

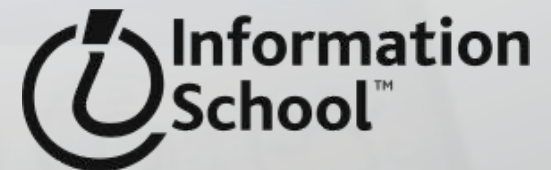
# Mobile Accessibility

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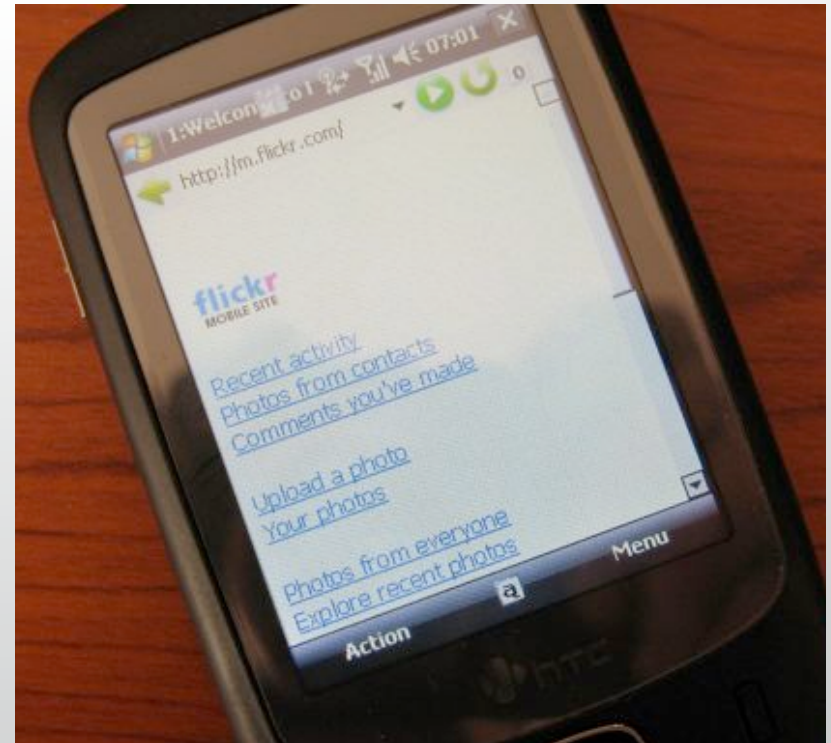


# Today

- Why mobile accessibility is important
- Challenges of mobile accessibility
- Our mobile accessibility research

# The Mobile Miracle

- Mobile devices are becoming ubiquitous
- Increasing variety of applications
- Always-on connection to family, friends, and information



# Benefits of mobile access

- Stay in contact with friends and family
- Access information via the web
- Access local information (e.g. weather, bus schedules)



**Google Mobile App**  
Category: Reference  
Released Nov 14, 2008  
Free [GET APP](#)



**Flick Fishing**  
Category: Games  
Released Nov 06, 2008  
\$0.99 [BUY APP](#)



**Facebook**  
Category: Social Networking  
Released Jul 10, 2008  
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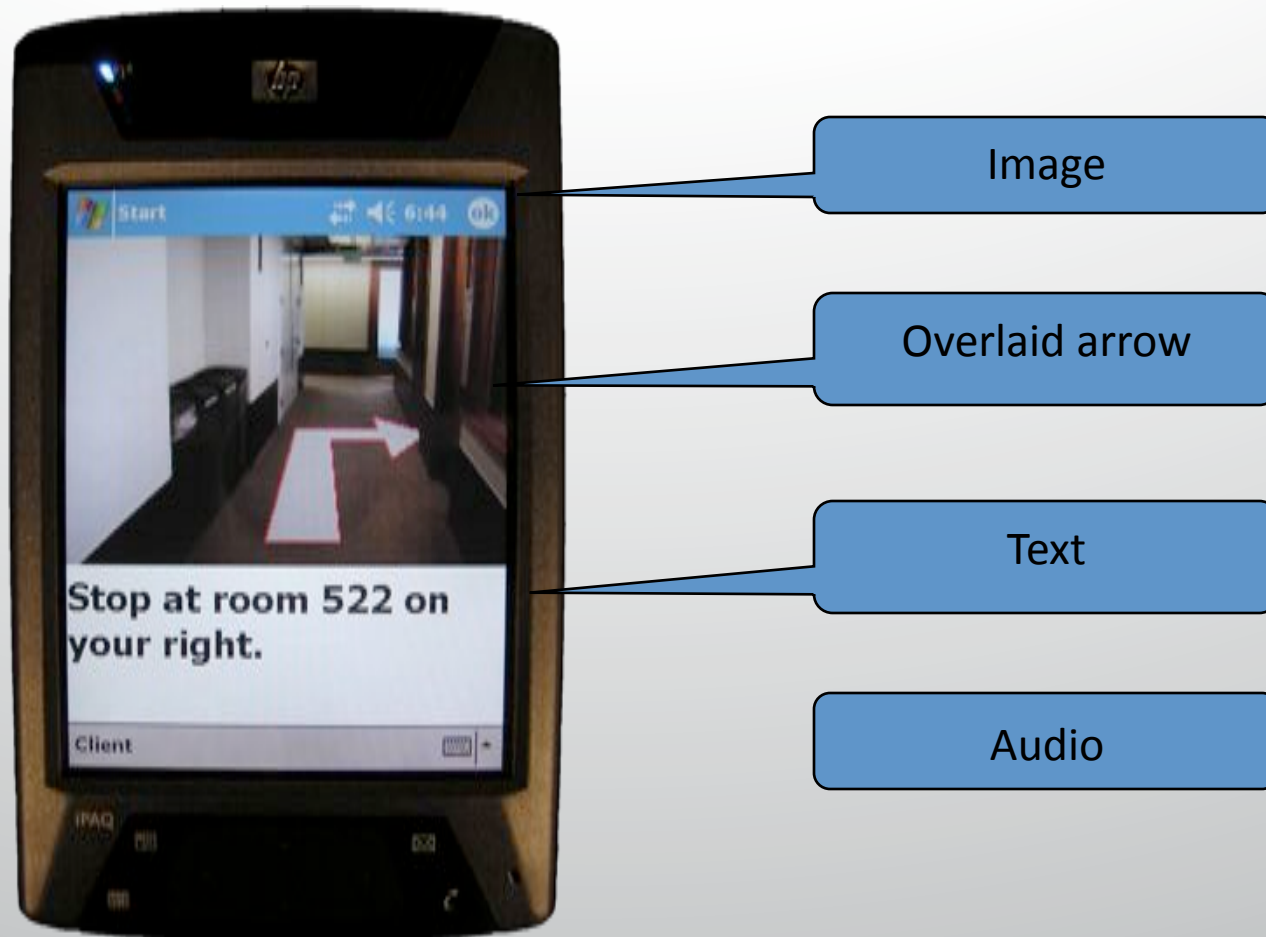


**Seattle Bus**  
Category: Travel  
Released Jul 09, 2008  
\$4.99 [BUY APP](#)

# Assistive technologies

- Mobile devices enable new assistive technologies
  - Navigation assistance
  - Augmentative and alternative communication (AAC)
  - Task management and prompting

# Indoor wayfinding (Liu et al., 2006)



# Trinetra (Lanigan et al., 2007)



# Mobile accessibility

- Before users can benefit these tools, they must be accessible
  - Across available applications
  - Across available devices
  - Across different situations

# Mobile accessibility challenges

# Mobile accessibility challenges

- Small devices
- Touch screens
- Lack of standardized UIs
- Lack of device expandability
- Using devices out “in the wild”

# Mobile devices in the wild

- Movement
- Obstacles
- Weather
- Noise and distractions
- User fatigue



# Improving mobile accessibility

- Specialized devices for people with disabilities
- Accessibility add-ons for existing devices
- New accessible interaction techniques for mainstream devices

# Specialized accessible mobile devices



# Specialized vs. mainstream devices

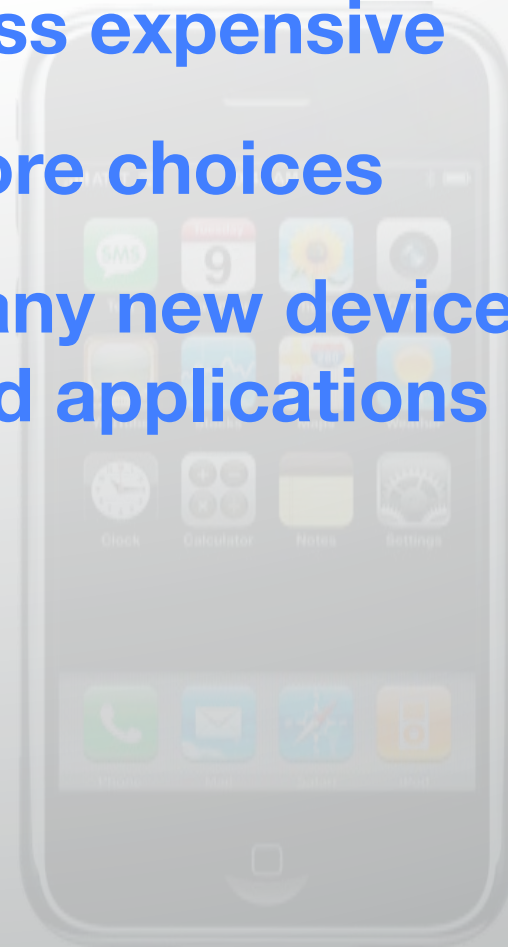


# Specialized vs. **mainstream** devices

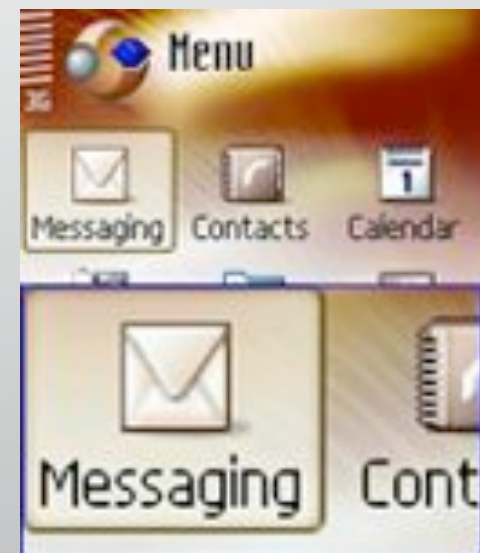
- Expensive
- Fewer choices
- Slow to add features



- **Less expensive**
- **More choices**
- **Many new devices and applications**



# Accessibility add-ons (software)



# Accessibility add-ons (hardware)



# Limitations of add-ons

- May tie user to a specific device
- Often difficult to use
- May not fully support the device
  
- But these can be helpful, too

# Mobile Speak Pocket



# Accessibility solutions

- Specialized devices for people with disabilities
- Accessibility extensions for existing devices
- New accessible interaction techniques for mainstream devices

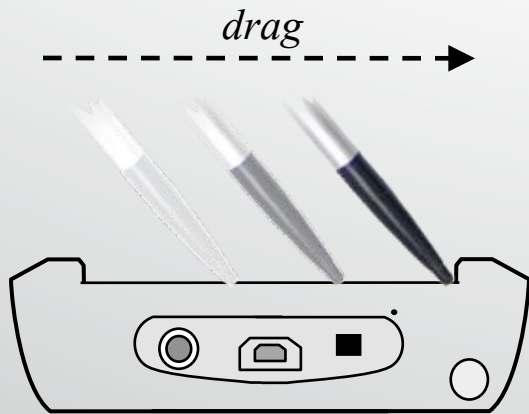
# Some projects

- EdgeWrite → text entry
- Barrier pointing → targeting on touch screens
- Slide Rule → interaction with touch screens
- Walking User Interfaces → accessibility for everyone

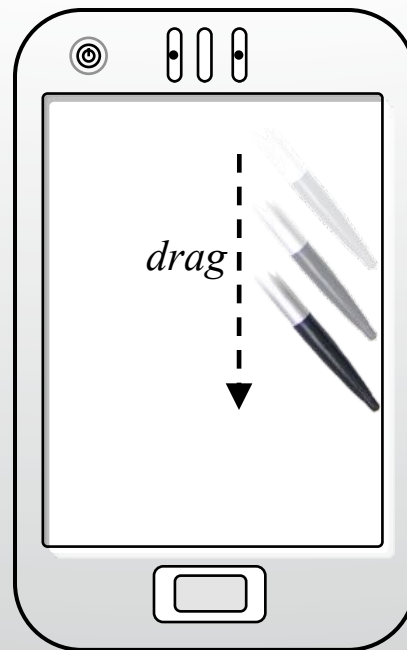
# EdgeWrite (Wobbrock et al., 2003)



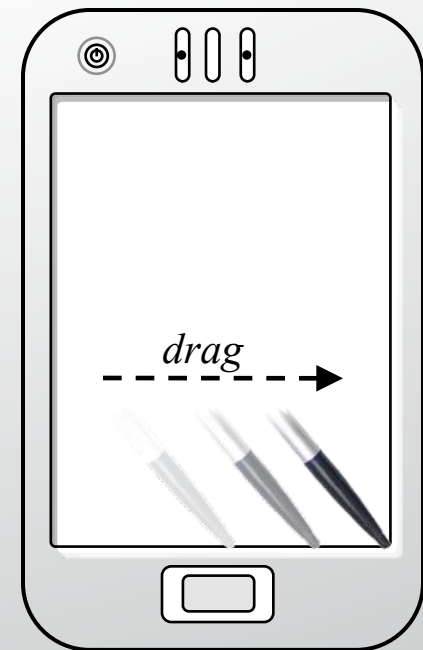
# Barrier pointing (Froehlich et al., 2007)



Allow user to rely on screen surface to assist movement.



Use screen edge to guide movement.



Use screen corner to trap movement.

# Projects

- EdgeWrite → text entry
- Barrier pointing → targeting on touch screens
- Slide Rule → interaction with touch screens
- Walking User Interfaces → accessibility for everyone

# Slide Rule (Kane et al., 2008)

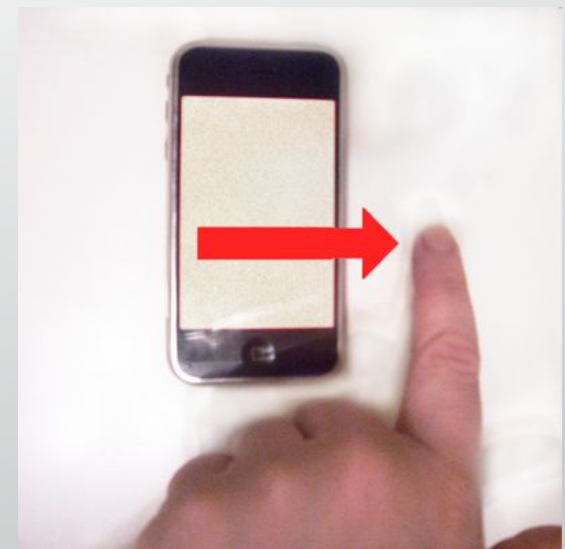
- Touch screens are everywhere, including phones
- Most do not provide sufficient audio or tactile feedback
- Therefore inaccessible to blind and visually impaired users





# Slide Rule

- **Idea:** Use gestures to increase accessibility of mobile touch screens



# Design process

- Interviewed blind informants about how they currently use touch screens
- Developed a set of design guidelines for accessible touch screen interactions
- Designed 4 gestural interaction techniques for interacting with mobile touch screens

# Interaction principles

- Allow risk-free exploration
- Reduce demand for selection accuracy
- Intuitive gestural mappings
  
- Operate at finger resolution, not screen resolution
- Allow quick browsing and navigation
- Enable users to query location and return home at any time

# Implementation

- Developed for Apple iPhone
- Touch input, speech and audio output
- Items arrayed in linear lists
- User slides her finger across screen to activate items

Video available at  
<http://students.washington.edu/skane/sliderule/>

# Evaluation

- 10 blind computer users (8m, 2f)
- Compared Slide Rule with a button-based Pocket PC with screen reader
  - 4-way control, plus 4 regions on touch screen

# Mobile Speak Pocket



# Results

- 7 out of 10 participants preferred Slide Rule
- Slide Rule was significantly faster than the Pocket PC
- However, Slide Rule was more error prone

# Reactions from users

- “Flat screens without a grid—a real tangible grid—are difficult for blind people ... I think that flat screens are not really accessible.”
- “I’ve never seen a touch screen that accessible before, and that was pretty cool.”

# Future work

- Additional applications and interaction techniques
- Slide Rule on other (bigger) touch screens
- Demo on iPhone App Store
- Evaluation with sighted users

# Projects

- EdgeWrite → text entry
- Barrier pointing → targeting on touch screens
- Slide Rule → interaction with touch screens
- Walking User Interfaces → accessibility for everyone

# Accessibility for everyone

- Mobile accessibility benefits people without disabilities too
- Environmental factors can reduce user's ability
- **Situationally-induced impairments and disabilities** (or situational impairments)  
(Sears and Young, 2002)

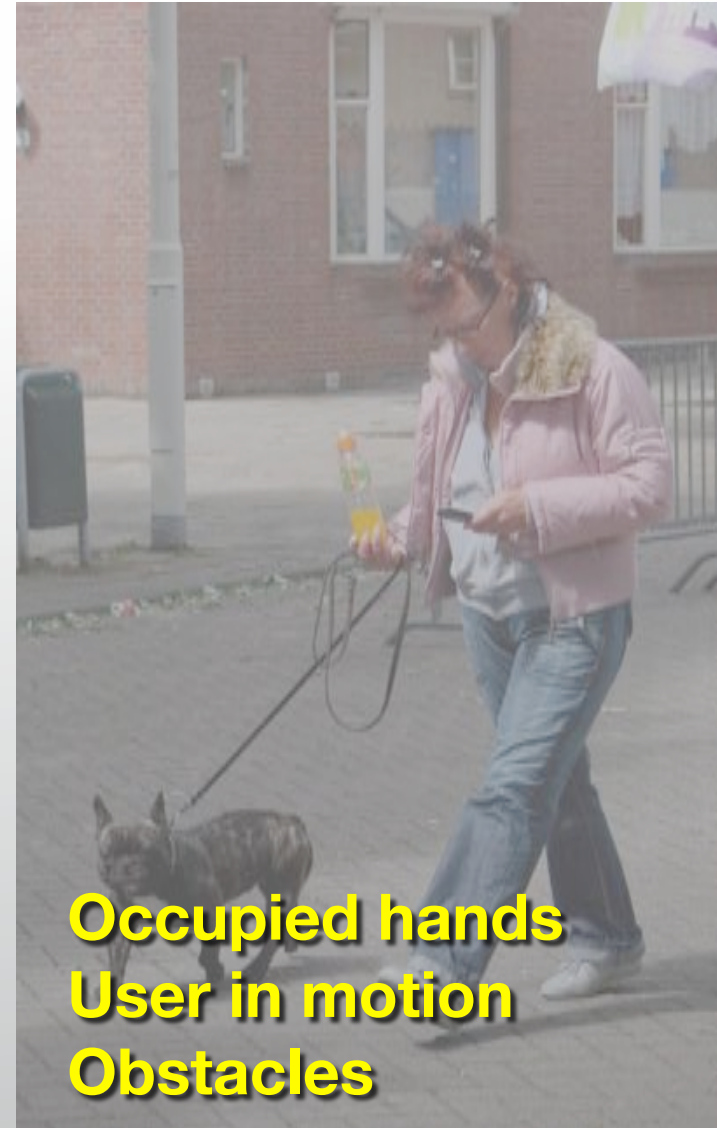




**Divided attention**



**Reduced dexterity**



**Occupied hands  
User in motion  
Obstacles**

# Situational impairments

- **Environmental factors:** low light, glare, ambient noise, vibration tremor, extreme temperatures, rainwater, uneven terrain
- **Attentional factors:** Physical obstacles, social interactions, divided attention, abrupt distraction, device out-of-sight
- **Physical factors:** Impeding clothing, baggage, occupied hands, user or device movement, posture or grip, user fatigue

# Walking User Interfaces (Kane et al, 2008)

User interfaces designed to compensate for the effects of walking on mobile device usability

**WUIs use context to adapt to user activity** (e.g. increase text and button sizes as the user walks)

**Accessible technology that benefits people without disabilities, too**



# Adaptive WUI prototype



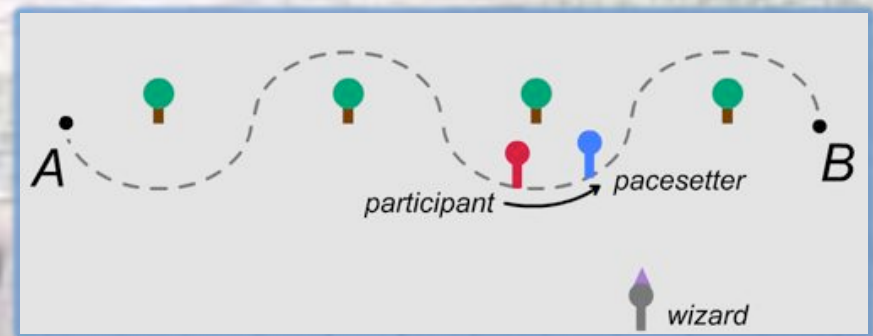
User begins walking:  
UI element size increases



User stops walking:  
More items appear on screen

# Evaluation

- Evaluated adaptive WUI prototype with 29 participants (10m, 19f)
- Participants used WUI prototype while standing and walking along an outdoor course



# Results

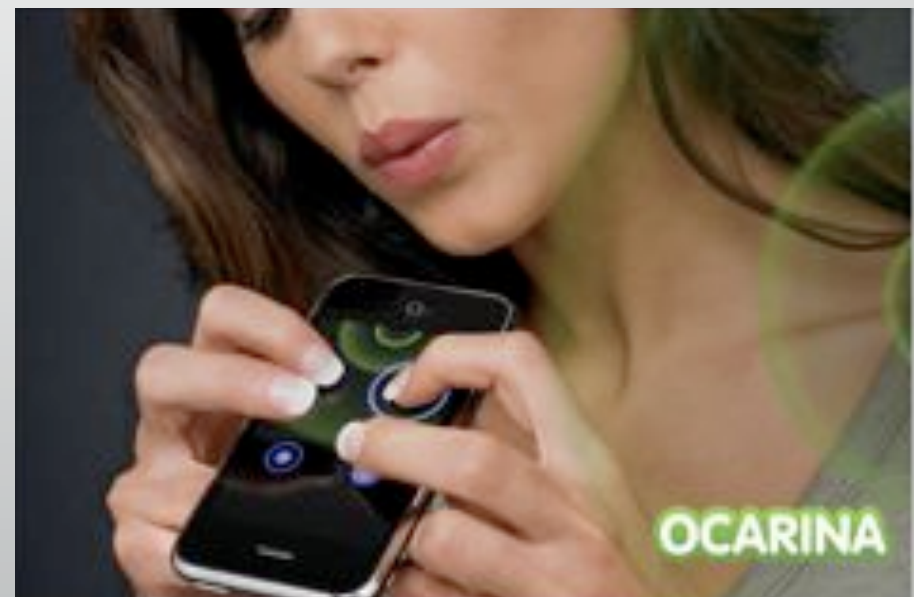
- WUI performed comparably to non-adaptive interfaces (no adaptive penalty)
- However, performance was not substantially better with WUI
- Users were generally open to the idea, but more work is needed

**What's next**

# Ongoing work:

## Accessible Mobile Widgets

- Mobile devices are becoming a mainstream computing platform
- **10,000 applications** on the iPhone App Store
- Many applications use novel interaction techniques



# Accessible mobile widgets

- How do we ensure that these applications are accessible?
- Look at how applications are developed



## iPhone user interface widgets

- List box
- Button
- Soft keyboard

# Accessible mobile widgets

- How do we ensure that these applications are accessible?
- Look at how applications are developed
- Develop a toolkit of **context-sensitive, accessible user interface components** (widgets)



List control →  
talking list

Button →  
barrier widget

Keyboard →  
expanding  
keyboard

# Using context

- Adapt the user interface for people with disabilities as well as people on the go
  - Resize user interface when the user is walking
  - Turn on video captions when the environment is noisy
  - Use speech feedback when the device is in a pocket

# Conclusions

- Mobile devices have tremendous potential for people with disabilities
- But present accessibility challenges (size, environmental factors)
- Improved interaction techniques can improve accessibility of common devices

# Design goals

- Use mainstream hardware when possible
  - Use full capabilities of device
- Support use by people without disabilities
- Develop generalizable, learnable interaction techniques







# Thanks

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# Discussion

- How do mobile accessibility issues differ from other issues you've encountered?
- How can everyday users benefit from accessible technologies?
- How can we use context to improve mobile accessibility?