

**Martin Scherpinski**

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# Using AI

to solve a key a11y problem  
of maps!

# a11y – Accessibility

- Create an inclusive web for everyone
  - for the visually, motorically, cognitive impaired ...
- became more and more important over the past years, even by law
- **A11Y IS NOT "JUST A FEATURE"!**
  - and adding it afterwards means a lot of effort....
- Typical Problems:
  - **Keyboard accessibility:** Many interactive elements can only be reached with a mouse or touch.
  - **Semantic structure:** Screen readers can't interpret if elements are built without **ARIA roles or labels**.
  - **Focus and live region:** Dynamic content changes (e.g., AJAX/SPAs) without notifying the screen reader.
  - **Contrast and readability:** Low color contrast and non-scalable text make use difficult for many users.



Image created with ChatGPT

# a11y – Problems with maps

- Maps are inherently **visual**, dynamical and interactive
  - Screen readers usually only encounter an **empty** `<div>` or `<canvas>`
- Missing alternatives
  - POIs and layer information are rarely available as accessible lists or tables (**Non-Visual View**)
- Maps have no linear structure
  - Spatial **relationships** are mainly visual (e.g., “north of...”) can roughly be transported with plain text in lists
- Interaction issues
  - Zooming, panning, or clicking markers or popups often isn't **keyboard-accessible**.
- Dynamic content:
  - Screen readers are not automatically informed when maps move, filters change, or layers switch.



Image created  
with ChatGPT

## Another approach to a11y: AI

- LLMs (Large Language Models) nowadays offer strong capabilities to generate textual descriptions of images
- **Why not use this for a11y?**
- 💡 Concept
  - Users can actively trigger a textual description of the current map view.
  - The application creates a **screenshot**, an LLM analyzes it, and generates a semantic textual description.
  - The description can be read out by a screen reader
- Assumed example output:
  - *“The map shows the city center of Frankfurt with the train station. A river runs along in the south.”*

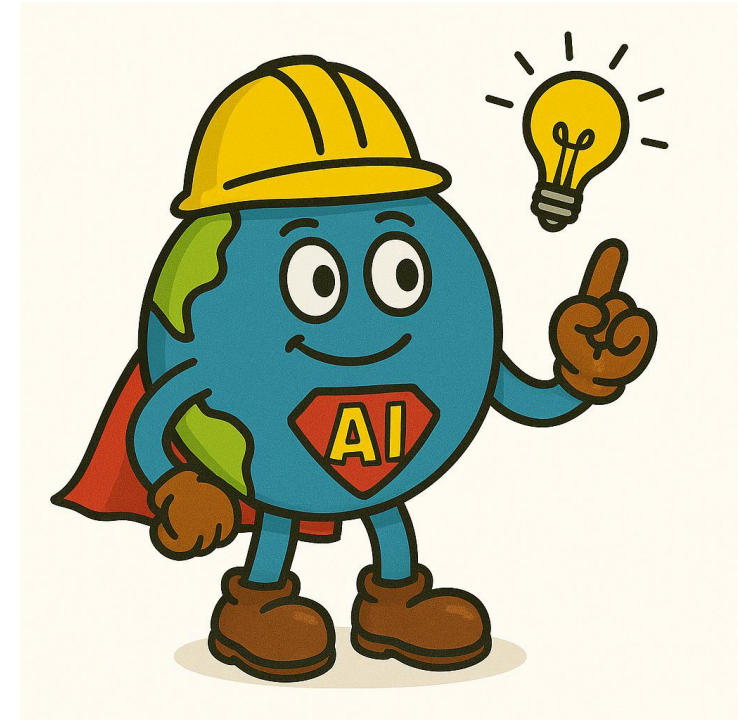


Image created with ChatGPT



Image created  
with ChatGPT

## Advantages of the approach

- **Provides access** to dynamic, visually rendered maps (e.g., WebGL, raster maps) that were **previously unreadable** for screen readers.
- **Independent and extensible:** works with any type of layer, map, data type, client
  - Potentially applicable to heatmaps, 3D views, or any thematic maps.
- **Spatial orientation** becomes linguistically perceivable (“north of the city center,” “nearby...”).
- **Visual context** can be included in the analysis like street patterns, map labels, colors of POIs
- **User-controlled interaction:** The user triggers the description on demand, avoiding information overload.

# Challenges

- **Accuracy:** AI-generated descriptions may be **incorrect** (“hallucinations”)
  - Output is not **deterministic**, small changes in the input can have different results
  - **Can I trust the output?** ("I think, this could be ...")
  - **Context is King!** Best results may be achieved in combination with additional feature data
- **Complement, not replacement:** Screenshot descriptions should supplement, not replace, accessible structured alternatives (e.g., ARIA-based POI lists)
- **Latency:** Processing must be fast enough for practical use, screenshot upload needs to be considered
- **Data protection:** Screenshots may contain sensitive (geo-)data
- **Lack of standards:** No WCAG-compliant guidelines **yet** for AI-based descriptions.

## CHALLENGES



Image created with ChatGPT

# Technical realisation – What do you need for a prototype?

- Depends on the target client:
  - Prototyping in **map.apps**, which is based on the ArcGIS Maps SDK for JavaScript
- OpenAI API <https://platform.openai.com/docs/api-reference/introduction>
  - Rest API to communicate with an LLM like GPT-4.1 (basically, just like ChatGPT)
  - Completions API / Responses API
- API-Key: Directly from OpenAI or from a deployment in Azure Open AI
- Access to a model: le.g. **GPT-4.1** hosted in West-Europe
- Node.js packages: <https://www.npmjs.com/package/openai> / <https://www.npmjs.com/package/@azure/openai>
- `view.screenshot()` from the Maps SDK 😊



Image created with ChatGPT

No LLM  
evaluation  
has been  
done, yet!



# Prompting / Interacting with the API



Image created  
with ChatGPT

```
1 { "messages": [{
2     "role": "system",
3     "content": [
4         { "type": "text",
5           "text": "Always respond in the language from the locale 'de'.
6             Please provide your answer in visually appealingly formatted html.
7             Make the output accessible, so a screen reader can read it out loud.
8             Do not include markers for the file format in the content.
9             Do not include images in your response."
10        }
11    ],
12    "role": "user",
13    "content": [
14        { "type": "text",
15          "text": "Give me a description of what can be seen on the map.
16            Assume that a visually impaired person is asking you.
17            Make a guess about the location."
18        },
19        { "type": "image_url",
20          "image_url": {
21              "url": "data:image/png;base64,..."
22          }
23        }
24    ],
25    "model": "aoai-gpt-4.1-demo-m.scherpinski",
26    "store": true
27 }
```



# Demo 1 – General workflow with satellite images

Esri European Developer & Technology Summit 2025

Using AI to Solve a Key a11y Problem of Maps!

Basemap Topographical Map

Language English

NVDA Speech Viewer

Map Explanation

Description of the Map

- The image is a detailed satellite view of an urban area with a dense network of streets.
- There is a significant railway station near the center of the map, with many tracks converging in one area.
- A curved river runs diagonally from the lower right corner to the middle right, spanned by several bridges.
- Clusters of large buildings, possibly commercial or governmental, are visible close to the river and railway station.
- Residential neighborhoods with regular blocks and green spaces surround the central area.
- Parks and open areas can be seen, especially towards the upper left.

Location Guess

Frankfurt am Main, Germany

Request Explanation

con terra

map.apps Community

alert Close window

Request Explanation

button

Abort request button

alert busy Loading

response from AI...

Request Explanation

button

AI Response Text Area

alert

<h2>Description of the

Map</h2>

<ul>

<li>The

image is a detailed satellite

view of an urban area with a

dense network of

streets.</li>

<li>There is a

significant railway station

near the center of the map,

with many tracks converging

in one area.</li>

<li>A

curved river runs diagonally

from the lower right corner

to the middle right, spanned

by several bridges.</li>

<li>

Clusters of large buildings,

possibly commercial or

governmental, are visible

close to the river and railway

station.</li>

<li>

Residential

neighborhoods with regular

blocks and green spaces

surround the central

area.</li>

<li>

Parks and

open areas can be seen,

especially towards the upper

left.</li>

</ul>

<h2>

Location Guess</h2>

<p>

<strong>Frankfurt am Main,

Germany</strong>

</p>

200 m

Microsoft, Vantor

Powered by Esri

Map Content Legend

Imprint Privacy Statements

Show Speech Viewer on Startup



# Demo 2 – Different Prompts and Geodata

Esri European Developer & Technology Summit 2025 Using AI to Solve a Key a11y Problem of Maps!

Basemap Street Map (gray) Language English NVDA Speech Viewer

con+terra map.apps Community

Problem of Maps! — Mozilla Firefox button System audio unmuted. Select to mute system audio button DesktopWindowXamlSource http://office.conterra.de:9090/?lang=en&vm=2D&s=18055.9548215&c=964309.210966704%2C6465060.684743555&bm=gray&dl=erfrischungsbrunnen&r=0 Using AI to Solve a Key a11y Problem of Maps! — Mozilla Firefox Map Explanation clickable Can be moved with arrow keys heading level 2 Map Explanation tool bar button Close window out of tool bar Click the button below to request an AI-generated explanation of the current map view. tool bar Close window button alert Close window Request Explanation button Configure Prompt button New Prompt edit multi line Enter a new prompt... blank Send prompt button

Map Explanation

Click the button below to request an AI-generated explanation of the current map view.

Current Prompt:

Give me a description of what can be seen on the map. Assume that a visually impaired person is asking you. Make a guess about the location.

New Prompt:

Give me a description of what can be seen on the map. Assume that a visually impaired person is asking you. Give me the count of POIs on the map.

Send prompt

Frankfurt

200 m

Esri Community Maps Contributors, HVBG, Esri, TomTom, Garmin, GeoTechnologies, Inc., METI/NASA, USGS

Map Content Legend Imprint Privacy Statements Show Speech Viewer on Startup

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# Demo 2 – Different Prompts and Geodata

Esri European Developer & Technology Summit 2025

Using AI to Solve a Key a11y Problem of Maps!

Basemap Street Map (gray) Language English NVDA Speech Viewer

con+terra  
map.apps Community

Map Explanation

Map Description

The map displays a central urban area with a river running through it. Numerous points of interest (POIs) are marked, mainly fountains and wells. The surrounding area includes labeled neighborhoods and roadways. The POIs cluster around the river and the city center.

- Most POIs are fountains or wells with names ending in "brunnen"
- The prominent location on the map is **Frankfurt**
- Main roads and river are clearly visible, providing orientation

Count of POIs

There are 22 POIs shown on this map.

Request Explanation

alert Close window  
Request Explanation  
button  
Configure Prompt button  
New Prompt edit multi line  
Enter a new prompt... blank  
Send prompt button  
Abort request button  
alert busy Loading  
response from AI...  
Request Explanation  
button  
AI Response Text Area  
alert  
<h2>Map Description</h2>  
<p>The map displays a  
central urban area with a  
river running through it.  
Numerous points of interest  
(POIs) are marked, mainly  
fountains and wells. The  
surrounding area includes  
labeled neighborhoods and  
roadways. The POIs cluster  
around the river and the city  
center. </p> <ul> <li>Most  
POIs are fountains or wells  
with names ending in  
"brunnen"</li> <li>The  
prominent location on the  
map is <strong>  
Frankfurt</strong> </li>  
<li>Main roads and river are  
clearly visible, providing  
orientation</li> </ul> <h2>  
Count of POIs</h2> <p>  
There are  
<strong>22</strong> POIs  
shown on this map. </p>

200 m

Esri Community Maps Contributors, HVBG, Esri, TomTom, Garmin, GeoTechnologies, Inc, METI/NASA, USGS

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# Demo 3 – GeoGuesser and spatial context

Esri European Developer & Technology Summit 2025 Using AI to Solve a Key a11y Problem of Maps! Basemap Topographical Map Language English NVDA Speech Viewer

**Map Explanation**

### Stadium Identification

- Guess: Volksparkstadion
- Location: Hamburg, Germany
- Notable for: Home of Hamburger SV
- Clues: The logo visible in the seats and the surrounding training pitches help identify it.

Request Explanation

**GeoGuesser**

Location 1a	Location 1b
Location 2	
Location 3	
Location 4	

conterra  
map.apps Community

Firefox  
Map Explanation dialog  
Can be moved with arrow keys  
clickable Can be moved with arrow keys heading level 2 Map Explanation tool bar  
Close window button  
alert Close window  
Request Explanation button  
Configure Prompt button  
New Prompt edit multi line  
Enter a new prompt... blank  
Send prompt button  
Abort request button  
alert busy Loading  
response from AI...  
Request Explanation button  
AI Response Text Area alert  
<h2> Stadium Identification</h2> <ul>  
<li> <strong>  
Guess:</strong>  
Volksparkstadion</li> <li>  
<strong>  
Location:</strong>  
Hamburg, Germany</li>  
<li> <strong>Notable  
for:</strong> Home of  
Hamburger SV</li> <li>  
<strong>Clues:</strong>  
The logo visible in the seats  
and the surrounding training  
pitches help identify it.</li>  
</ul>

Microsoft, Vantor  
Map Content Legend  
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# Demo 3 – GeoGuesser and spatial context

Esri European Developer & Technology Summit 2025

Using AI to Solve a Key a11y Problem of Maps!

Basemap Topographical Map Language English NVDA Speech Viewer

Map Explanation

Stadium Identification

Based on the satellite image, the stadium shown is most likely:

- Deutsche Bank Park (formerly known as Waldstadion) in Frankfurt am Main, Germany.

This stadium is home to Eintracht Frankfurt and is located on the edge of a large forested area, fitting the context of the image.

Request Explanation

GeoGuesser

Location 1a

Location 1b

Location 2

Location 3

Location 4

con+terra

map.apps Community

Close window button

alert Close window

Location 1a button

Location 1b button

Location 1a button

tool bar

Close window button

alert Close window

GeoGuesser dialog Can be moved with arrow keys

Map Explanation dialog Can be moved with arrow keys

button Configure Prompt

Request Explanation button

Abort request button

alert busy Loading response from AI...

Request Explanation button

AI Response Text Area alert

<h2>Stadium Identification</h2> <p>Based on the satellite image, the stadium shown is most likely:</p> <ul> <li><strong>Deutsche Bank Park</strong> (formerly known as Waldstadion) in Frankfurt am Main, Germany.</li> </ul> <p>This stadium is home to Eintracht Frankfurt and is located on the edge of a large forested area, fitting the context of the image.</p>

Microsoft, Vantor

Map Content Legend

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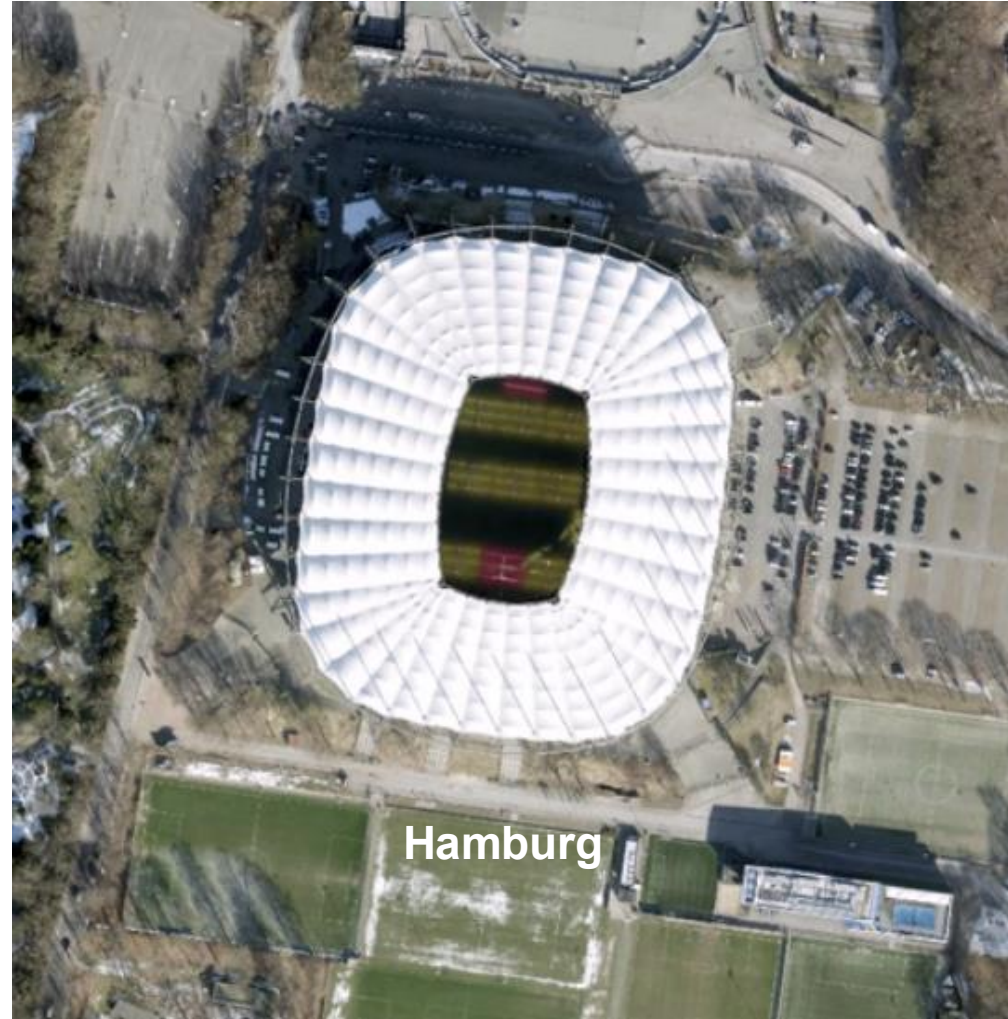
Imprint Privacy Statements

Show Speech Viewer on Startup

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## Demo 3 – GeoGuesser and spatial context





# Demo 4 – GeoGuesser with more obvious data

Esri European Developer & Technology Summit 2025

Using AI to Solve a Key a11y Problem of Maps!

Basemap Topographical Map

Language English

Map Explanation

Stadium Identification

Based on the aerial view and distinctive oval shape, my guess is:

- Olympiastadion Berlin

This stadium is located in Berlin, Germany, and is known for hosting major sports events, including football matches and the 1936 Summer Olympics.

Request Explanation

GeoGuesser

Location 1a

Location 1b

Location 2

Location 3

Location 4

con terra

map.apps Community

Location 1b button

Location 2 button

Location 3 button

Location 2 button

Location 1b button

Location 1a button

tool bar

Close window button

GeoGuesser dialog Can be moved with arrow keys

Map Explanation dialog Can be moved with arrow keys

button Request Explanation

Configure Prompt button

Request Explanation button

Abort request button

alert busy Loading response from AI...

Request Explanation button

AI Response Text Area alert

<h2>Stadium Identification</h2>

<p>Based on the aerial view and distinctive oval shape, my guess is:</p><ul><li><strong>Olympiastadion Berlin</strong></li></ul><p>This stadium is located in Berlin, Germany, and is known for hosting major sports events, including football matches and the 1936 Summer Olympics.</p>

Geoportal Berlin, Microsoft, Vantor

Map Content Legend

Imprint Privacy Statements

Show Speech Viewer on Startup



# Demo 5 – GeoGuesser with labels for context

Esri European Developer & Technology Summit 2025 Using AI to Solve a Key a11y Problem of Maps! Basemap Topographical Map Language English NVDA Speech Viewer

Map Explanation

### Stadium Guess

- Eintracht-Stadion
- Location: Braunschweig, Germany
- Characteristic features: Distinct rectangular stadium with adjacent athletics track and training grounds

Request Explanation

GeoGuesser

Location 1a Location 1b

Location 2

Location 3

Location 4

conterra  
map.apps Community

Location 2  
Location 3  
Location 4  
Using AI to Solve a Key a11y Problem of Maps! — Mozilla Firefox  
GeoGuesser dialog Can be moved with arrow keys  
button Location 3  
Location 4 button  
Location 3  
Location 2  
Request Explanation  
Map Explanation dialog Can be moved with arrow keys  
button Request Explanation  
Request Explanation  
Abort request button  
alert busy Loading response from AI...  
Request Explanation button  
AI Response Text Area alert  
<section aria-label="Stadium Guess">  
<h2>Stadium Guess</h2>  
<ul> <li><strong>Eintracht-Stadion</strong></li> <li>Location: Braunschweig, Germany</li> <li>Characteristic features: Distinct rectangular stadium with adjacent athletics track and training grounds</li></ul> </section>

Microsoft, Vantor

Map Content Legend

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# Demo 5 – GeoGuesser with labels for context

Esri European Developer & Technology Summit 2025 Using AI to Solve a Key a11y Problem of Maps!

Basemap Aerial (hybrid) Language English NVDA Speech

conterra map.apps Community

**Map Explanation**

### Stadium Identification

Based on the visible labels and layout, the stadium in the image is the Ostseestadion in Rostock, Germany.

- Location: Rostock, Mecklenburg-Vorpommern
- Main tenant: FC Hansa Rostock
- Commonly used for: Football matches and events

Request Explanation

**GeoGuesser**

Location 1a	Location 1b
Location 2	
Location 3	
Location 4	

Microsoft, Vantor | Esri Community Maps Contributors, Hansestadt Rostock, Esri, TomTom, Garmin, GeoTechnologies, Inc, METI/NASA, USGS

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Request Explanation button  
Topographical Map menu  
Basemap selection. Selected basemap is Topographical Map  
Map combo box Basemap Topographical Map expanded  
Aerial (hybrid) row 4 of 4  
Basemap selection. Selected basemap is Aerial (hybrid)  
combo box Basemap Aerial (hybrid) collapsed  
Request Explanation button  
Abort request button  
Abort request button  
alert busy Loading response from AI...  
Request Explanation button  
AI Response Text Area  
alert  
<h2> Stadium Identification</h2>  
<p> Based on the visible labels and layout, the stadium in the image is the <strong> Ostseestadion</strong> in Rostock, Germany. </p>  
<ul>

# Conclusion

- Accessibility for web maps has long been challenging because screen readers cannot interpret spatial structures.
- The **AI approach** with screenshots represents an **innovative bridge**:
  - It translates visual map content into textual, semantic descriptions, making it **understandable for visually impaired users**.
- **Good Practice for map a11y**:
  - **Combine traditional accessibility methods (ARIA, keyboard navigation, structured lists) with an optional AI-powered descriptive layer** for contextual understanding. Use screenshots and actual feature data to boost the results.



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[conterra.de/aktuelles/newsletter](https://conterra.de/aktuelles/newsletter)





# Thank you very much!

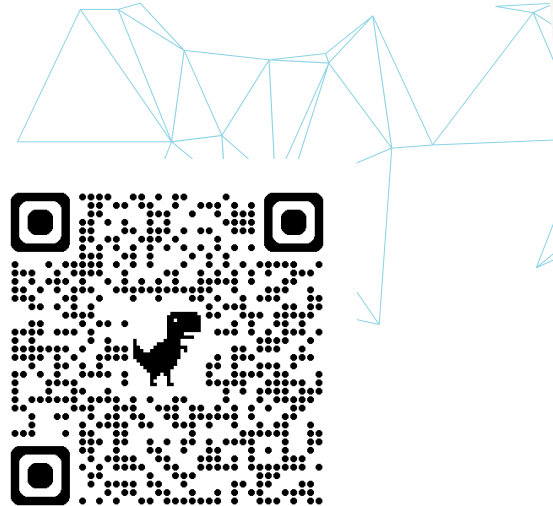
Find me at the expo for  
questions!

**Martin Scherpinski**  
Software Engineer

con terra  
Martin-Luther-King-Weg 20  
48155 Muenster  
Germany

T +49 251 59689 300  
info@conterra.de  
con-terra.com

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Slides

<https://github.com/m-scherpi/a11y-ai>

Image created with ChatGPT

