

# Exploring The Affordances of Game-Aware Streaming to Support Blind and Low Vision Viewers: A Design Probe Study

Noor Hammad, Frank Elavsky, Sanika Moharana, Jessie Chen, Seyoung Lee, Patrick Carrington, Dominik Moritz, Jessica Hammer, Erik Harpstead



Presented by Frank Elavsky, PhD Student



[hcii.cmu.edu](https://hcii.cmu.edu), [axle-lab.com](https://axle-lab.com), [dig.cmu.edu](https://dig.cmu.edu), [cmu-ctp.github.io](https://cmu-ctp.github.io)

# Game accessibility is on the rise



<https://www.playstation.com/en-us/games/the-last-of-us-part-ii/accessibility/>

# What about game streaming accessibility?

The screenshot displays a Dota 2 esports stream. The main game view shows a 'World First Pull' for Queen Ansurek, with a large 'Pick up Essence (3.0)' text overlay. A leaderboard on the left lists player names and their respective scores. A webcam view of a player is visible in the bottom left. The chat window on the right shows viewer comments, including 'shizukami97: sub 5% they started talking like the birds in finding Nemo hahaha' and 'Khuzvhan: THD!'. The stream is presented by RWF (Presented by Coinbase) and features logos for Liquid, Secret Lab, and Honda. The game title 'QUEEN ANSUREK' is prominently displayed at the bottom.

Rank	Player	Score
1	Rikuarms	989,99M 1.67M
2	Fireup	876,34M 148M
3	BoomiTurbo	859,26M 145M
4	Dumpy Pumpy	848,07M 143M
5	Lilstick	832,97M 141M
6	Dzrr	830,14M 140M
7	Mälärk	827,71M 140M

Chat on Videos

0:19 shizukami97: sub 5% they started talking like the birds in finding Nemo hahaha

0:20 Khuzvhan: THD!

0:20 BlackLabel2021: THD!

0:21 reagsy: HATS OFF CLUTCH

# What about game streaming accessibility?

The screenshot displays a Dota 2 esports match stream. The central focus is a 'World First Pull' for the item Queen Ansurek. A large overlay reads 'Pick up Essence (3.0)' with a value of 4,736,557. A leaderboard on the left lists player names and their respective scores. The chat window on the right shows viewer interactions, including comments like 'shizukami97: sub 5% they started talking like the birds in finding Nemo hahaha' and 'Khuzvhan: THD'. A small inset video shows the streamer, a man with glasses and a headset, reacting to the event.

Rank	Player Name	Score
1	Rikuarms	989.99M 1.67M
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**coinbase WORLD FIRST PULL**

**Pick up Essence (3.0)**  
4,736,557

**THD!**

**BlackLabel2021:** [Brackets]

**reagisy:** HATS OFF CLUTCH

# What about game streaming accessibility?

The image shows a Dota 2 esports stream. The main content is a game screen with a 'coinbase WORLD FIRST PULL' overlay. A large text overlay reads 'Pick up Essence (3.0)'. The game interface shows a team of heroes, a scoreboard, and a pull progress bar at the bottom. The pull progress bar includes logos for SECRET LAB, HONDA, and MYTHIC, and shows progress for Queen Ansurek with values 1, 1, 1, 1, 120, 304, 171, 403. The chat window on the right shows viewer comments, including 'shizukami97: sub 5% they started talking like the birds in finding Nemo hahaha' and 'Khuzvhan: THD'. The stream is titled '19 days ago' and has options for 'Watch Full Video', 'Edit', and 'Share'.

Rank	Player	Score	Damage
1	Rikuarms	989.99M	1.87M
2	Fireup	876.34M	148M
3	Boomieturbo	859.26M	145M
4	Dumpy Pumpu	848.07M	143M
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# What about game streaming accessibility?

The image shows a screenshot of a game streaming video. The main content is a Dota 2 match. On the left, there is a vertical sidebar with various icons and logos, including 'RWF', 'coinbase', 'LIQUID', '1ST WORLD', '1ST REGION', 'SECRET LAB', 'HONDA', and 'MYTHIC'. The top left corner of the stream displays 'LOCAL TIME 00:32 PDT'. The main game area shows a Dota 2 match with a 'Pick up Essence (3.0)' notification. A 'coinbase WORLD FIRST PULL' banner is visible at the top of the game. A small inset window shows a streamer's face. The bottom of the stream features a progress bar with a '29' timer and various icons. On the right side, there is a 'Chat on Videos' section with several messages from users like 'shizukami97', 'Khuzvhan', 'BlackLabel2021', and 'reagsy'. The chat messages are partially obscured by a large, semi-transparent white box.

LOCAL TIME 00:32 PDT

RWF PRESENTED BY coinbase

LIQUID 1ST WORLD 1ST REGION

SECRET LAB HONDA MYTHIC

coinbase WORLD FIRST PULL

Pick up Essence (3.0)

Chat on Videos

0:19 shizukami97: sub 5% they started talking like the birds in finding Nemo hahaha

0:20 Khuzvhan: THD

THD!

0:20 BlackLabel2021:

0:21 reagsy: HATS OFF CLUTCH

19 days ago Watch Full Video Edit Share

# What about game streaming accessibility?

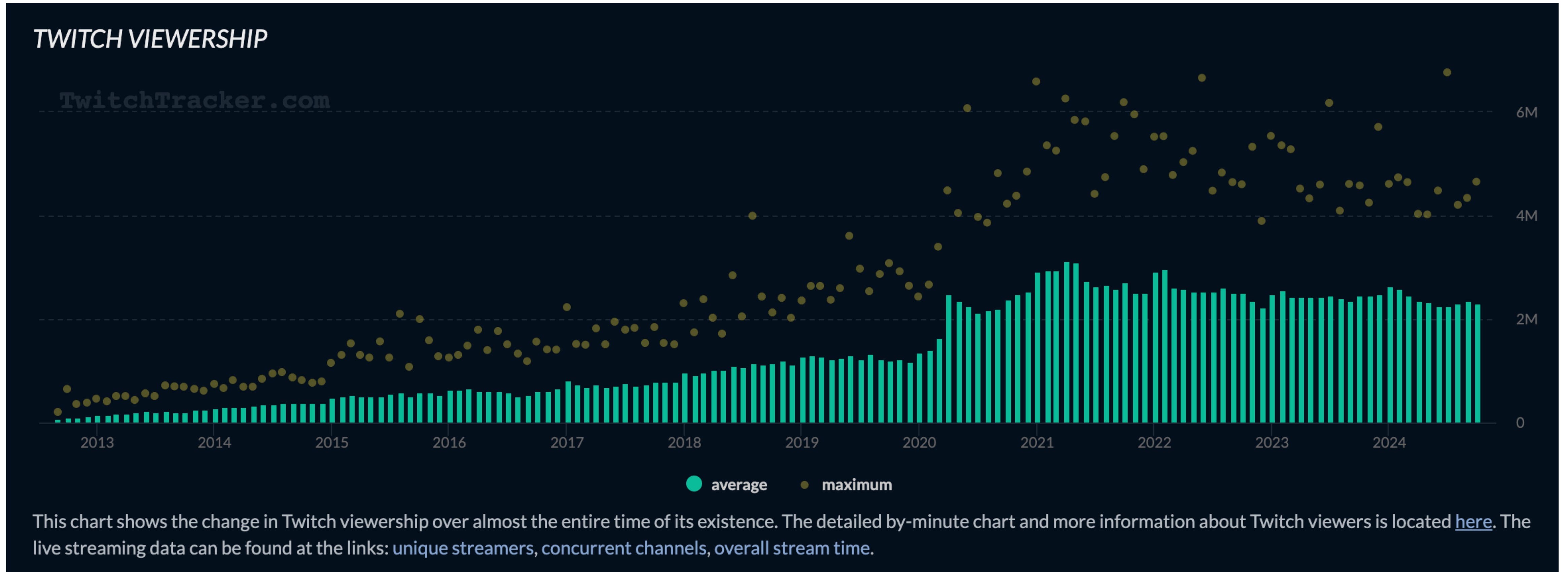
The image shows a screenshot of a game stream interface. On the left, there is a vertical sidebar with a list of viewer avatars. The main content area is split into three sections:

- Left Panel:** A dark blue overlay for the team "QUEEN ANSUREK". It features the "RWF" logo, "coinbase" branding, and the text "LIQUID 1ST WORLD 1ST REGION". At the bottom, there are logos for "SECRET LAB" and "HONDA".
- Center Panel:** A Dota 2 match in progress. A large blue text overlay reads "Pick up Essence (3.0)". A "coinbase" overlay in the top left corner displays "WORLD FIRST PULL" and a table of player statistics:

Rank	Player	Score	Deaths
1	BoodyWickbe	799M	1.53M
2	BoodyWickbe	876.67M	1.48M
3	Foxxyrwe	388.44M	822K
4	BoodyWickbe	310.84M	530K
5	haddock	132.23M	223K
- Right Panel:** A chat window titled "Chat on Videos". It shows messages from users like "shizukami97" and "BlackLabel2021". The chat contains a large amount of text represented by small, illegible icons, likely due to a lack of proper text rendering or a specific accessibility filter.

At the bottom of the stream, there is a "MYTHIC" logo and the team name "QUEEN ANSUREK" with a score of 29. A "19 days ago" timestamp is visible in the bottom left corner.

# Many people watch streams



<https://twitchtracker.com/statistics>



# Accessible stream descriptions are a hard problem! [1]

The screenshot shows a Dota 2 live stream. The main content is a game scene with a large text overlay that says "Pick up Essence (3.0)". A leaderboard on the left lists player names and their scores. A webcam in the bottom left shows a player named YIPZZ. The bottom of the screen features a progress bar for the "RAID PROGRESS" and a list of "PULLS" with corresponding numbers: 1, 1, 1, 1, 120, 304, 171, 403. The chat window on the right contains several messages, including one with a large block of Braille text.

coinbase  
WORLD FIRST PULL

LOCAL TIME  
00:32  
PDT

QUEEN  
ANSUREK

LIQUID  
1ST WORLD 1ST REGION

YIPZZ

RAID PROGRESS

SECRET LAB HONDA MYTHIC

QUEEN ANSUREK

19 days ago

Chat on Videos

0:19 shizukami97: sub 5% they started talking like the birds in finding Nemo hahaha

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[1] Killough and Pavel, "Exploring Community-Driven Descriptions for Making Livestreams Accessible" (2023)

# Descriptions are great, but what about *sense-making*?

**coinbase WORLD FIRST PULL**

Rank	Player	Score	Value
3	Derepriestf	907.91M	1.53M
4	Drineytwo	876.67M	1.48M
5	Passionw	388.44M	622K
6	Beanbaker	313.94M	530K
7	Thdlock	132.23M	223K

**LIQUID 1ST WORLD 1ST REGION**

**RAID PROGRESS**

Item	PULLS
1	1
1	1
1	1
1	1
120	120
304	304
171	171
403	403

**MYTHIC QUEEN ANSUREK**

19 days ago

Watch Full Video Edit Share

Chat on Videos

0:19 shizukami97: sub 5% they started talking like the birds in finding Nemo hahaha

0:20 Khuzvhan: THD

THD!\

0:20 BlackLabel2021:

0:21 reagsy: HATS OFF CLUTCH

# 3 major problems

## For stream accessibility

1. Existing customization and accessibility exists only for the gamer/streamer
2. Serial audio doesn't allow sensemaking/exploration of information and can become overwhelming
3. A serial video feed of an interface loses semantics and interactivity



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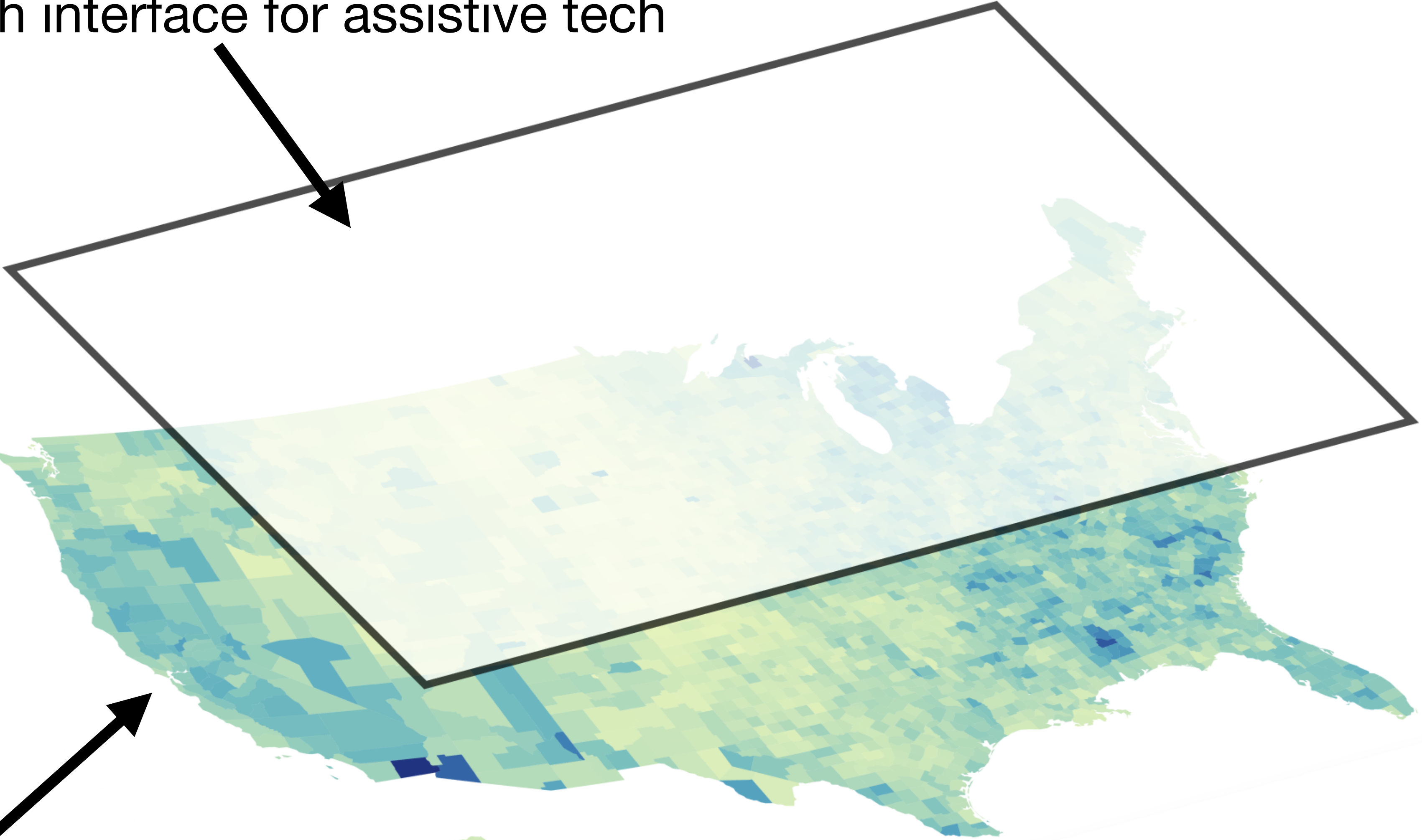
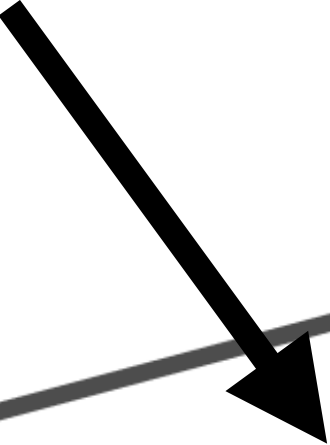
# 3 major problems

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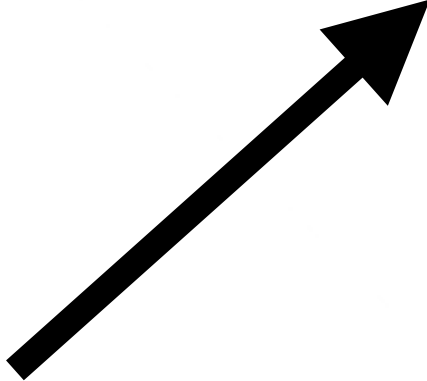
1. Existing customization and accessibility exists only for the gamer/streamer
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3. A serial video feed of an interface loses semantics and interactivity



This is a rich interface for assistive tech

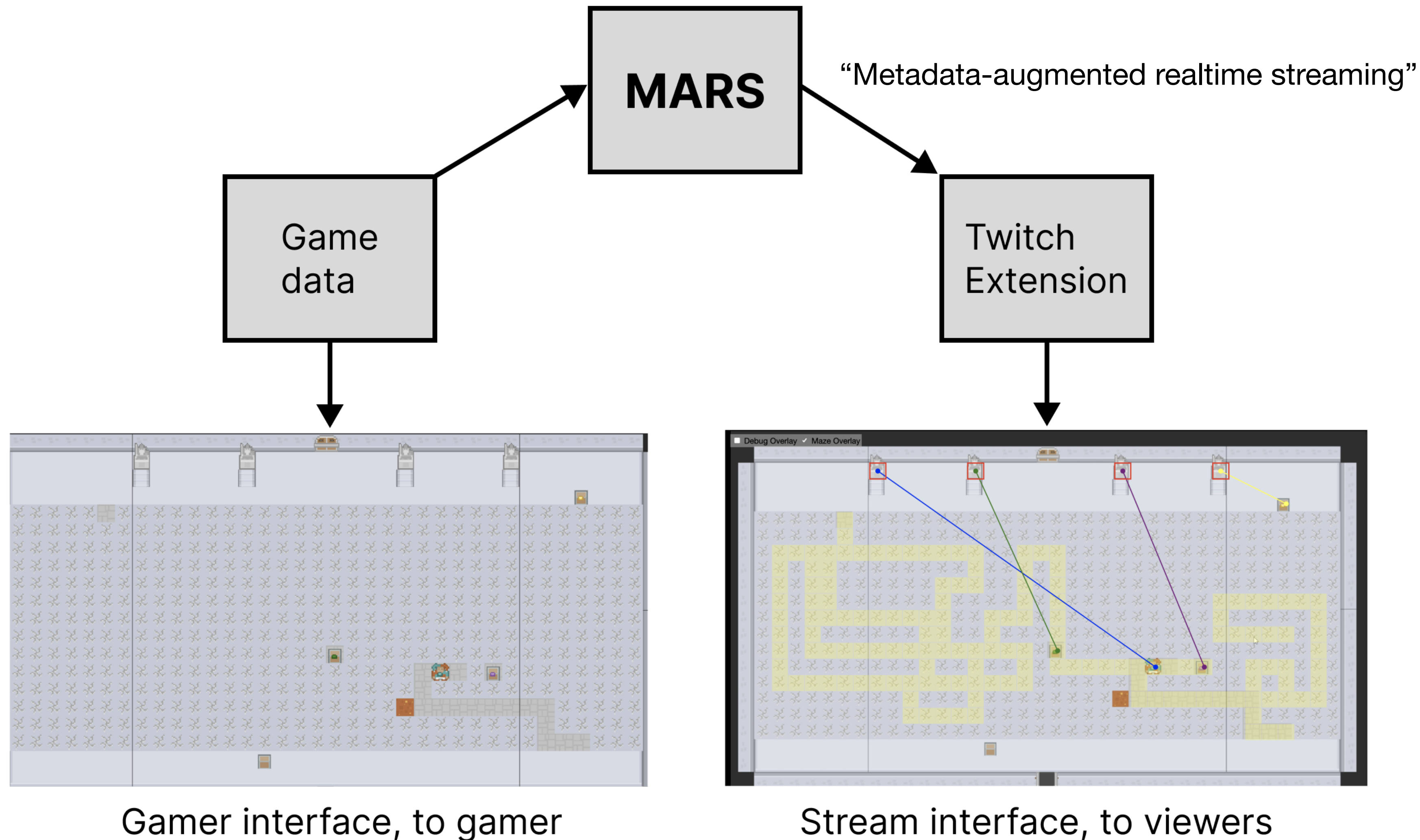


This is made of pixels



Elavsky et al, "Data Navigator" (2023)

# Game-aware streaming: potential?



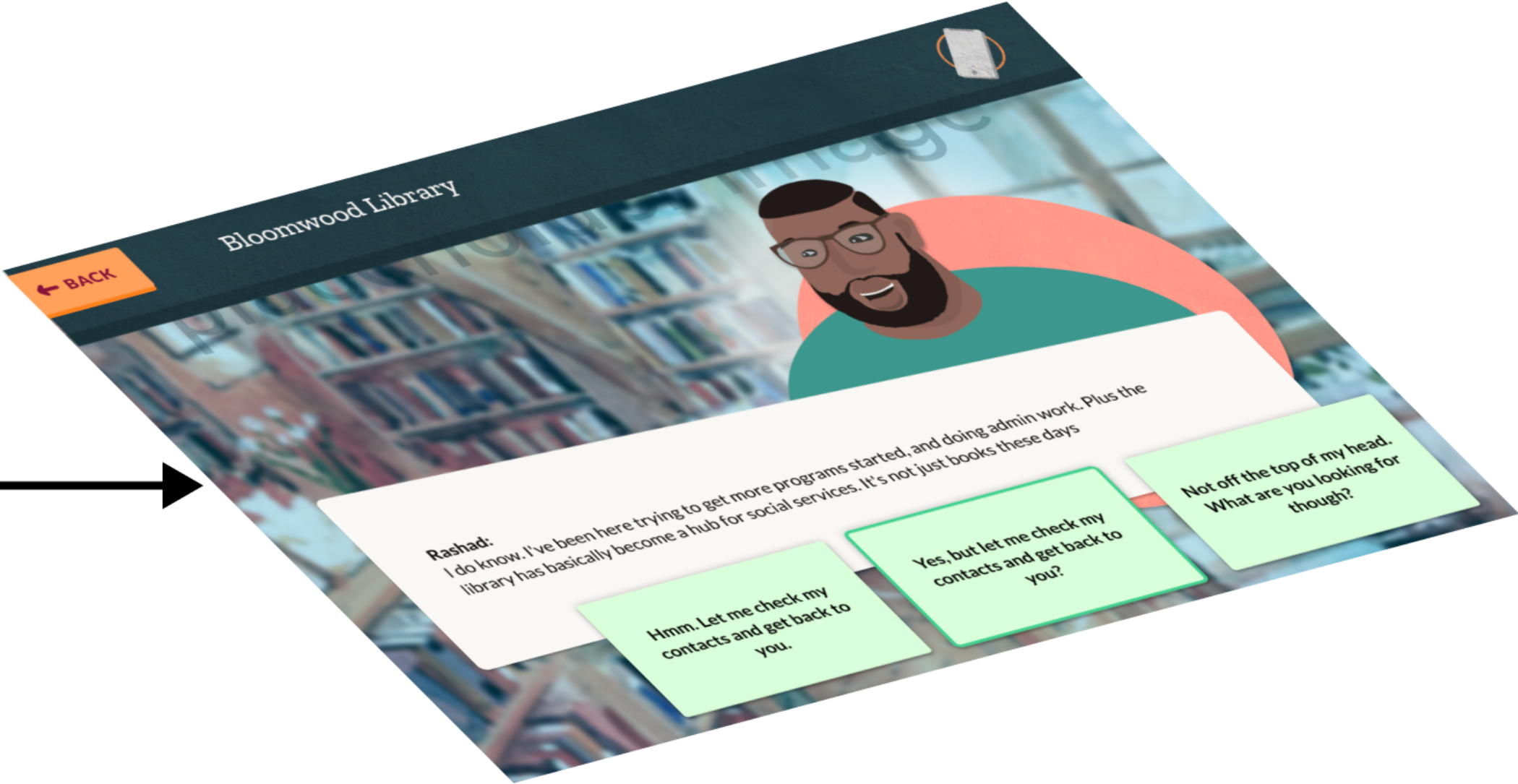
Hammad et al, "The View from MARS" (2023)



Audio, video,  
+ Stream UI

Game engine

Stream software

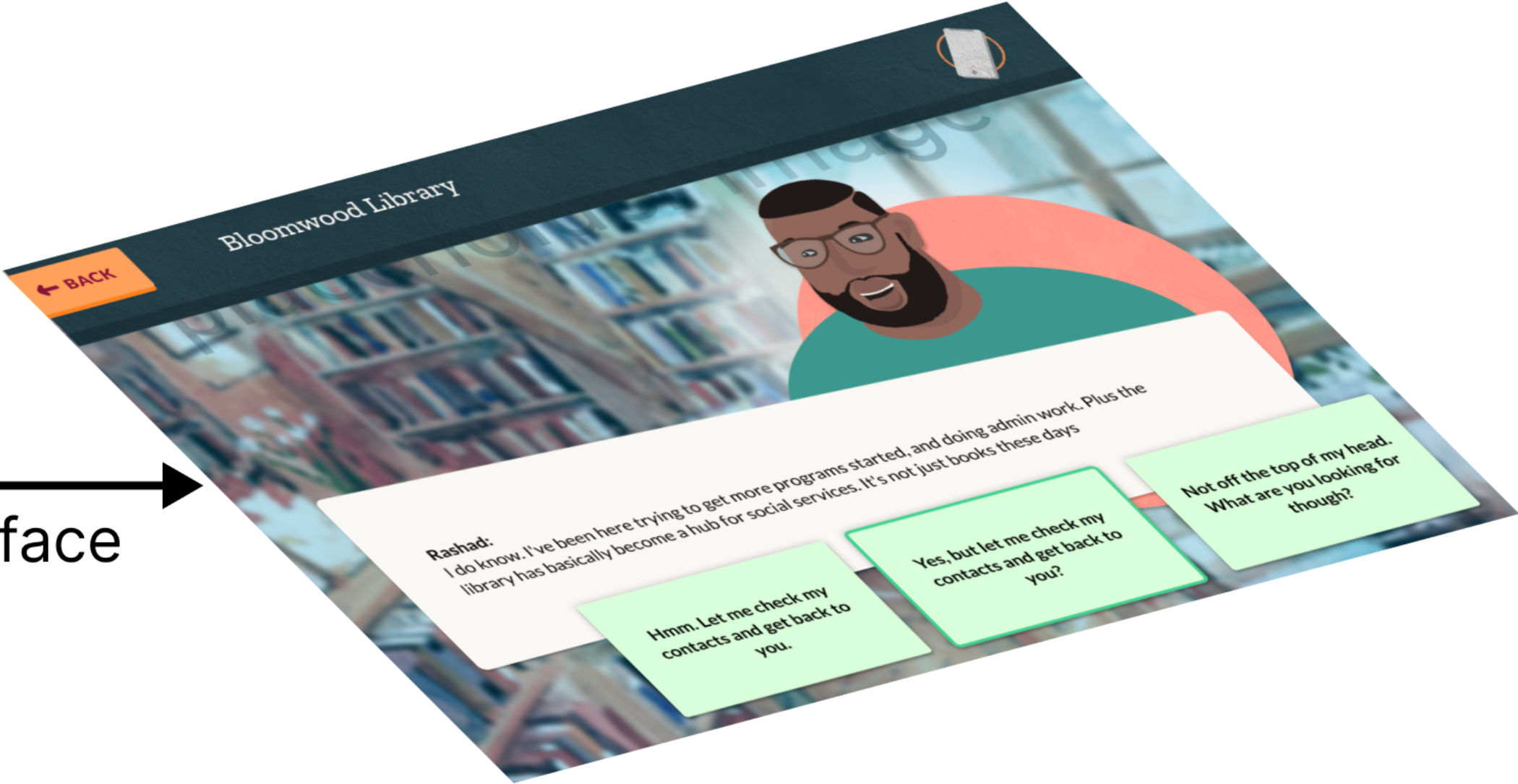


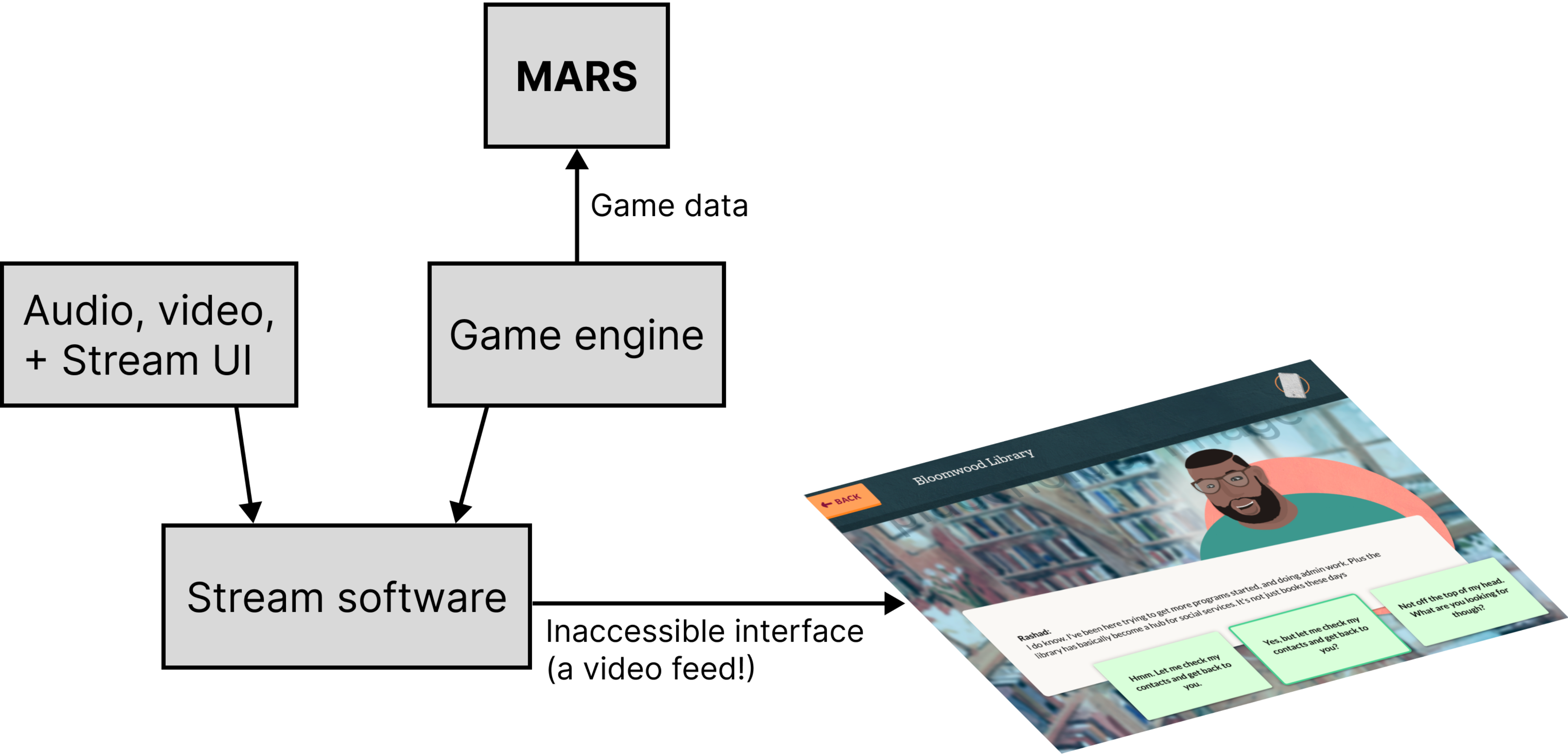
Audio, video,  
+ Stream UI

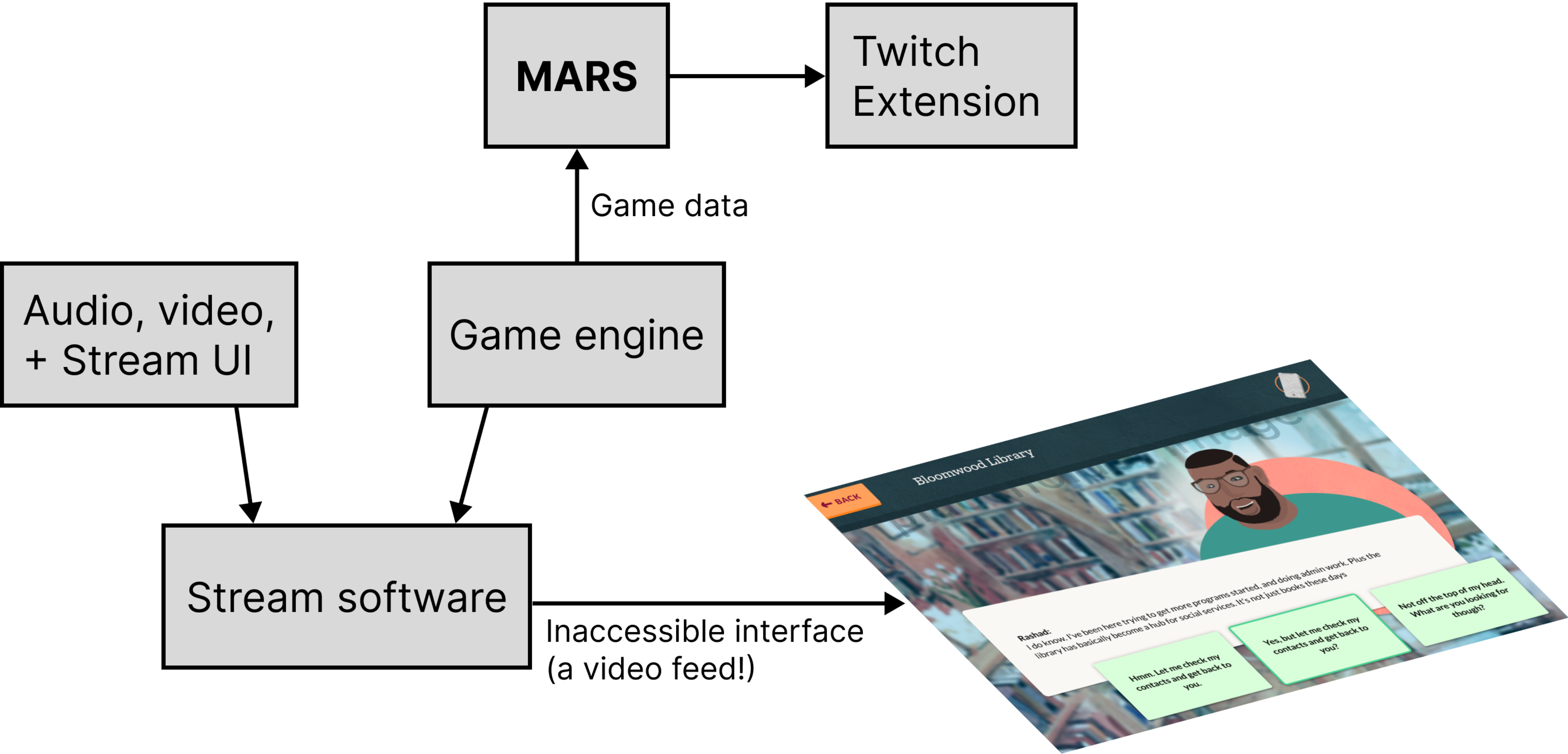
Game engine

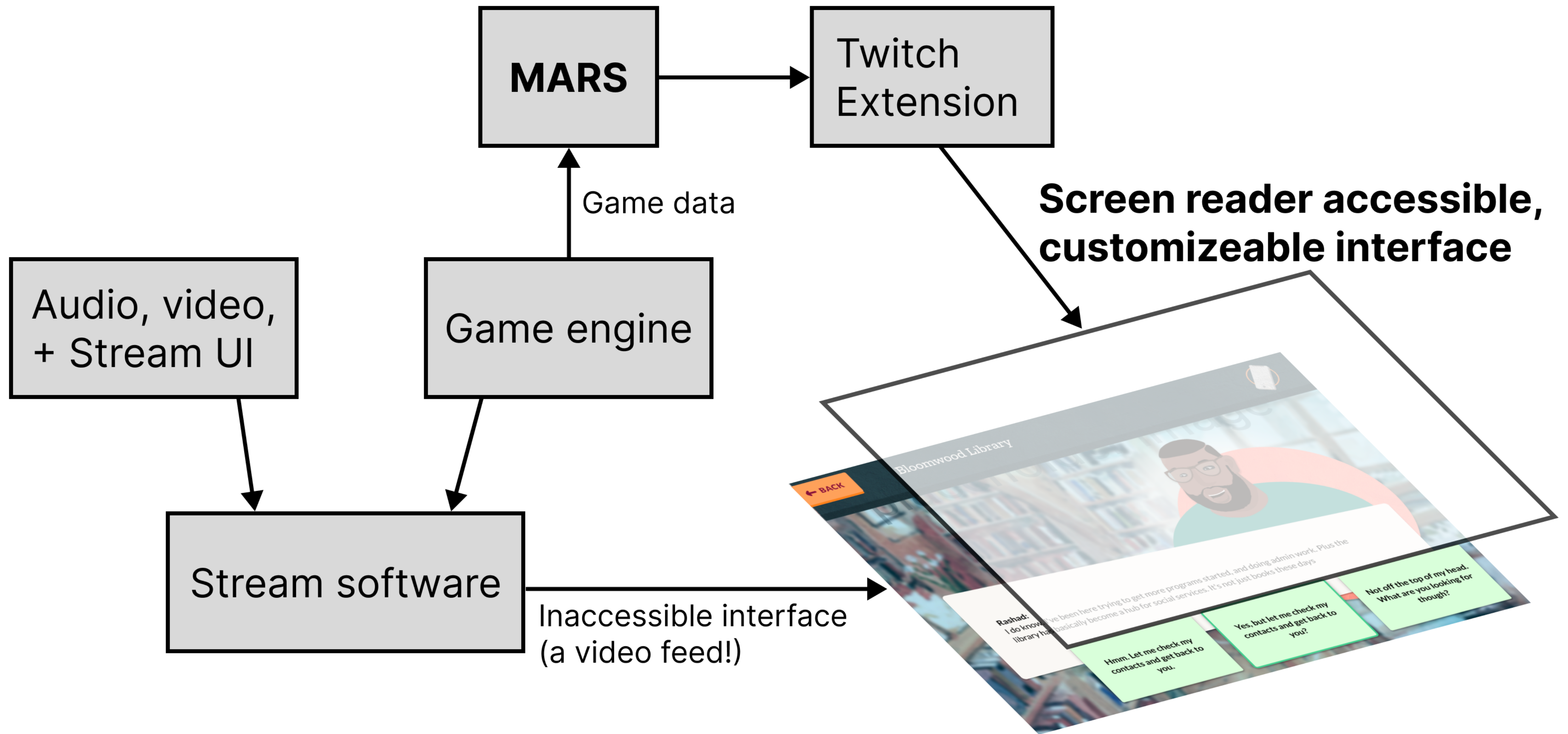
Stream software

Inaccessible interface  
(a video feed!)









# Research questions

- How do existing game-aware streaming technologies support, or fail to support, game stream viewing for blind and low vision (BLV) viewers?
- What qualities, challenges, and design opportunities do BLV viewers envision for game-aware streaming technologies?

# Research questions

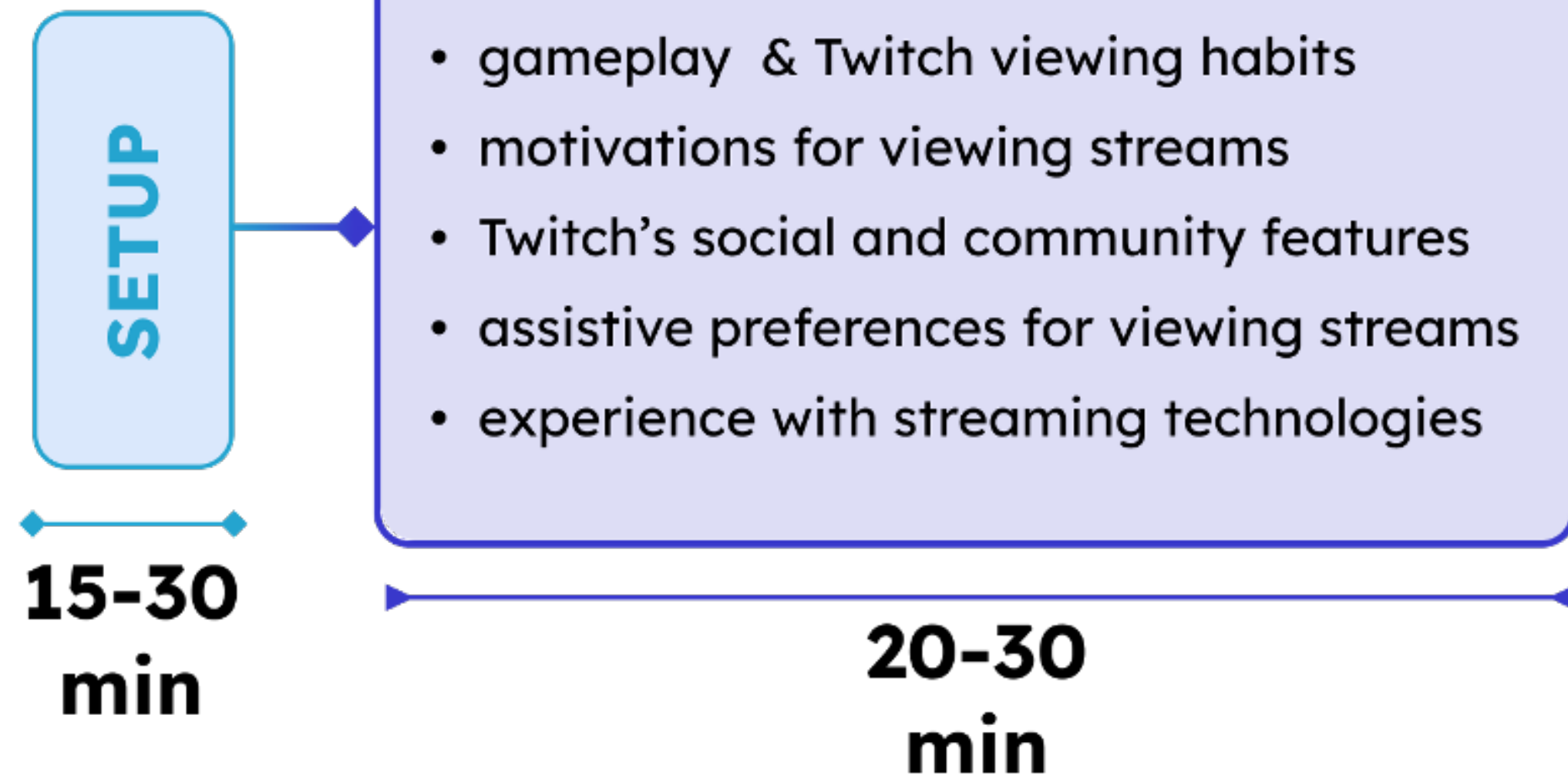
- **How do existing game-aware streaming technologies support, or fail to support, game stream viewing for blind and low vision (BLV) viewers?**
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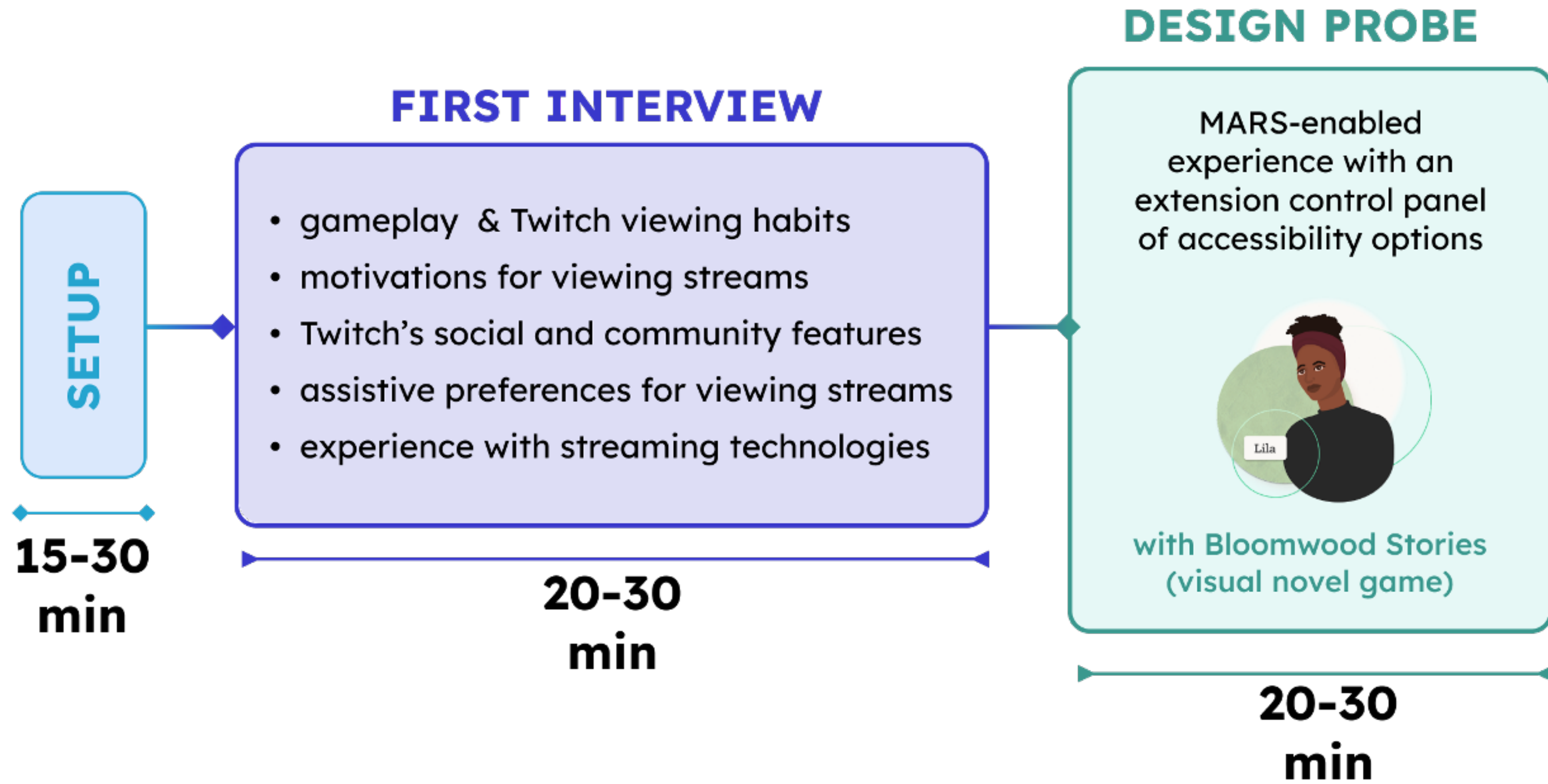
# Research questions

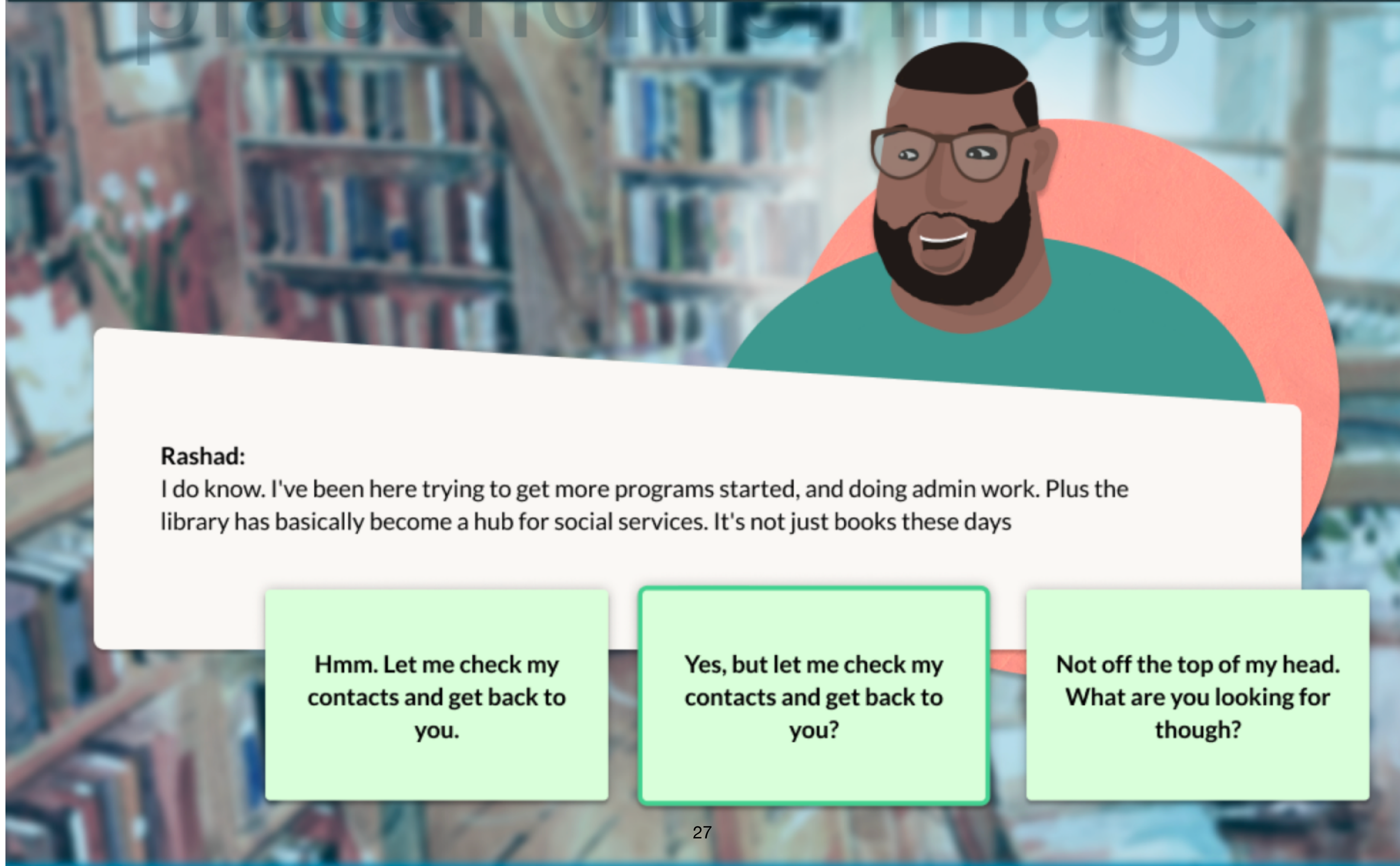
- How do existing game-aware streaming technologies support, or fail to support, game stream viewing for blind and low vision (BLV) viewers?
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## FIRST INTERVIEW







**Rashad:**

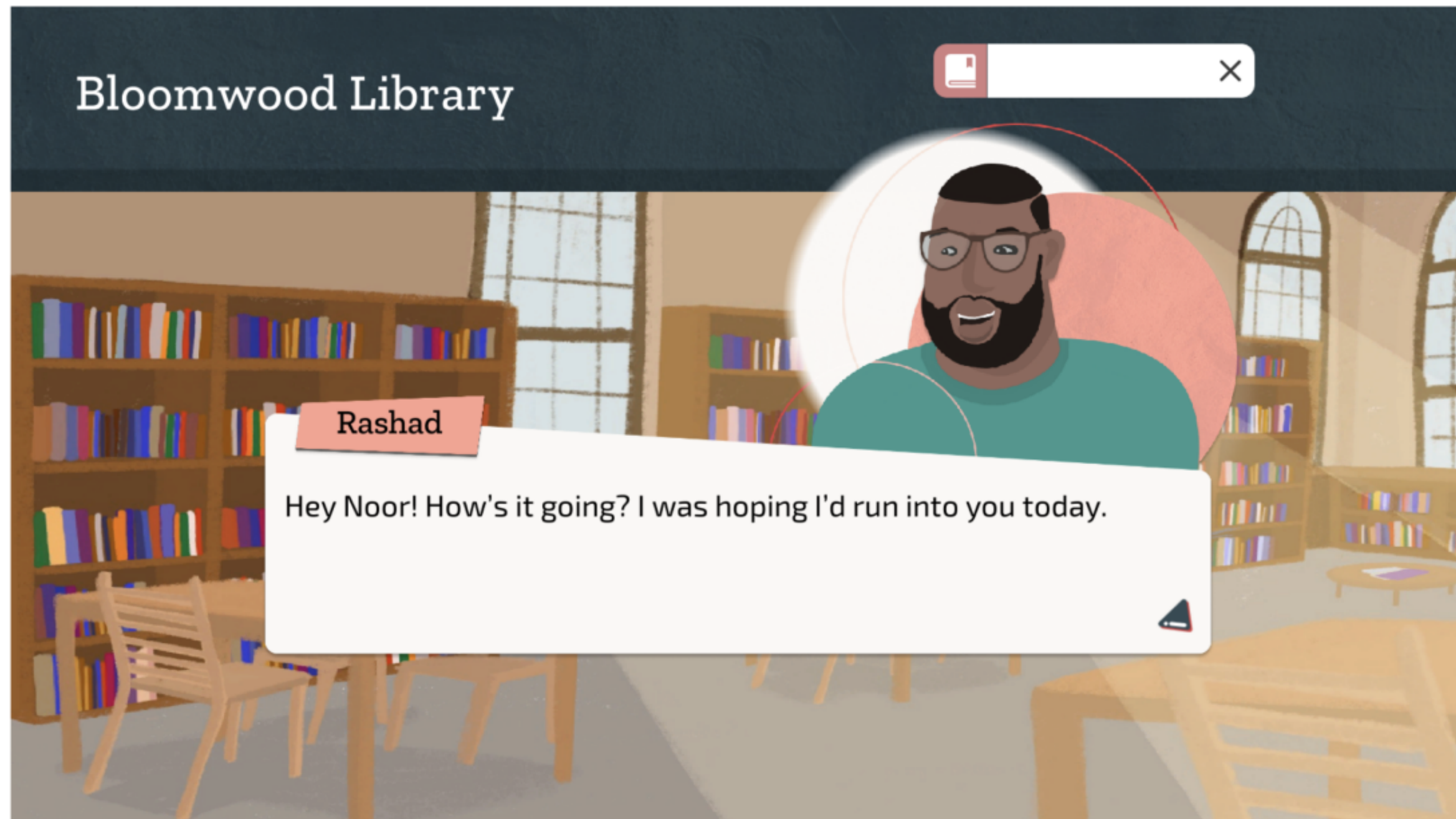
I do know. I've been here trying to get more programs started, and doing admin work. Plus the library has basically become a hub for social services. It's not just books these days

Hmm. Let me check my contacts and get back to you.

Yes, but let me check my contacts and get back to you?

Not off the top of my head. What are you looking for though?

# Our prototype and design probe



Gamer interface, to gamer

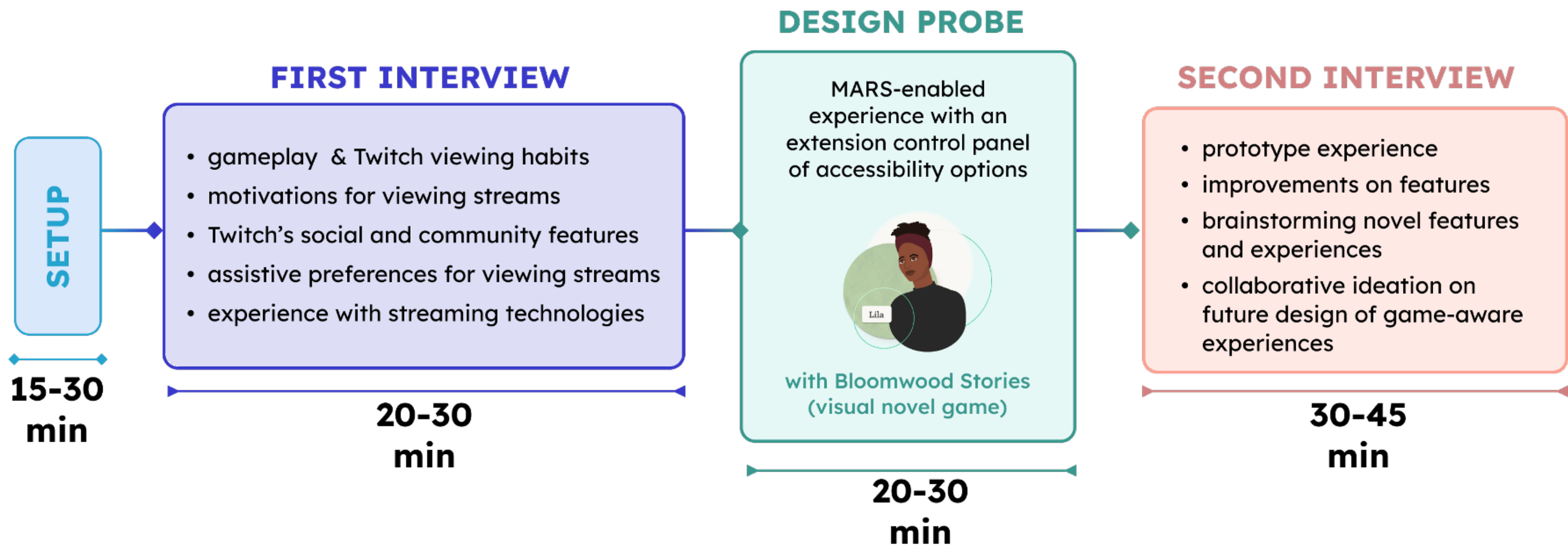


Stream interface, to viewers

# Enabled by accessible HTML, under the hood

```
1 <h2>Dialogue Navigation</h2>
2   <div id="dialogue-browsing-buttons">
3     <button id="previous-dialogue-button" aria-label="Previous dialogue">&#x25C0;</button>
4     <button id="next-dialogue-button" aria-label="Next dialogue">&#x25B6;</button></div>
5   </div>
6   <div>
7     <label>
8       <input id="keyboard" type="checkbox" name="dialog" value="keyboard">Enable Keyboard Nav Shortcuts
9     </label>
10  </div>
11  <h2>Accessibility Options</h2>
12  <button id="increase-font-size-button">Font Size (+)</button>
13  <button id="decrease-font-size-button">Font Size (-)</button>
14  <div class="dropdowns">
15    <label for="font-color-select">Font Color:</label>
16    <select id="font-color-select">
17      <option value="black">Black</option>
18      <option value="red">Red</option>
19      <option value="blue">Blue</option>
20    </select>
21  </div>
```



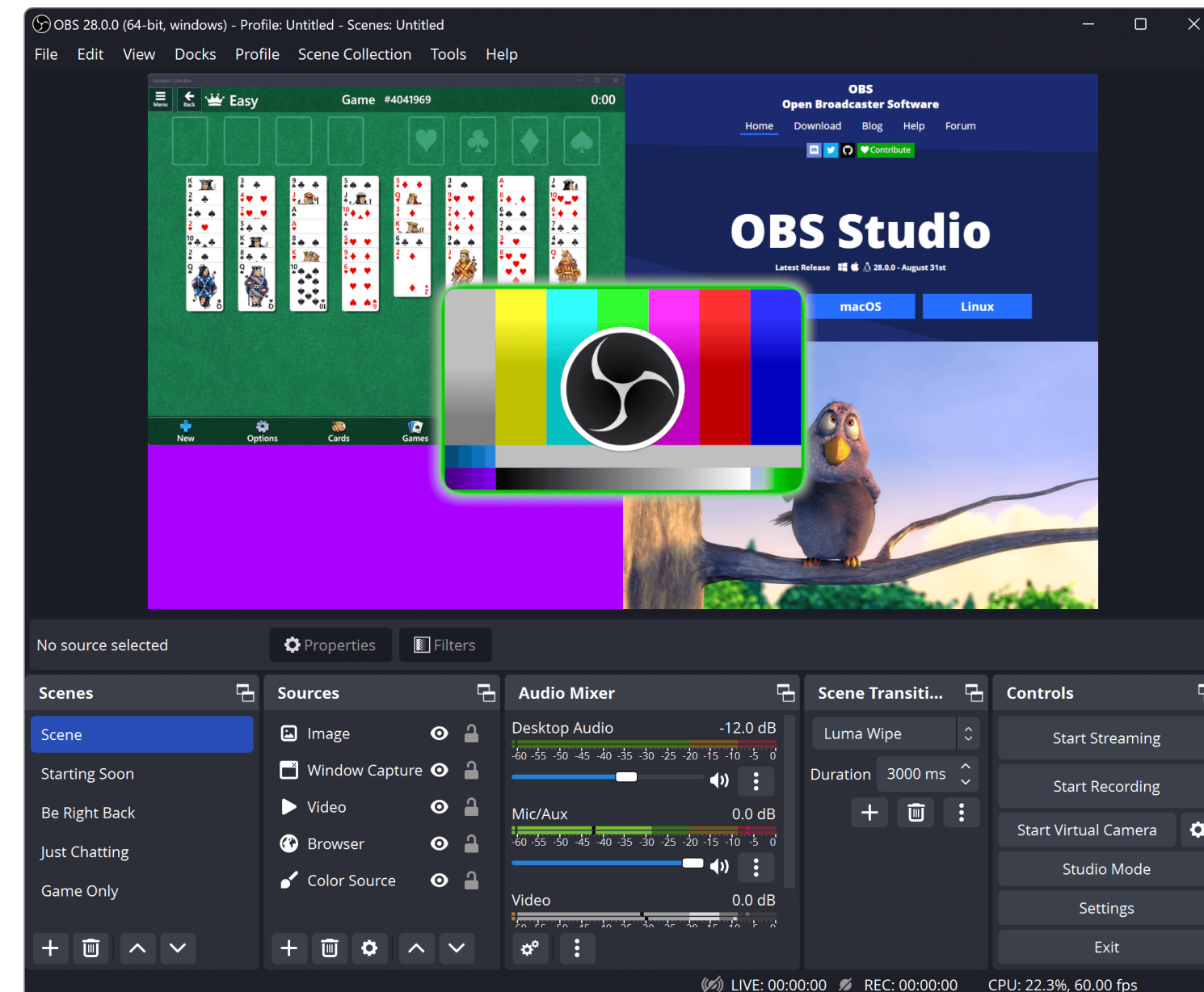
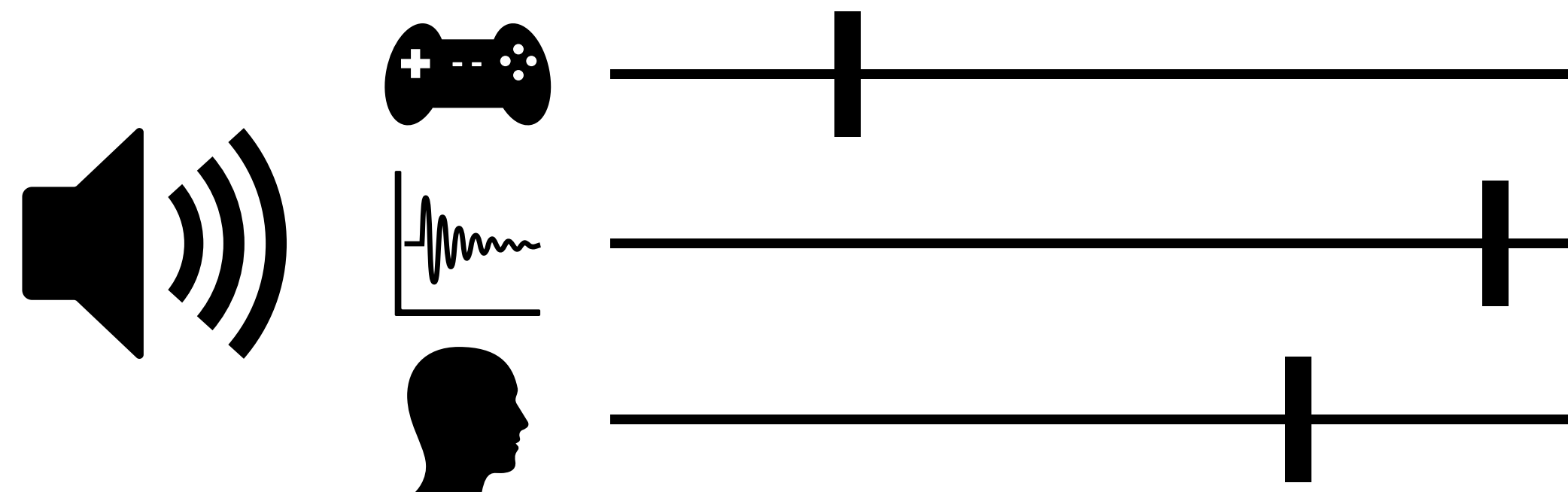


Results I think are the most awesome:  
**Dreaming of customization and imagining  
what access to game data can *enable***

# Dreaming of customization

“I’d love to have full control of stream audio”

Idea: stream viewer access to streaming software data



<https://obsproject.com/>



# Dreaming of customization

Idea: Cross-ecosystem preset and preferences transfer



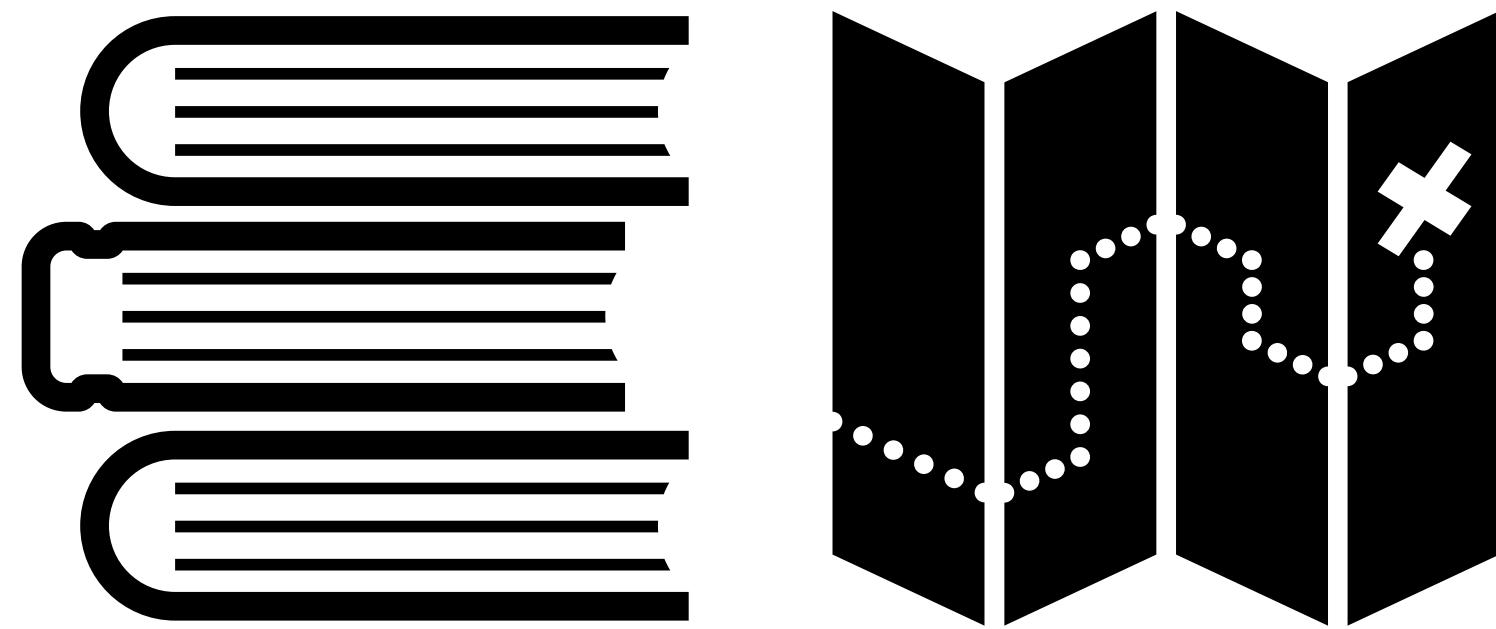
## Apply vision accessibility preset

Configures all the recommended settings designed for players who are blind or have low vision. This will enable settings across multiple menus, such as:

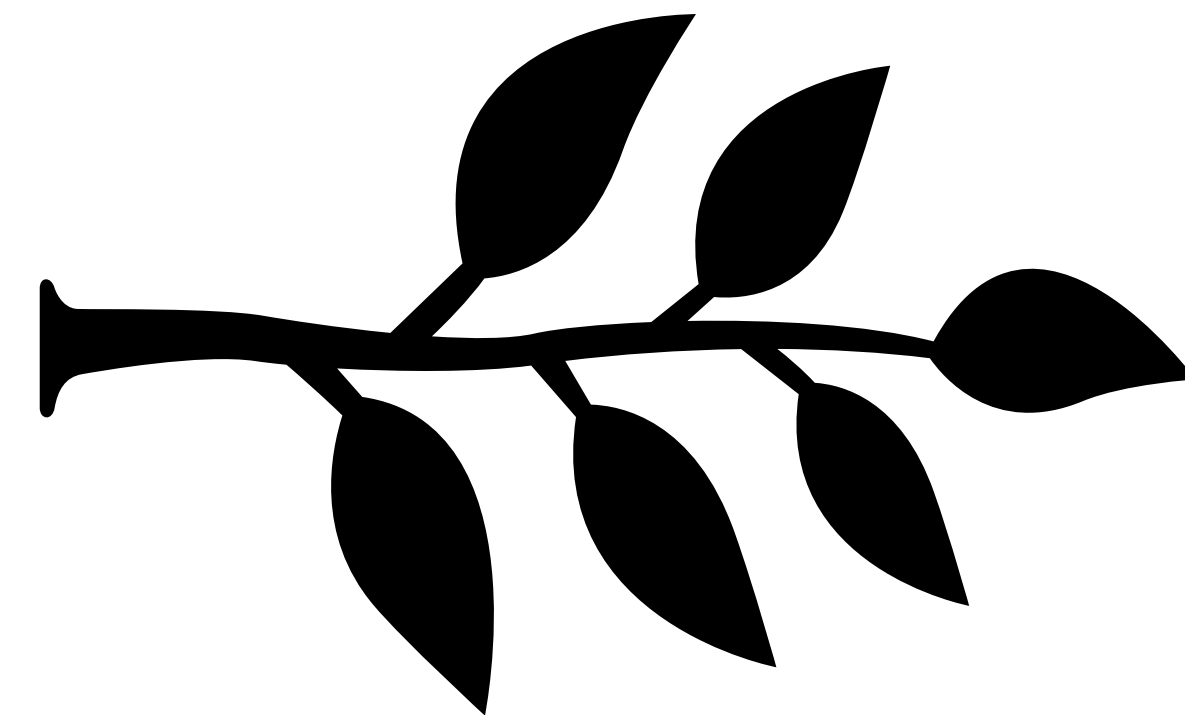
- **Options:** On or Off
- Text-to-Speech
- High Contrast Display
- HUD Scale > Large
- Lock-On Aim > Auto-Target
- Traversal and Combat Audio Cues
- Navigation and Traversal Assistance
- Ledge Guard
- Enhanced Listen Mode
- Invisible While Prone > Unlimited
- Skip Puzzle Option
- Various adjustments in the **Combat Accessibility** menu

What if presets and preferences from games could be easily loaded in streams or even into other games?

# Imagining what access to game data can *enable*



Explore a game's menus, world,  
and interface



Discover different, possible paths

# Imagining what access to game data can *enable*

Exploratory sense-making:  
“I would love to explore on my own.”



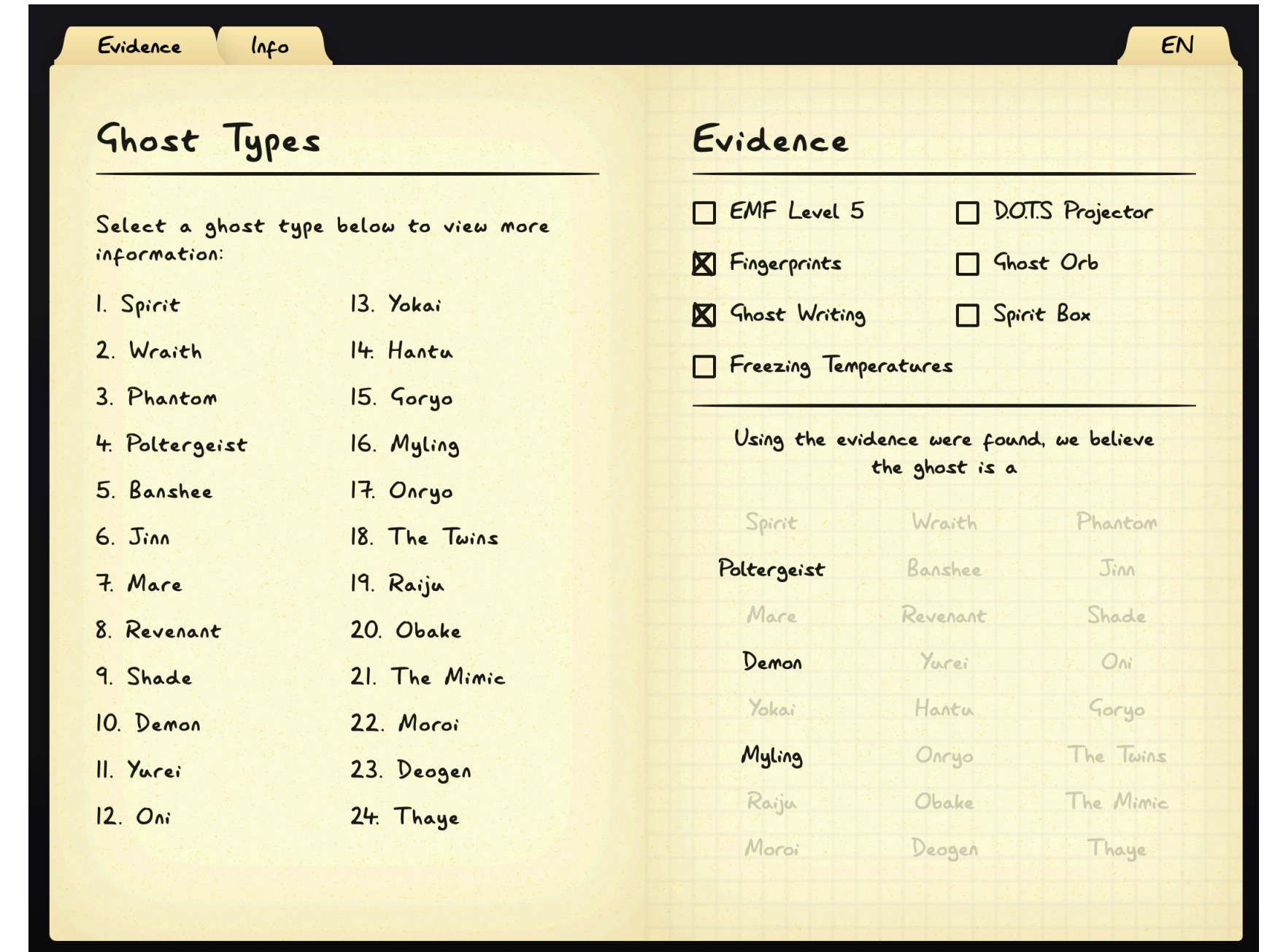
<https://hearthstoneaccess.github.io/>

# Imagining what access to game data can *enable*

Idea: Asymmetrical collaboration, using game data access



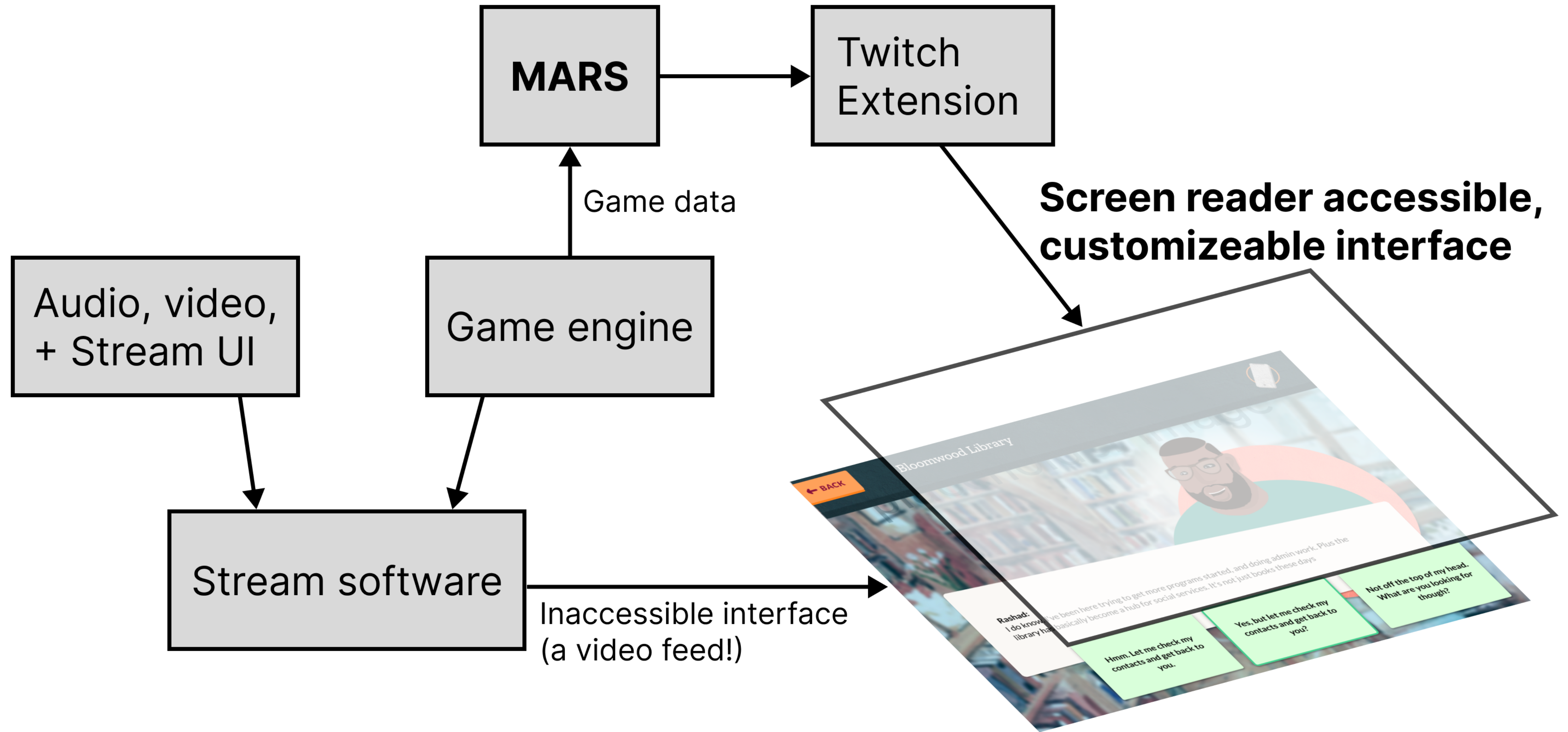
Streamer is inside a haunted school



Stream viewer has access to the evidence journal

<https://phasmophobia.vercel.app/>

# Paving the Way for Accessible Streaming



# Game-Aware Streaming as a New Frontier for Accessibility

## A call for action!

- What kinds of prototypes and new systems can we imagine? What problems could this technology solve?
- What if we took every accessibility feature of a game and made those same options available to stream viewers?
- What can we do with game data to enable new kinds of interactivity between streamers and viewers?
- Could game aware technology change how we imagine designing new games?

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