Accessibility of mobile rich internet applications for visually impaired users

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Which OS

Fig. 1: Percentage of devices with a particular operating system within the group of respondents (solid fill) \((n = 25; 29\) devices) and the predicted percentage of devices with a particular operating system in near future (dashed fill).

J. Balata and Z. Mikovec, “Why Visually Impaired People Resist to Adopt Touchscreen Smartphones in the Czech Republic?”, in 7th IEEE International Conference on Cognitive InfoCommunications.
Accessibility across devices

Screen readers

- **Windows** - [Narrator](#) (basic) x advanced 3rd-party (JAWS, NVDA)
- **Linux** - 3rd-party (Orca, BRLTTY)
- **Mac OS** - [VoiceOver](#) (advanced native)
- **Symbian** - 3rd-party (Talks, Mobile Speak)
- **Android** - [Talkback](#) (advanced native)
- **iOS** - [VoiceOver](#) (advanced native)
Android vs iOS

- iOS VoiceOver > Android TalkBack (roles, hints missing)
- Each Android web browser behaves differently with TalkBack, currently most stable is FireFox
- iOS all 3rd-party web browsers build on the same wrapper as native Safari -> identical experience

Paul J. Adam, “iOS vs. Android Accessibility”. pauljadam.com/iosvsandroida11y/
Native

Native pros (+)

- Nothing beats **performance** of native application

- More **situationally specific** accessibility API, a lot of one purpose objects and methods

- Easy access to GPS, compass, phone storage and device resources

Native cons (-)

- Totally different toolsets and **diverse accessibility API**. Results in various user experience on both operating systems

- Necessity to develop and maintain **multiple applications** separately

- High cost and high knowledge of each platform needed
Web based

Web pros (+)

• **Uniform** toolset for large number of platforms and devices (desktop, mobile)
• **Only one app** to develop and maintain for multiple platforms
• More or less the same **experience independent** on platform or version
• Option to seamlessly transform into hybrid app later
• **Easy distribution**

Web cons (-)

• Running in **browser** or browser **wrapper**
• **Restricted access** to Geolocation API and device resources
Application development options of approach

Native x Web based

- Both can achieve same accessibility level

- **Native is diverse** across platforms and set of possibilities is not equal

- **Web is uniform** between platforms and devices
Hybrid - what and why

• Web-based application wrapped in a thin layer of native code to allow use of native-only APIs on web-based app
• Same source code for all platforms, just different wrapper

  **Extension** to web-based app

• Any primarily web-based app can be wrapped later on

• Best of both worlds

• Same screen reader experience
Why developing accessible web application

- Friendly to disabled users
- More user-focused approach -> better UI & UX
- Universal multi-platform experience
- Easy content indexing for crawlers -> better SEO ranking
- Versatile and future-proof application
Website and web application accessibility

**W3C** Web Accessibility Initiative (WAI)

- Web Content Accessibility Guidelines (**WCAG**)
- Authoring Tool Accessibility Guidelines (**ATAG**)
- Accessible Rich Internet Applications (**WAI-ARIA**)
With or without javascript

**Non-JS**
- Covered by WCAG
- Symbian friendly
- Safer accessibility
- Cumbersome for complex applications

**JS**
- Covered by WCAG and WAI-ARIA
- Great support on Android and iOS
- Bug prone (by not using WAI-ARIA correctly)
- Rich applications
Guidelines are not almighty

- A lot of problems **not covered** by guidelines
- If covered - can be **implemented badly** or not at all
- Even if covered and implemented correctly - can be still a problem without **proper user evaluation**
User-Centered Design (UCD)

- Is a standard design process prioritising **maximum usability** rather than business goals, fancy features or capabilities of tools and resources.

- Puts user needs, wants and limitations at the top level of importance.

- Is an iterative process, each design step throughout the project is **evaluated by real users**.

- User feedback refines the design process itself, next steps and the final product.

- Creates user-friendly interface, that is easy-to-learn, supports user’s goals and tasks effectively and efficiently, and is satisfying and engaging to use.
How did I get to accessibility?

naviterier.cz/en/index_en.html
The route from Karlovo náměstí 290/16 to Václavské náměstí 778/14. The route is approximately 1100 meters long and leads over 5 crossings. Stand so that you have a building at your back.

Segment 1 of 21. You are at the address Karlovo náměstí 290/16. Turn to the left and go approximately 70 meters slightly downhill to the round corner with Odborů street. Keep the buildings on your left-hand side.

Segment 2 of 21. You are at the round corner of Karlovo náměstí and Odborů streets. Continue straight and cross Odborů street to the opposite corner via crossing with light signalization with one-way traffic from right.

Segment 3 of 21. You are at the beveled corner of Karlovo náměstí and Odborů streets. Continue straight and go approximately 10 meters slightly downhill to the crossing to your right. Keep the buildings on your left-hand side.
GPS is not precise enough
Increasing precision

• By movement
• By question
• By prediction
Detecting correct pathway

GPS location + View direction + Road side
Localisation

- User asks for localisation while searching route between start and destination location

- System tries to get location, asks user to walk a few meters in order to increase GPS precision while leaving the phone screen on

- System fails to receive user location - tells user about inaccuracy of GPS and asks to either input location or walk until system receives user location

- OR

- System receives user location - system asks on which side of the road is user, if no road available, uses compass only
Navigation

- System navigates user on route based on start and destination location
- User continues navigation step by step on its own
- User thinks he/she is lost, asks system - system gets user location and verifies if user is off the route, provides alternative route if so
Crowd-sourcing

• System tells user specifically he/she will be asked about something in the end of this segment

• User walks through the segment and asks for a new one

• System asks a question

• User answers YES/NO/I don’t know and gets back to navigation
Problem reporting

• User finds out that route is impassable (something is blocking way, user can’t pass)
  • User reports problem as “route blocked”
  • System provides alternative route

• User finds out that route is inappropriate (bad terrain, narrow passage)
  • User reports problem as “route inappropriate”
  • System asks if alternate route needed - user answers YES/NO - system fills the request

• User finds out that route information is incorrect (wrong terrain, slope, corner or crossing description)
  • User reports problem as “incorrect information”
  • System saves the report and thanks user
Start of navigation

Hello I'm Naviterier. A mobile navigation for blind and visually-impaired.

Naviterier asks for the destination.

Decide destination of the route

Where do you want to go?

Naviterier asks for the destination.

Precise localization of a user

To the café at Charles square 15

I need you to walk a few meters in order to improve precision.

Naviterier increases precision by requesting a movement.

Decide start of the route

Do you want me to use your current GPS location as a start point?

Naviterier asks for the start location.

Road side question

Nice, I almost got you. Can you tell me on which side is a road? On the left? On the right? No road?

Naviterier asks the user on which side of a road it is.

Localized

Your route from Long st. 23 to Charles square 15 is 1250 meters long and leads over 5 crossings. Tell me when you are ready to start.

I'm ready.

User localized, route found.
**First segment**

User request first segment.

Segment 1 of 12: You are at the Down st. 18. Go approximately 70 meters straight slightly downhill to a beveled corner.

**Next segment**

User finished the segment and requests a next one.

Segment 2 of 12: You are at the beveled corner of Down st. and Wheat st. Turn right and continue 200 meters straight on a paved walkway to a crossing at Wheat st. 6.

**Continue route**

User continues the route.

**Off the route**

User gets off the route.

**Request location**

User thinks that he/she is lost and requests a localization. Nviterier asks for details.

Let me check that. On what side do you have a road?

On the left side.

**Back on the route**

Naviterier localizes user and provides a new route.

I think I got off the route.

Yeah, you are off the route. Here is a new one for you.
Preparation

Segment 12 of 27: Walk 20 meters until you get to a corner and then turn right. I'll ask you about shape of that corner in the next step.

Request next segment

Tell me next segment of the route please.

Ok, but right before, let me ask you a question.

Question

Was that corner you just passed rather round or sharp?

Sharp.

Show next segment

Segment 13 of 27: Walk 250 meters straight until you get to a crossing.

Navitierer prepares user for a question about the route.

User invokes a finished segment and request a new one.

Navitierer asks additional question about the route to update the routing data.

Navitierer provides info about next segment.
Segment 6 of 14: Walk 100 meters straight and then turn left.

Report: There is a problem on my route.

Is it blocking your way?

Yes it is!

Thank you for reporting! There is your alternative route: Your route is 800 meters long and leads over 3 crossings. Segment 1 of 9: Turn around and walk 50 meters.
Hello, I'm Naviterier. Where would you like to go?

Your destination

Next

I found multiple addresses, pick one please.

- Down st. 1685/23
- Down st. 1623/15
- Down st. 1685/233

Choose

Back to search
Do you want me to use your current GPS location as a starting point?

Yes
No
Back to search

I need you to walk a few meters in order to improve precision. I'll tell you when it's enough.

Back to search

I've almost got you. Can you tell me on which side is a road please?

On the left
On the right
There is no road
Back to search
The route from Long st. 290/16 to Down st. 778/14. The route is approximately 1100 meters long and leads over 5 crossings. Stand so that you have a building at your back.

Start navigation
Back to search

Segment 1 of 21. You are at the address Long st. 290/16. Turn to the left and go approximately 70 meters slightly downhill to the round corner with High st.

Next segment
Previous segment
I think I'm lost
Report a problem
Back to search
Was that corner you just passed rather round or sharp?

Round
Sharp
I don't know
Back to search
Is something blocking your way?

- Yes
- No
- Back to search

What is blocking your way?

Shorty describe please

- Report
- Back to navigation

What kind of a problem do you encounter then?

Kind of a problem

Shorty describe your problem please

- Report
- Back to navigation
Thank you for your attention

Time for questions