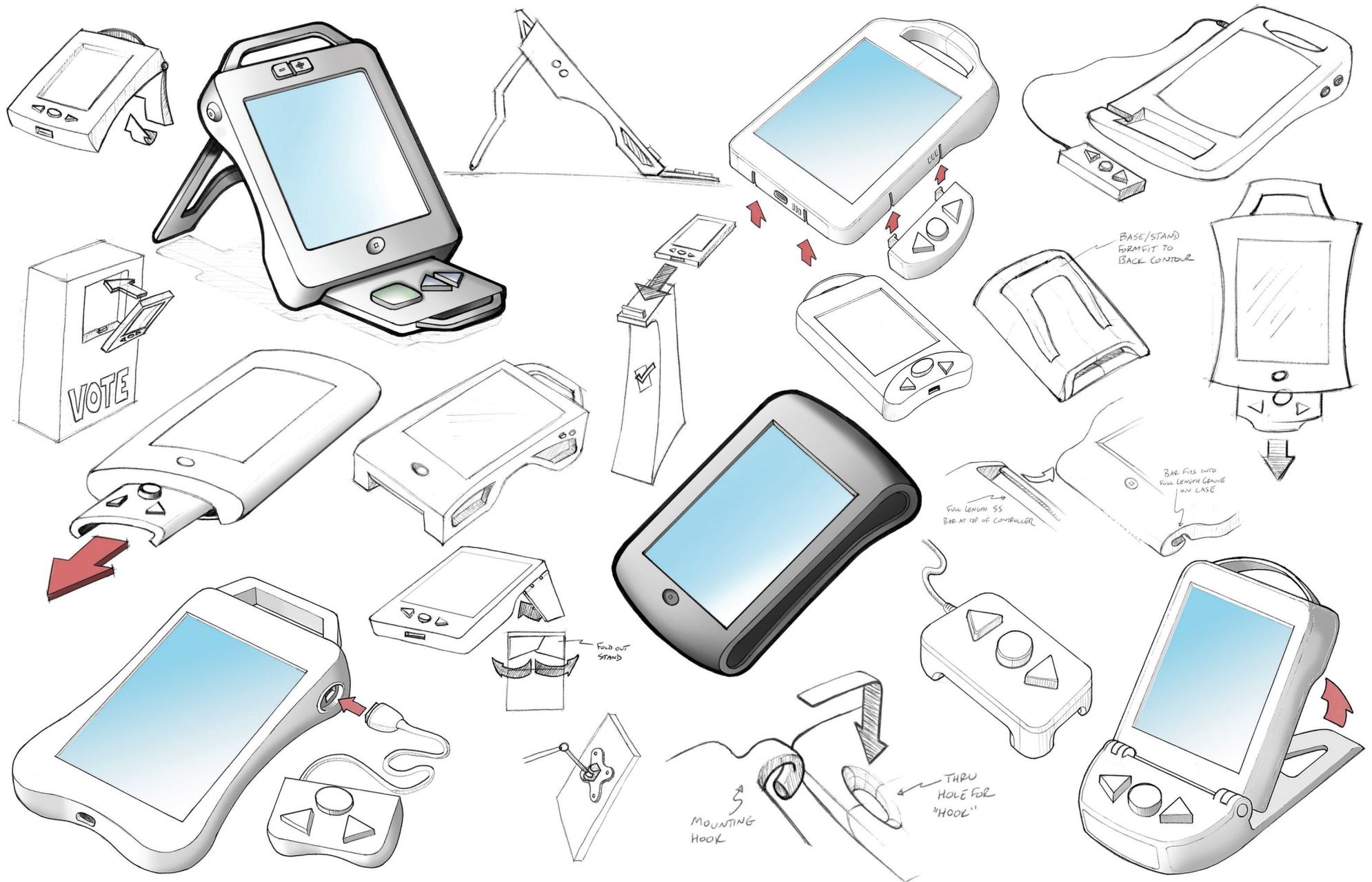
high = ●●● average = ●● low = ●		Concept 1 - Built In	Concept 2 - Pivoting	Concept 3 - Detachable	Concept 4- Hard Mounted
Usability					
	tactile control simplicity	●●	●●	●●	●●
	tactile control flexibility	●	●	●●●	●●
	low weight	●●	●	●●●	●
	minimal accessories needed	●●●	●●●	●●	●●
	flexible screen angle	●	●●●	●	●
	versatility for users	●	●●	●●●	●●
Engineering					
	case simplicity	●●●	●	●●●	●
	electronics simplicity	●●●	●	●●	●
	kiosk mounting potential	●●●	●	●●●	●●●
	ease of manufacture	●●●	●	●●●	●
Usage					
	repairability	●	●	●●●	●
	durability	●●	●	●●●	●
	ease of charging	●●	●●	●●	●●
	anticipated reliability	●●●	●●	●●●	●
TOTAL		30	22	36	21

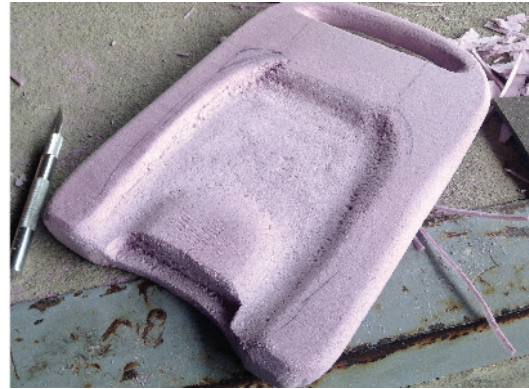
refining the design direction

The control concepts were brought to a number of voting and accessibility experts to obtain an outside opinion on their usability. Experts preferred the pivoting concept above all, followed by the hard mounted control concept. Their feedback led to a number of recommendations moving forward:

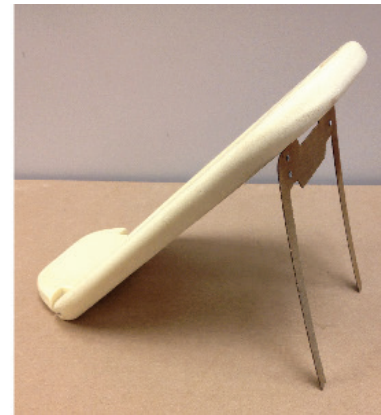
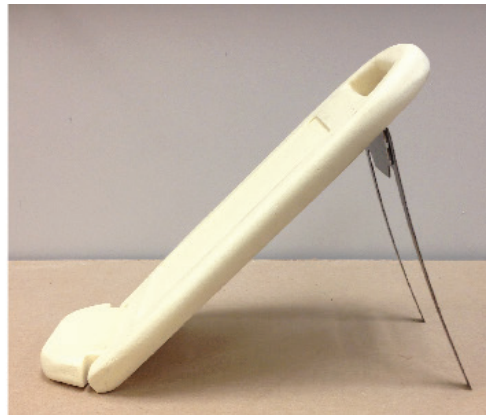
- Ability to slant screen is a must.
- Laptop form factor is familiar and easy to use, but unnecessary for the majority of users.
- Having detachable controls increases the device's serviceability if anything were to break.

further ideation sketching





The first pass of modeling was completed using “pink” foam, a lightweight, easy to shape foam. Shape was further examined, as were critical thicknesses and affordances for holding the case.

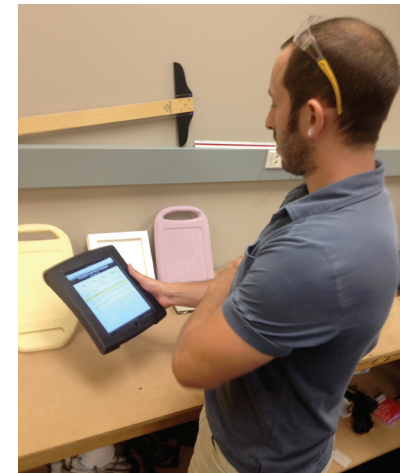
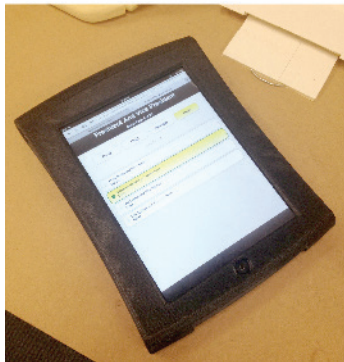
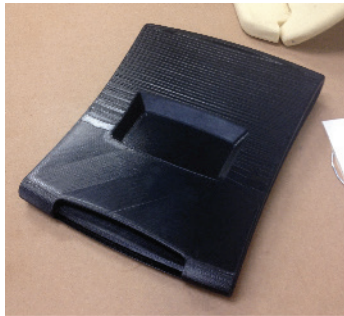


Another level of refinement was done using “sign” foam, a heavier, machineable foam.

voting case form and shape modeling



Eventually, a sliding control concept was developed. A quick study model was made from foam core and hot glue to understand the nuances of the idea.

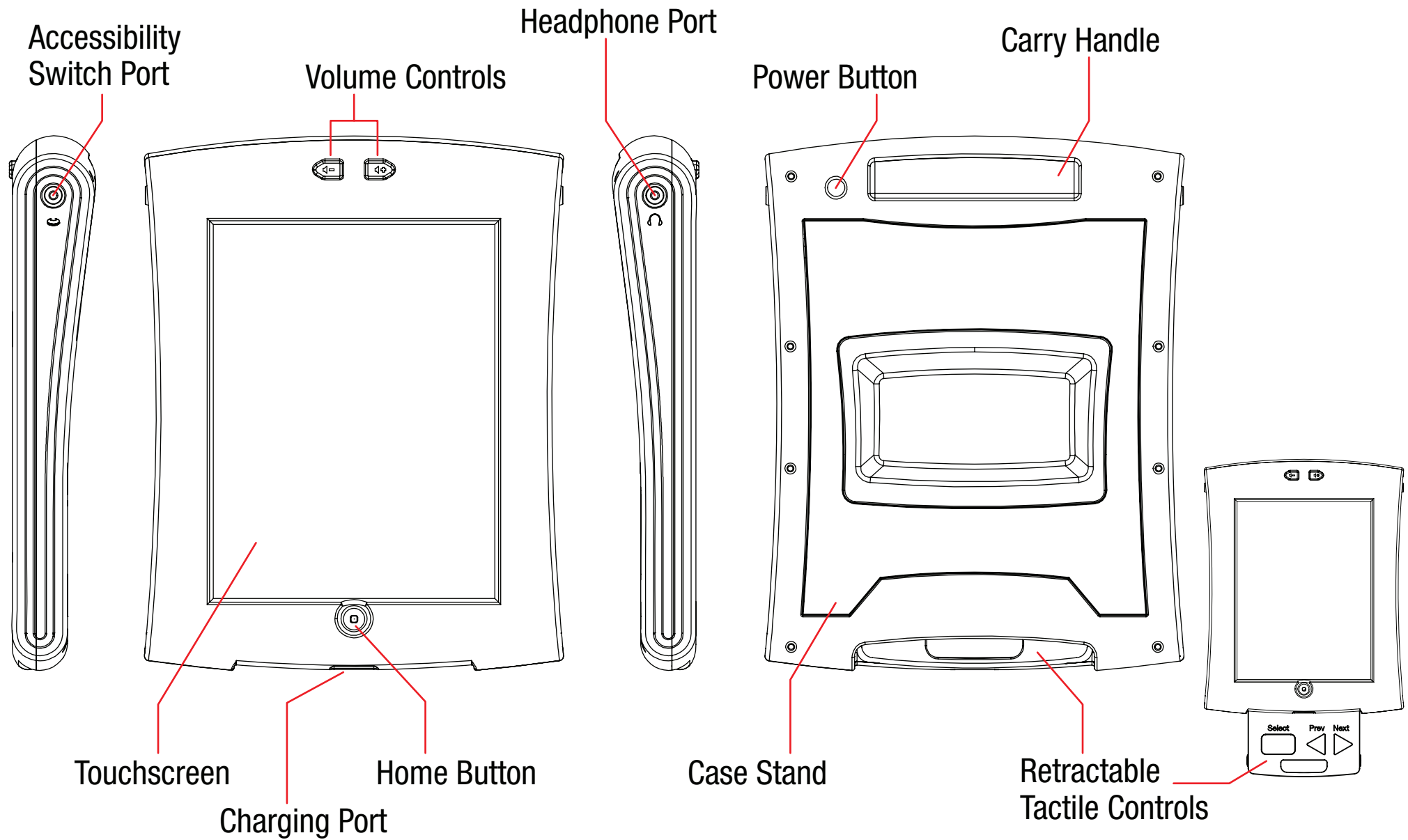


A form model was then developed in CAD and 3D printed to ensure a good size and hand feel.

functional modeling and 3d printing

FINAL CONCEPT



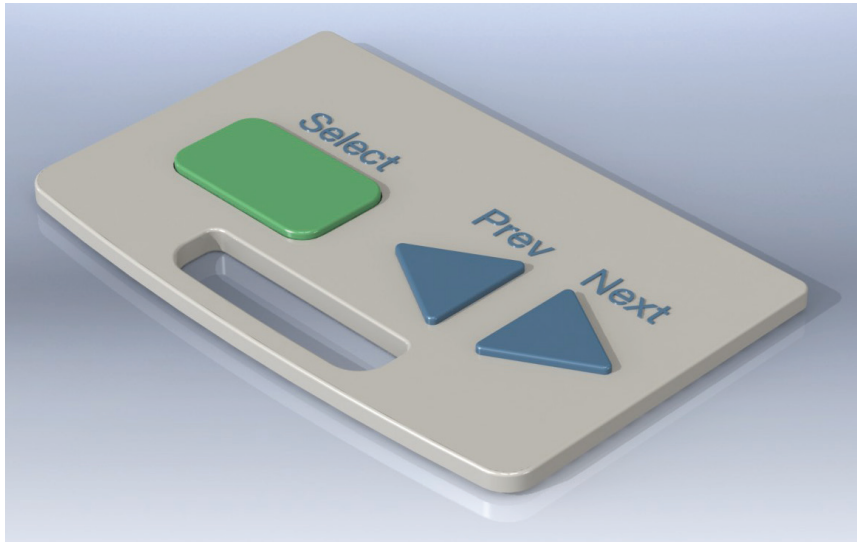


final components diagram



iPad case with attached accessories

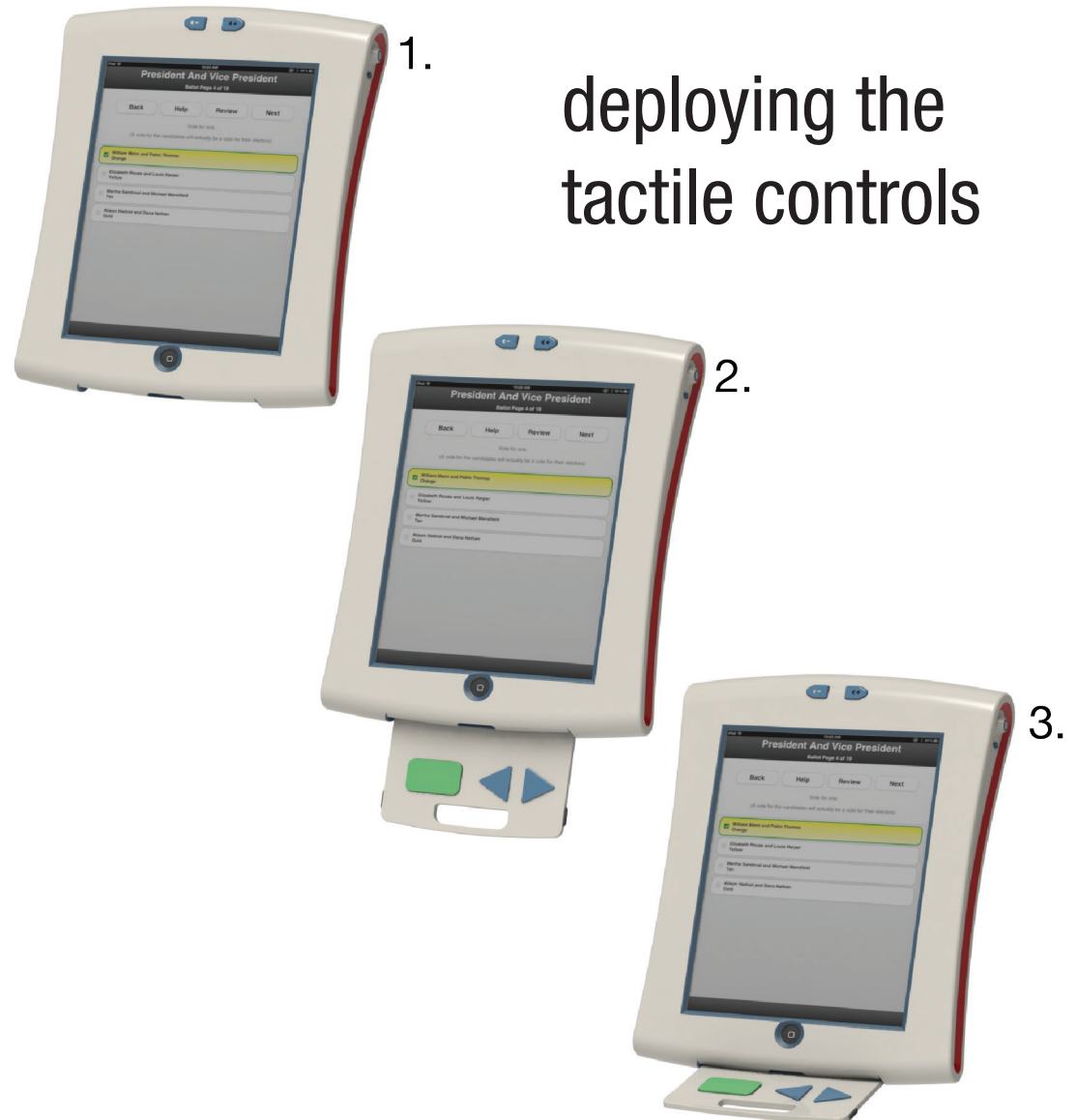
tactile controls



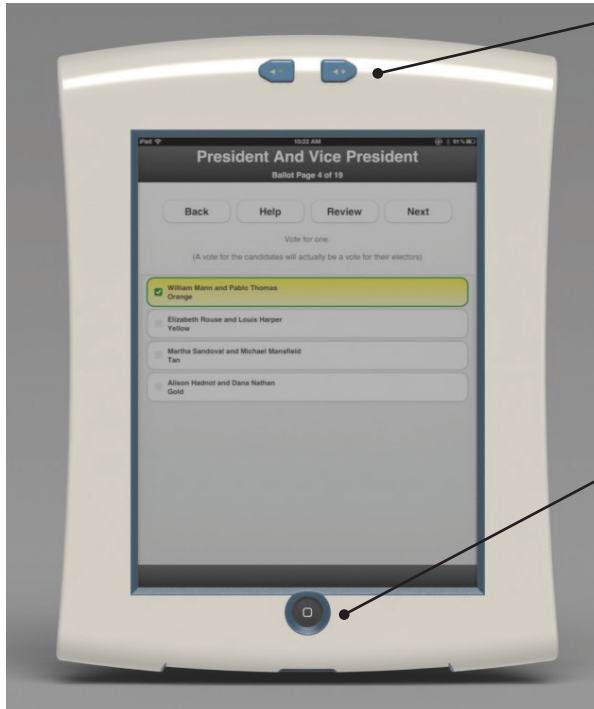
The tactile controls are one of the most unique aspects of the case design.

The control module slides out from an opening in the bottom of the case when a user needs the added functionality. A pivoting hinge allows it to rest on a flat surface for easy use.

Otherwise, the controls are neatly hidden away. If the module stops working for any reason, a technician can swap it out for a new one in under five minutes.



case features



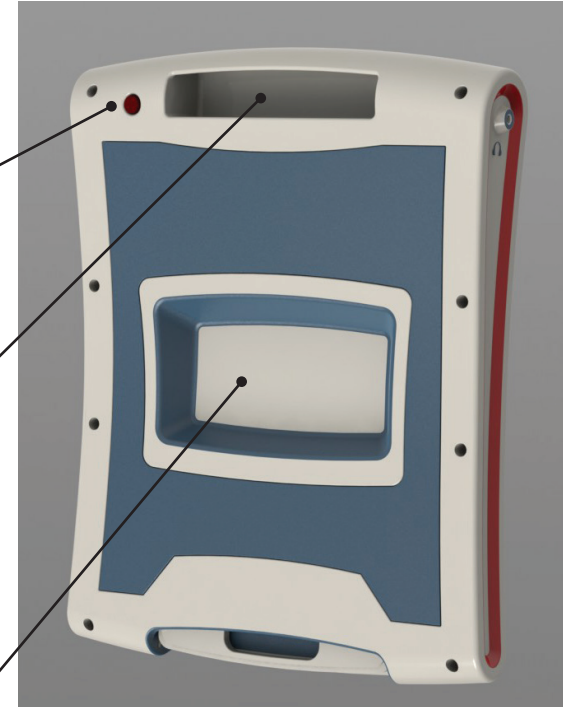
Large, centered volume controls allow for easy left or right handed access.

The iPad home button remains accessible for administrative use.

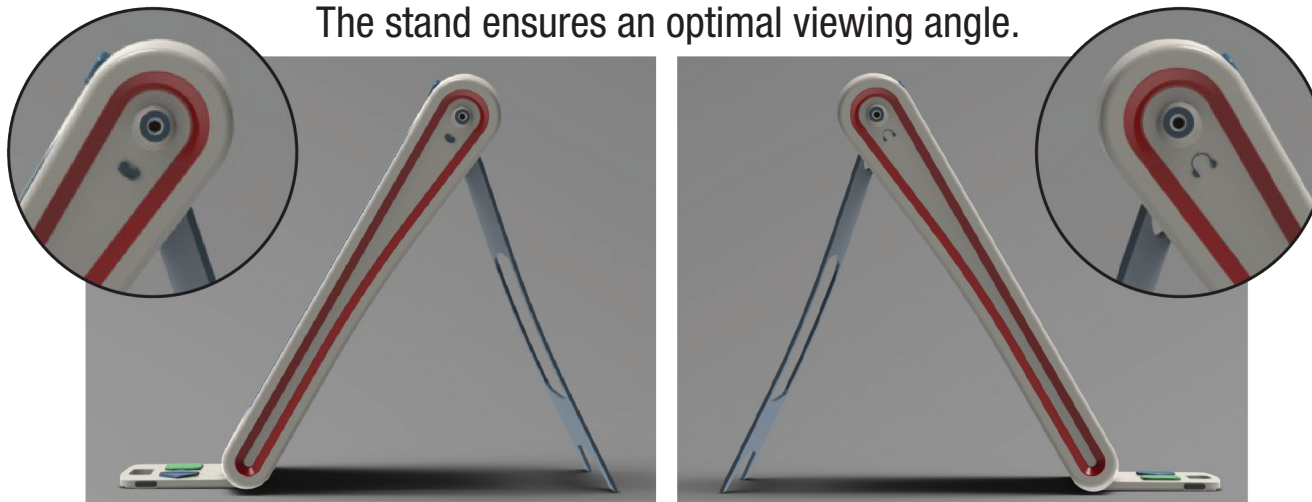
Large power button is easy to actuate, but located on the rear of the case to prevent accidental contact.

Hand affordance makes carrying and transporting the case safe and easy.

Large cutout in the rear of the case allows for a comfortable grip during use.



The stand ensures an optimal viewing angle.



Both 3.5mm jacks (for headphones and accessibility switch) are placed in a non-intrusive location for table top or lap top use.

Furthermore, when either of these devices are plugged in, the wires will not interfere with the screen visibility.

A fully functioning prototype is currently being built, however, there are already a number of lessons that have been learned while working with the final electronics and CAD model. Examples are:

- A separate on/off switch for the Tecla Shield is needed, as it draws power from the iPad whenever the iPad is powered on.
- Prototyped components are often larger than final production parts, resulting in increased case size (for the prototype).

Upon completion of these functional prototypes, a focus group and usability tests will be completed. Further refinements are expected to emerge from these efforts. Hopefully, enough will be learned to bring this voting case from a prototype to a reality.

conclusions and future work

