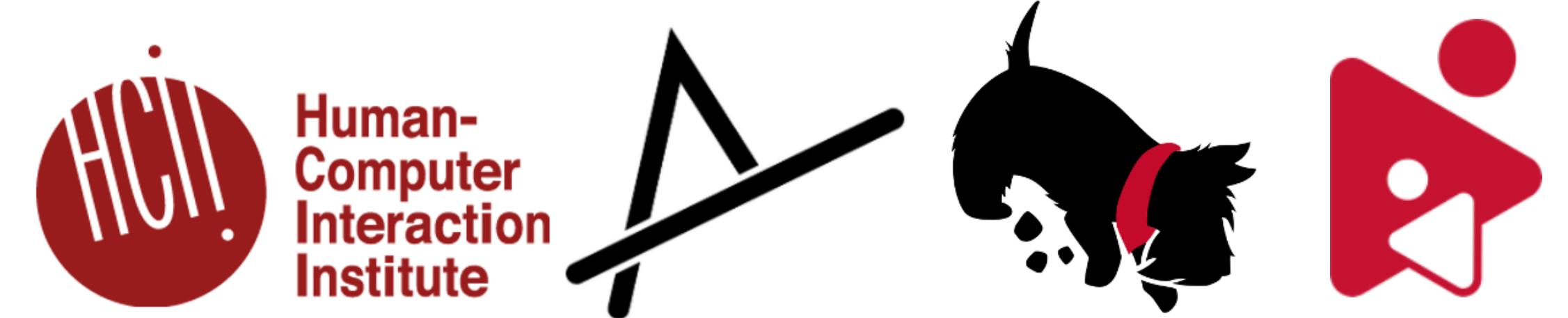


Exploring The Affordances of Game-Aware Streaming to Support Blind and Low Vision Viewers: A Design Probe Study

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, axle-lab.com, dig.cmu.edu, 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?

LOCAL TIME
00:32 PDT

Beledar's Shadow in 2h 58m 28s (03:00 Local Time)

Queen Anserek 1% 21366 K

PASSIONW

15,912 32,980

coincbase WORLD FIRST PULL

Queensurek

QUEEN ANSUREK

LIQUID

1ST WORLD 1ST REGION

SECRET LAB

HONDA RAID PROGRESS

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

MYTHIC QUEEN ANSUREK 29

Watch Full Video Edit Share

19 days ago

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

What about game streaming accessibility?

The image shows a composite of three panels. On the left is a sidebar with user icons and a video player showing a streamer. In the center is a game screenshot from World of Warcraft: Shadowlands, specifically the Queen Anserek raid. A large text overlay "Pick up Essence (3.0)" is overlaid on the game. On the right is a chat log from a video platform.

Left Panel (Streamer Interface):

- Top: RWF logo, LOCAL TIME 00:32 PDT, Coinbase logo.
- Middle: Large image of Queen Anserek.
- Bottom: LIQUID 1ST WORLD, 1ST REGION, SECRET LAB, HONDA RAID PROGRESS (1 PULLS, 1 PULLS, 1 PULLS, 120 PULLS, 304 PULLS, 171 PULLS, 403 PULLS).
- Bottom Left: "19 days ago".
- Bottom Right: Watch Full Video, Edit, Share, More options.

Center Panel (Game Screenshot):

Queen Anserek Raid progress:

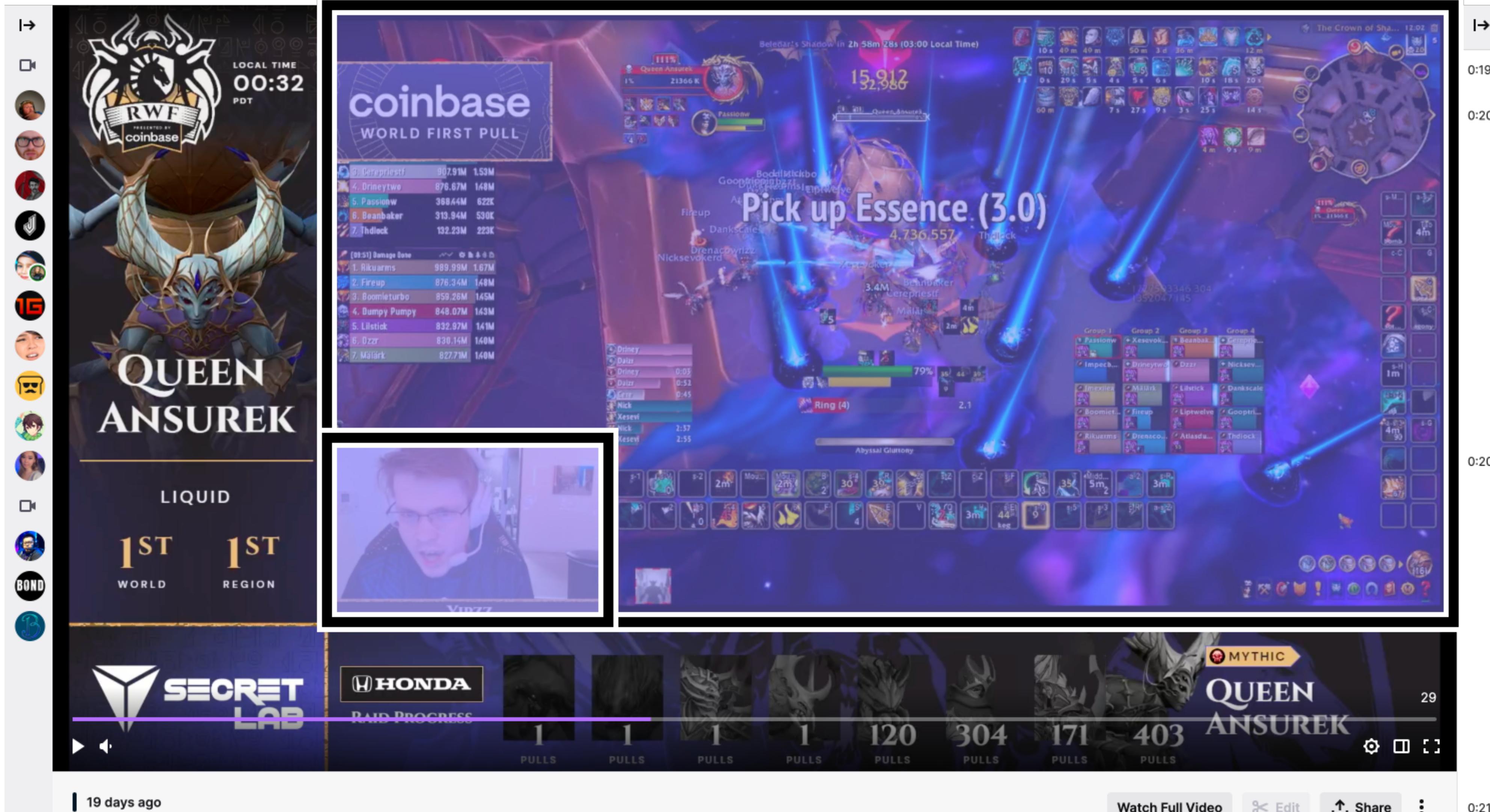
Rank	Name	Damage Done	M	H
1.	Derepriest	907.91M	1.53M	
2.	Drineytwo	876.67M	1.48M	
3.	Passionw	368.44M	622K	
4.	Beanbaker	313.84M	530K	
5.	Thdlock	132.23M	223K	
6.	[08:31] Damage Done			
7.	Rikuarms	989.99M	1.67M	
8.	Fireup	876.34M	1.48M	
9.	3. Boomieturbo	859.28M	145M	
10.	Dumpy Pumpy	848.07M	143M	
11.	Lilstick	832.97M	141M	
12.	Dzzr	830.14M	140M	
13.	Määrk	827.71M	140M	

Abilities and UI elements include: Belegar's Shadow in 2h 58m 28s (03:00 Local Time), The Crown of Sha... 12:02, PASSIONW, FIREUP, DANKSCALE, DRENAZYRIZZ, NICKSEVOKERD, BEANBAKER, CEREPRIEST, MÄÄRK, IMPECH..., DRINEYTWO, DZZR, NICKSEV..., GROUP 1, GROUP 2, GROUP 3, GROUP 4, Abyssal Gluttony, Ring (4), 2.1, 79%, 4.736.557, 15,912, 32,980.

Right Panel (Chat Log):

- 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?



Chat on Videos

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

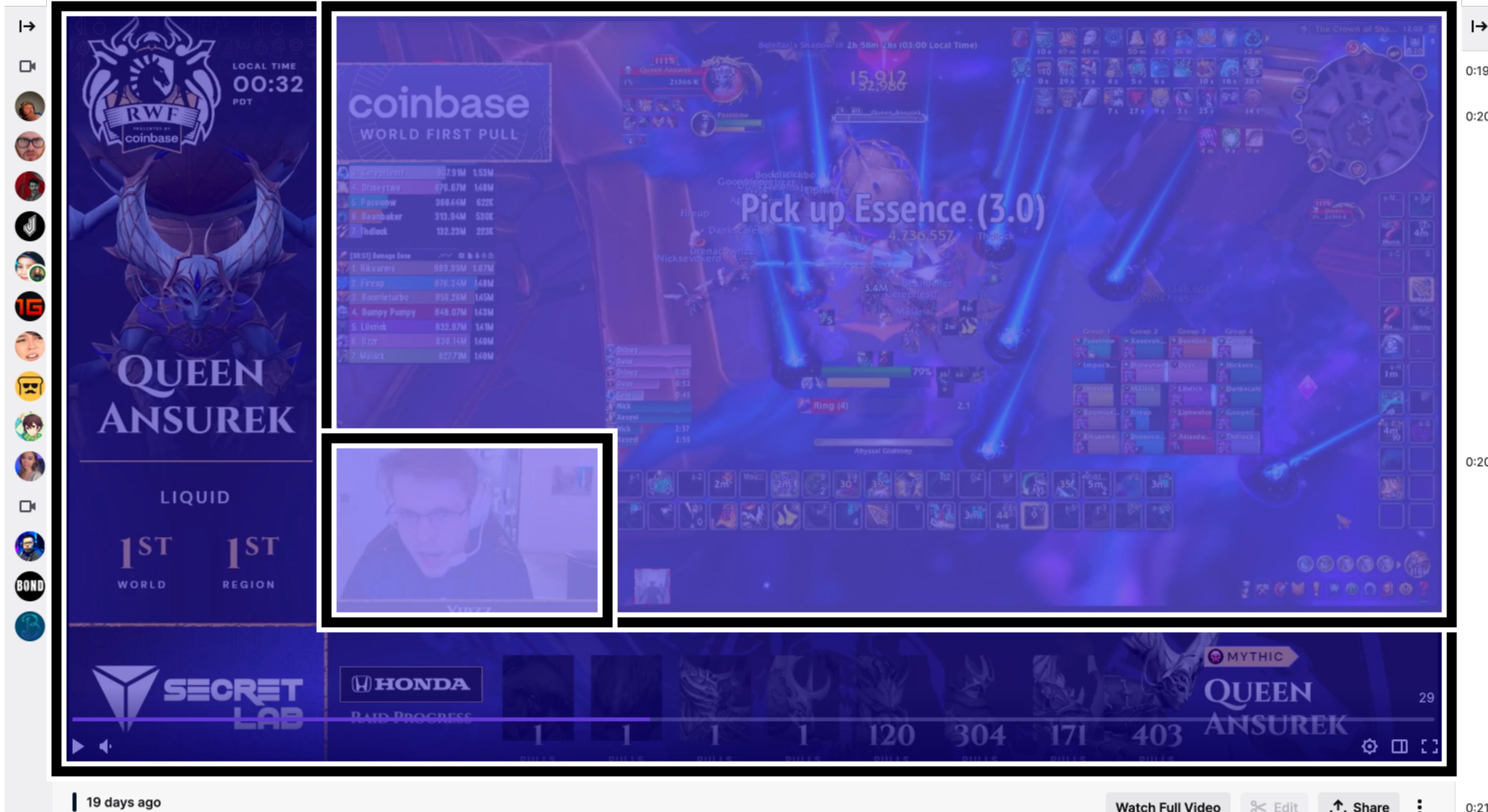
0:20 Khuzvhan: THD

THD!

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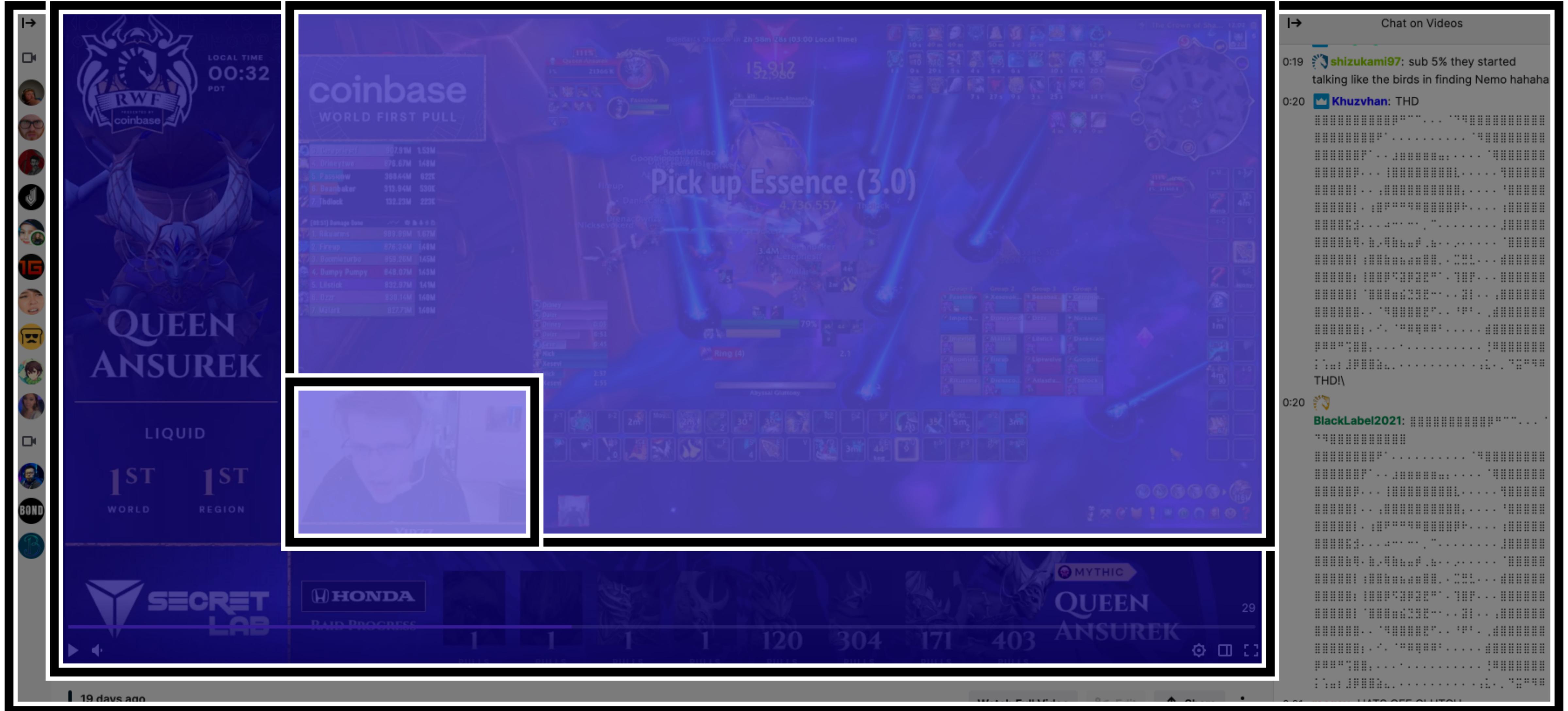
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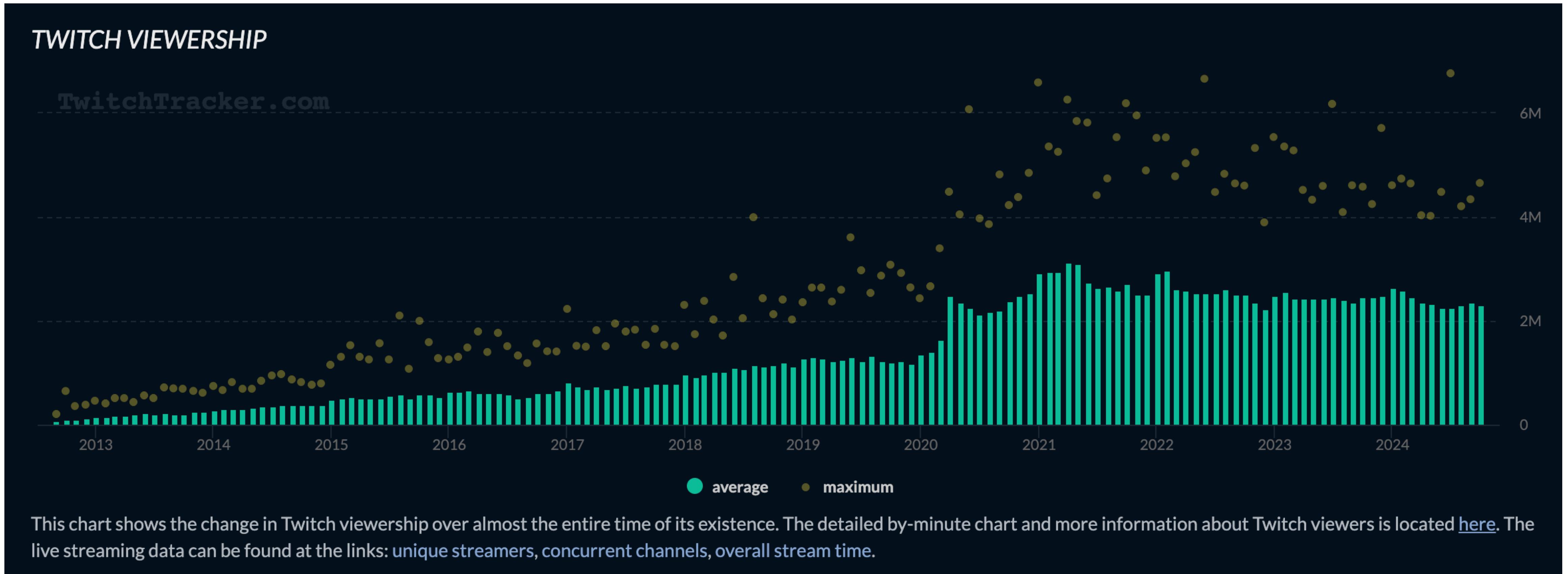
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What about game streaming accessibility?

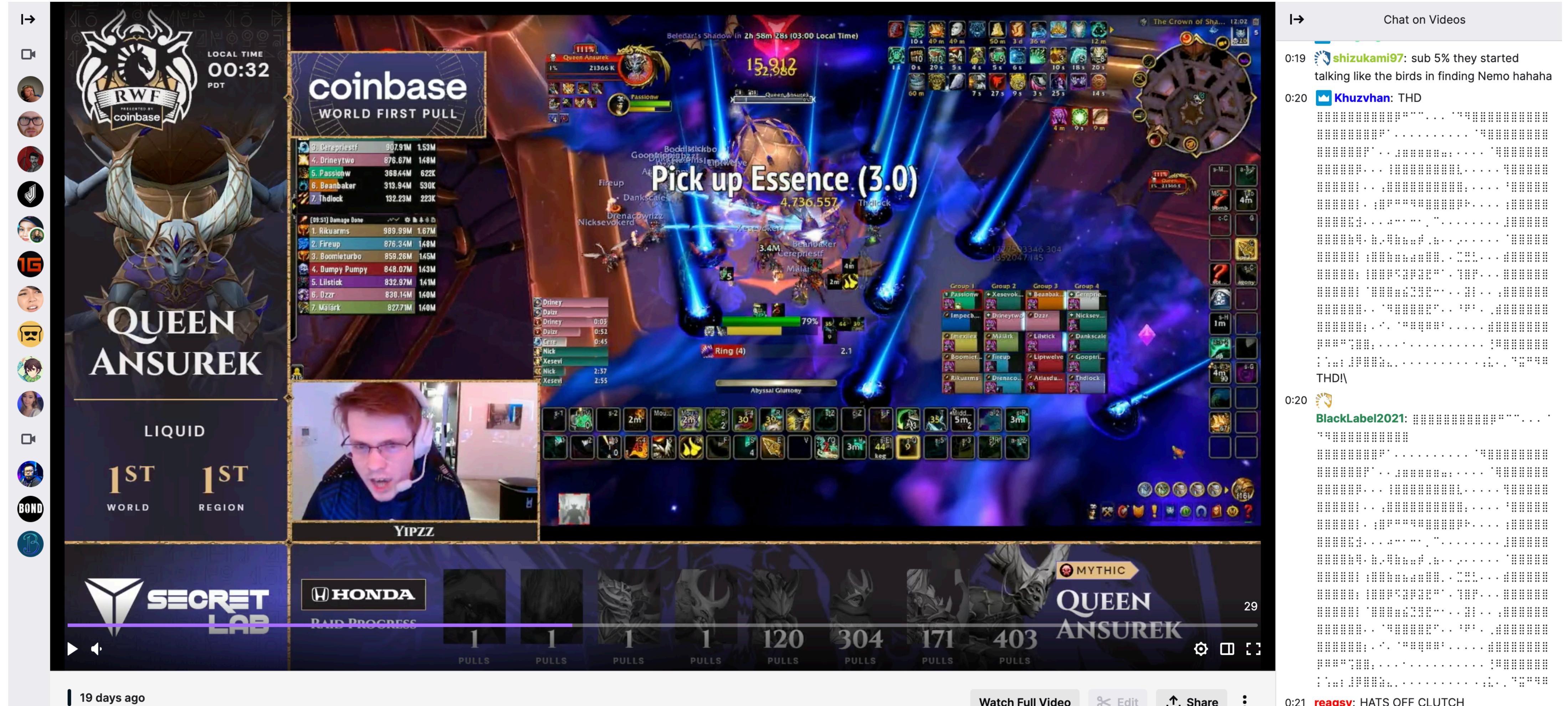


Many people watch streams



<https://twitchtracker.com/statistics>

Accessible stream descriptions are a hard problem! [1]



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

Descriptions are great, but what about sense-making?

QUEEN ANSUREK

LIQUID

1ST WORLD 1ST REGION

YIPZZ

HONDA RAID PROGRESS

PULLS PULLS PULLS PULLS PULLS PULLS PULLS

1 1 1 1 120 304 171 403

SECRET LAB

MYTHIC QUEEN ANSUREK 29

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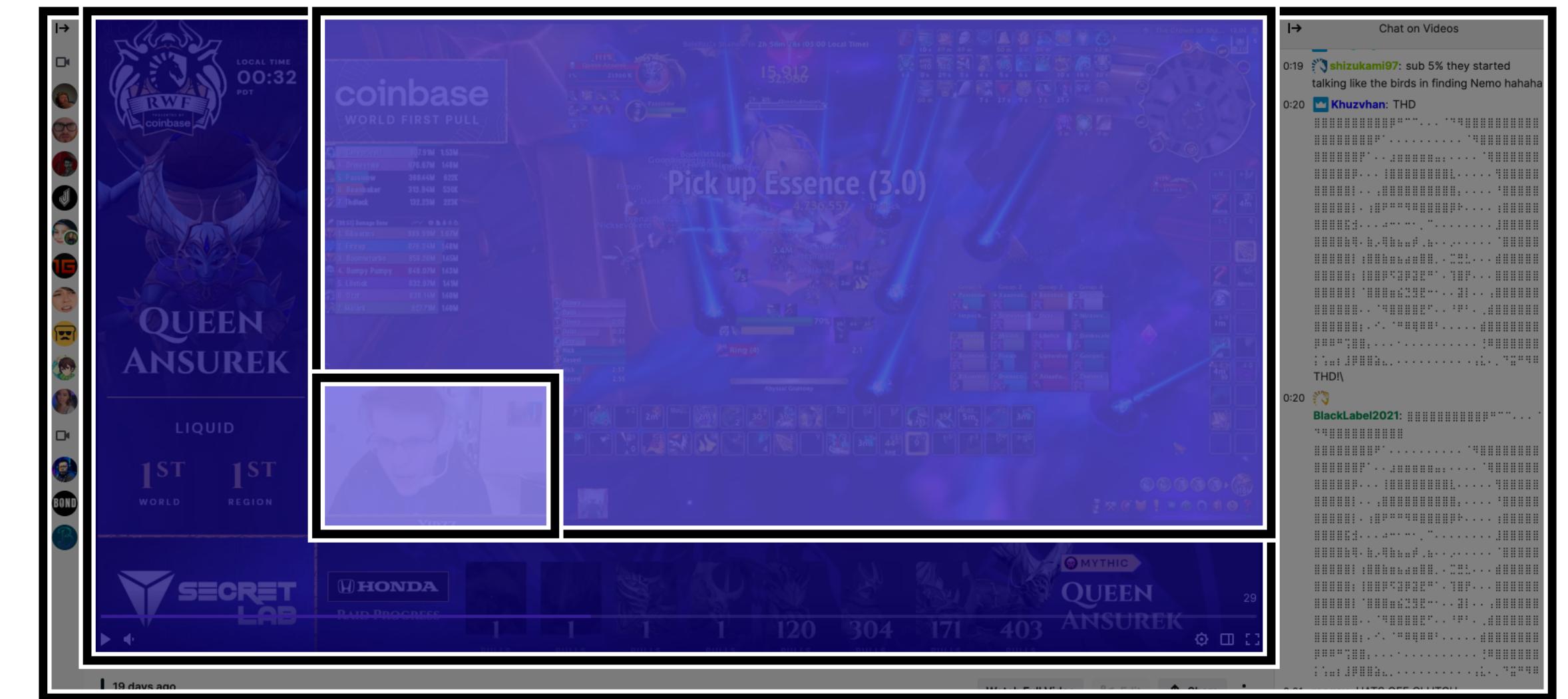
0:20 BlackLabel2021: THD

0:21 reagsy: HATS OFF CLUTCH

3 major problems

For stream accessibility

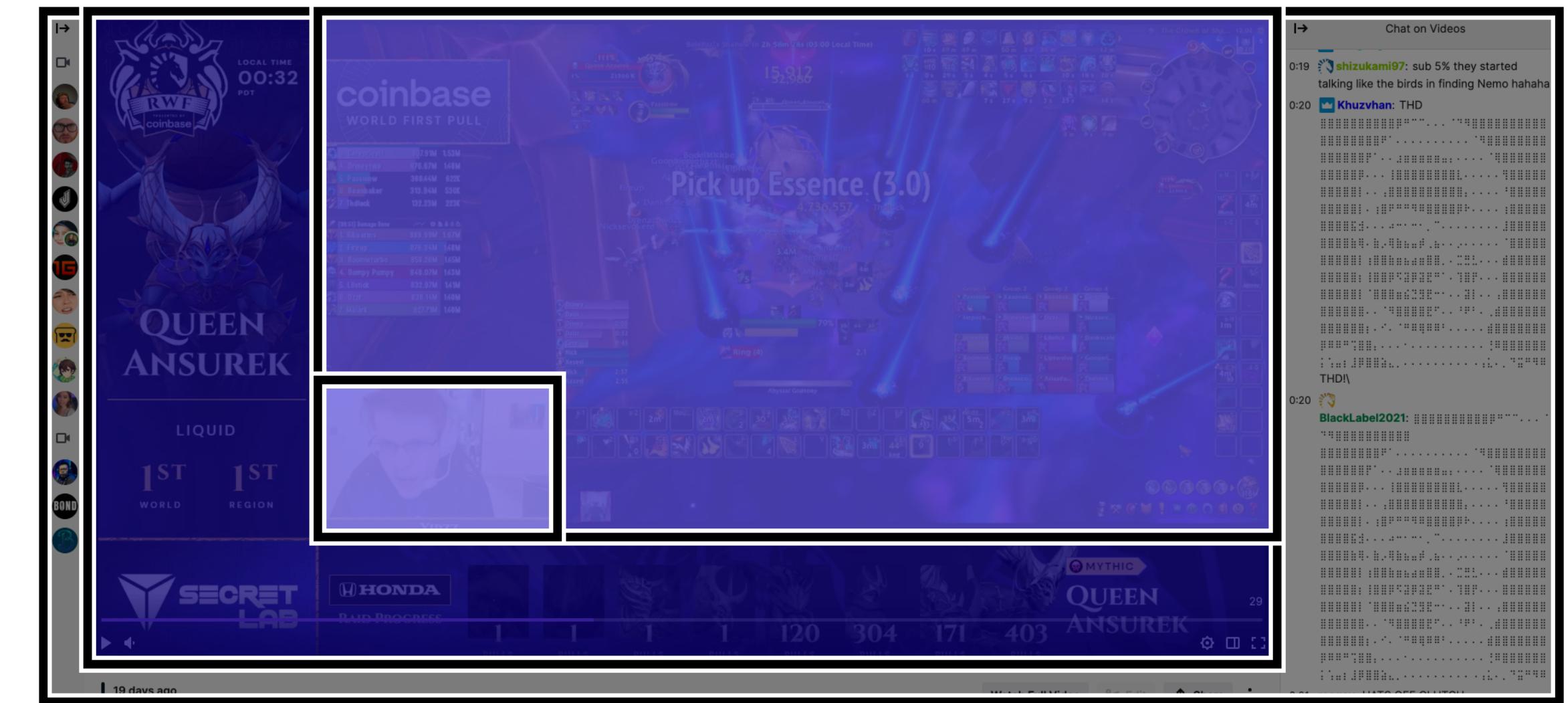
1. Existing customization and accessibility exists only for the gamer/streamer
2. Serial audio doesn't allow sensemaking/exploration of information and can become overwhelming
3. A serial video feed of an interface loses semantics and interactivity



3 major problems

For stream accessibility

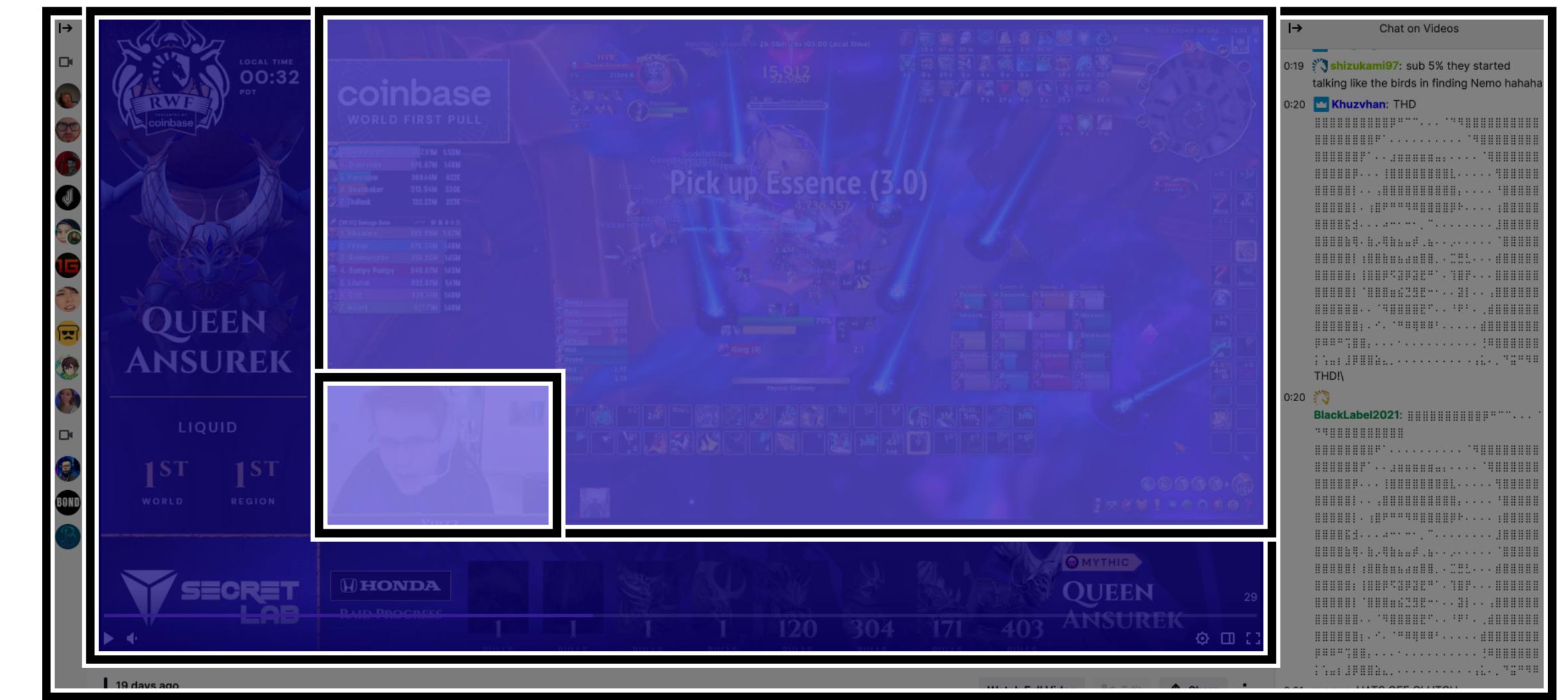
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3 major problems

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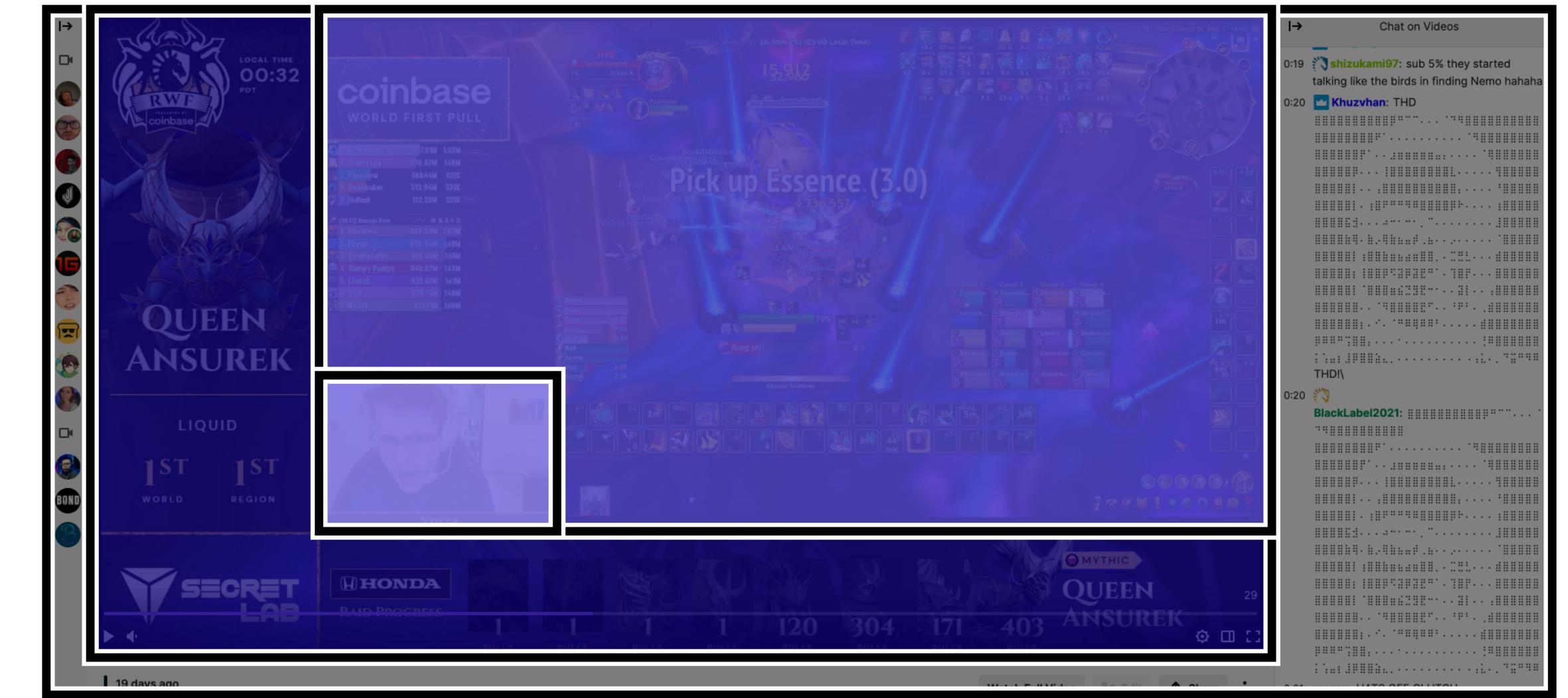
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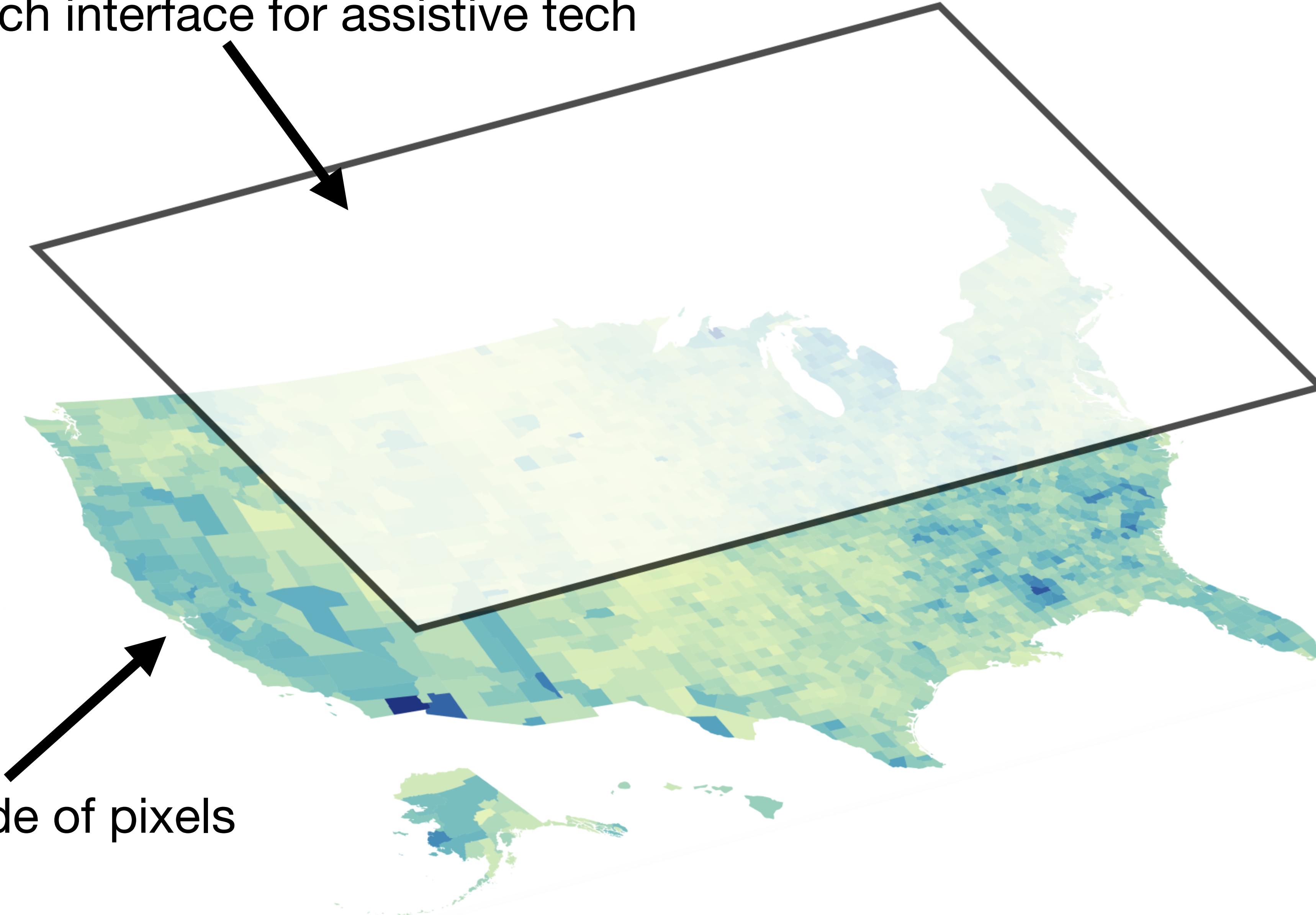
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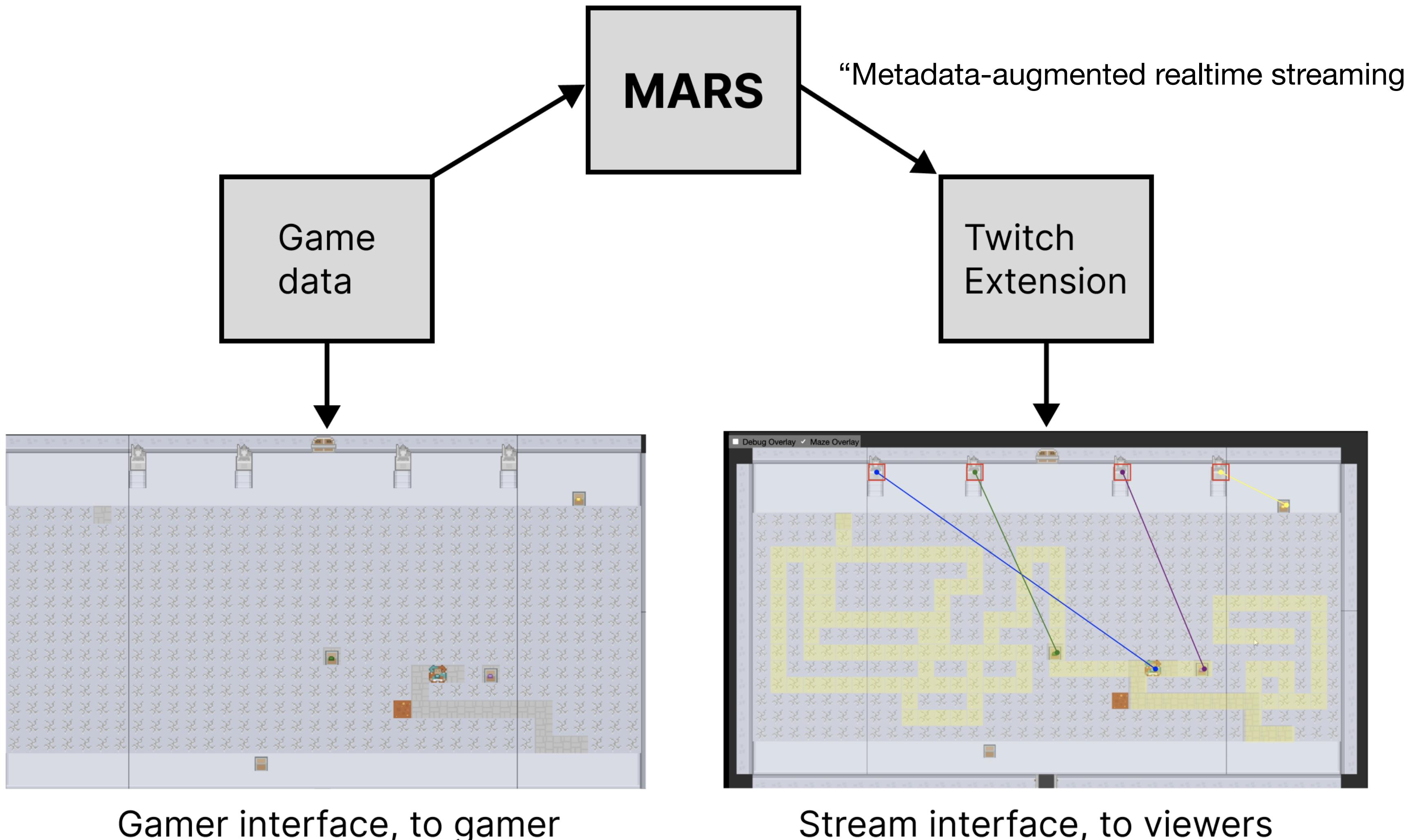
This is a rich interface for assistive tech



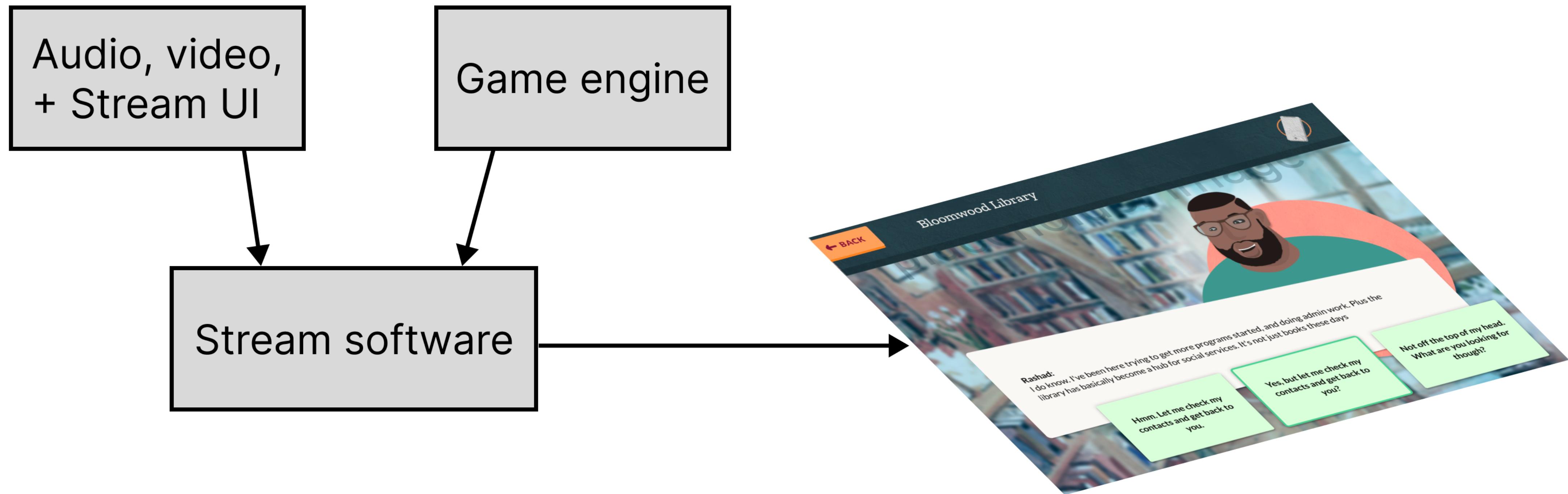
This is made of pixels

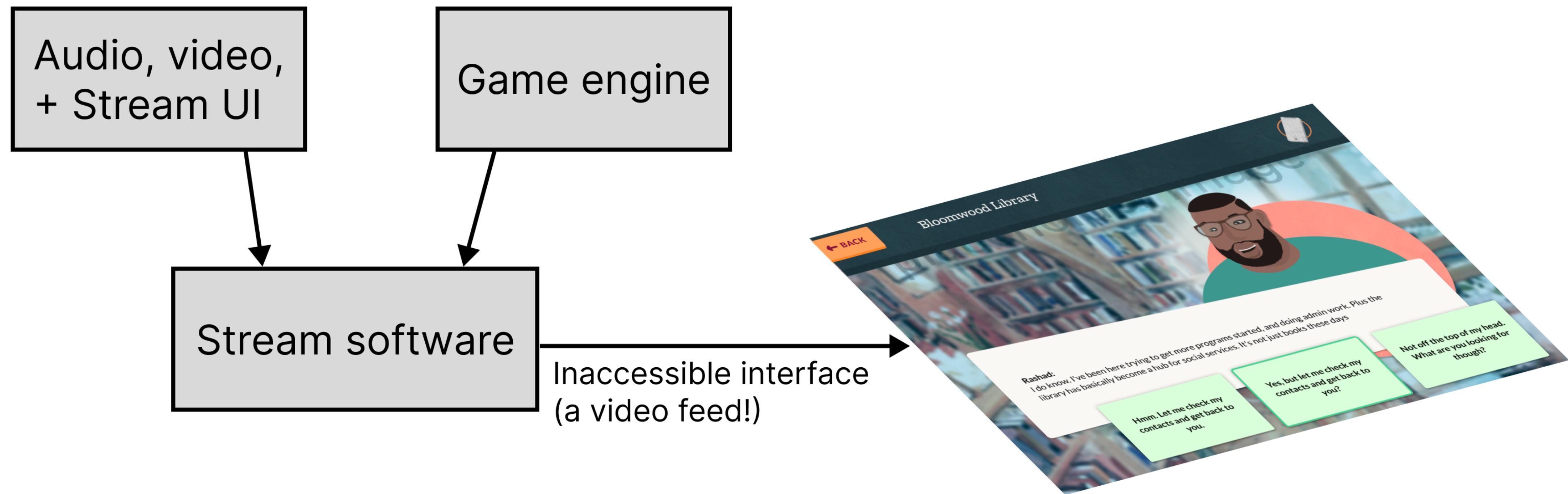
Elavsky et al, "Data Navigator" (2023)

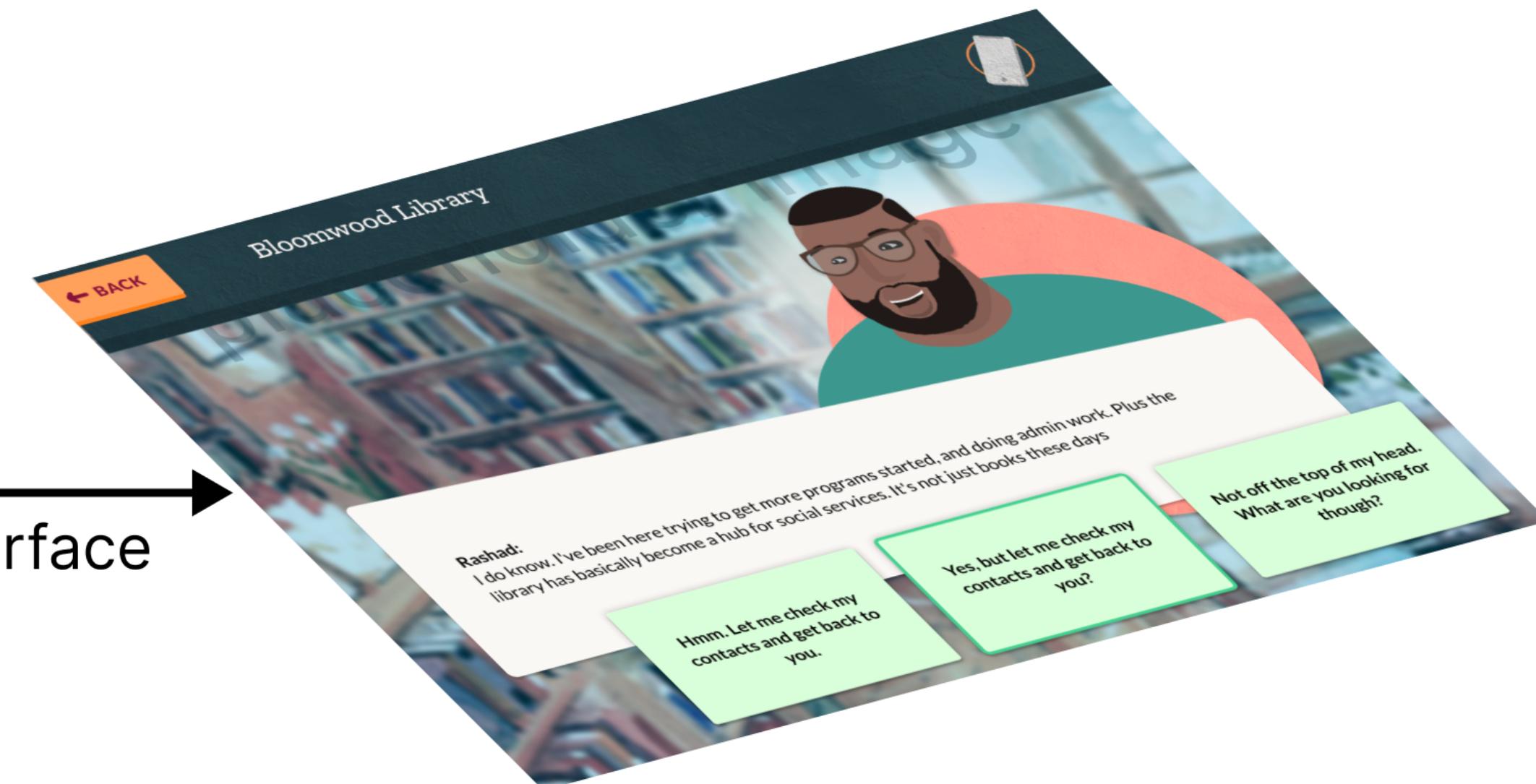
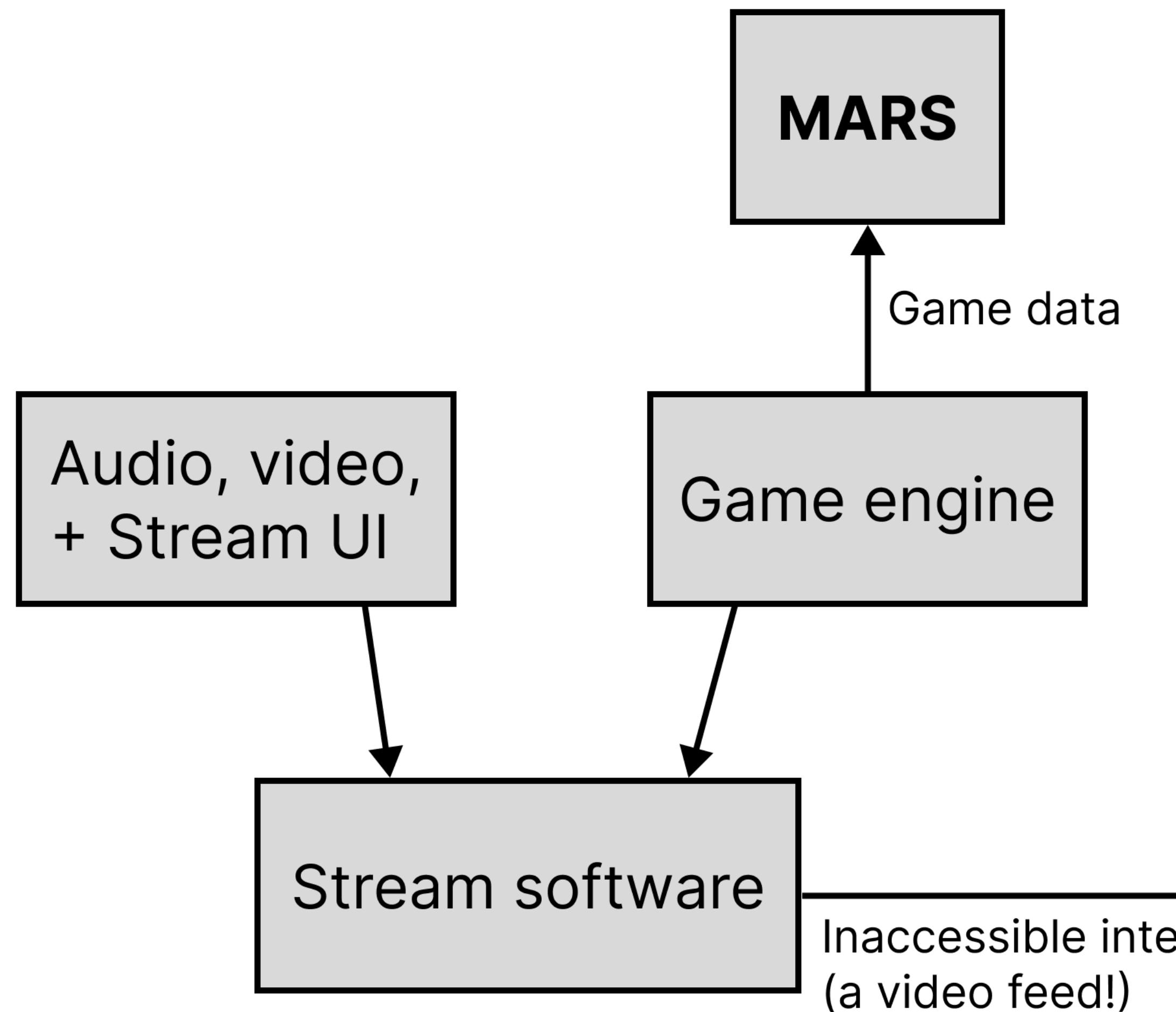
Game-aware streaming: potential?

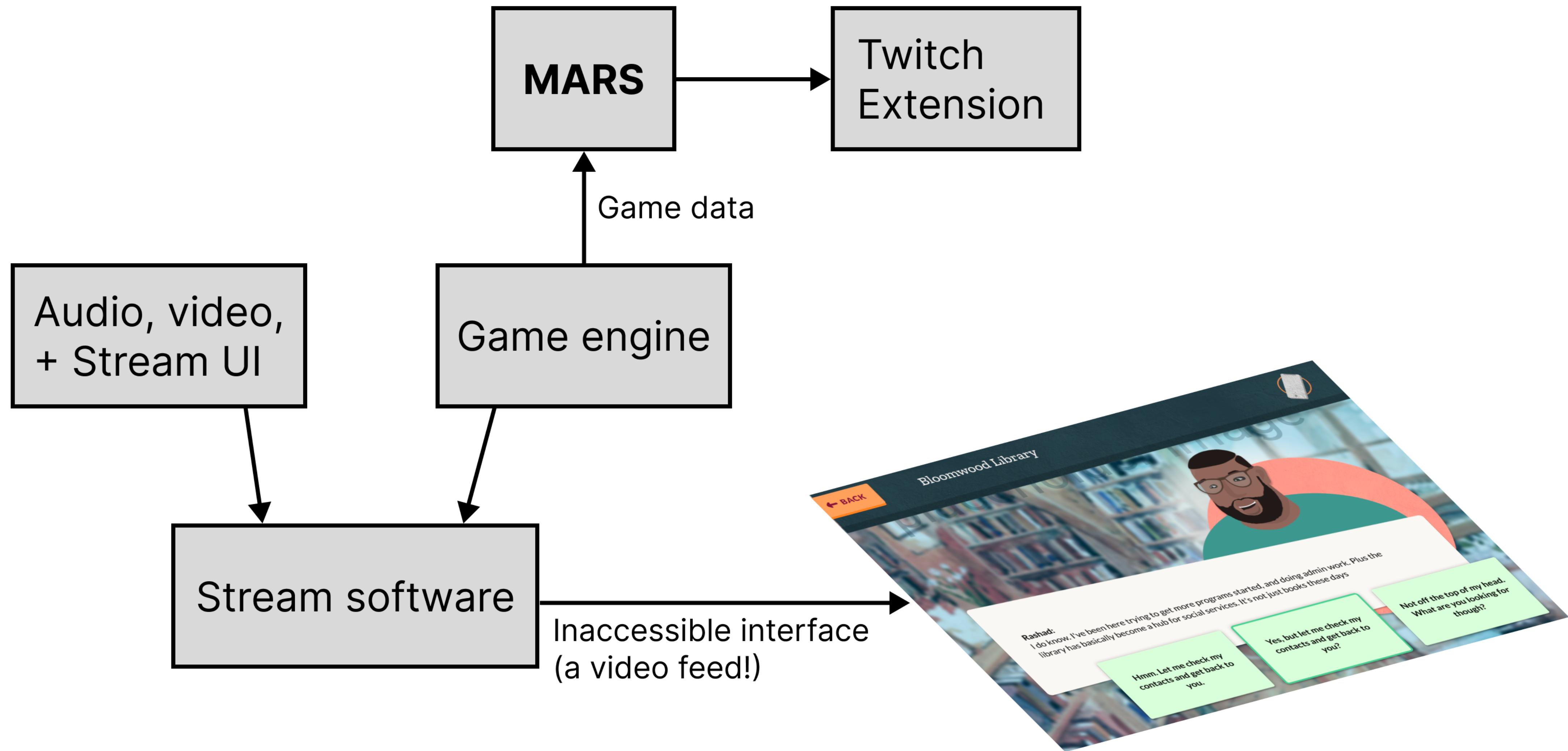


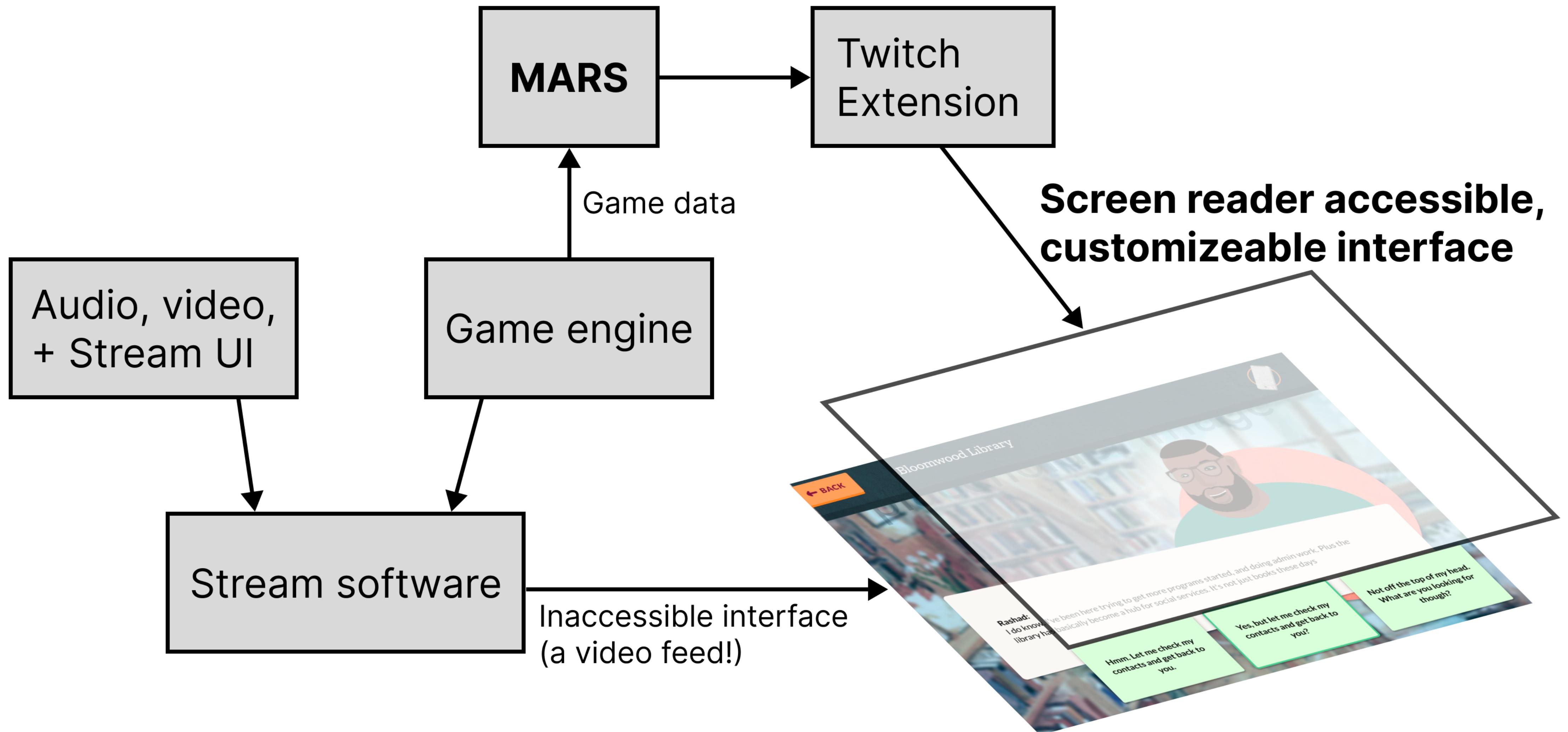
Hammad et al, “The View from MARS” (2023)











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?

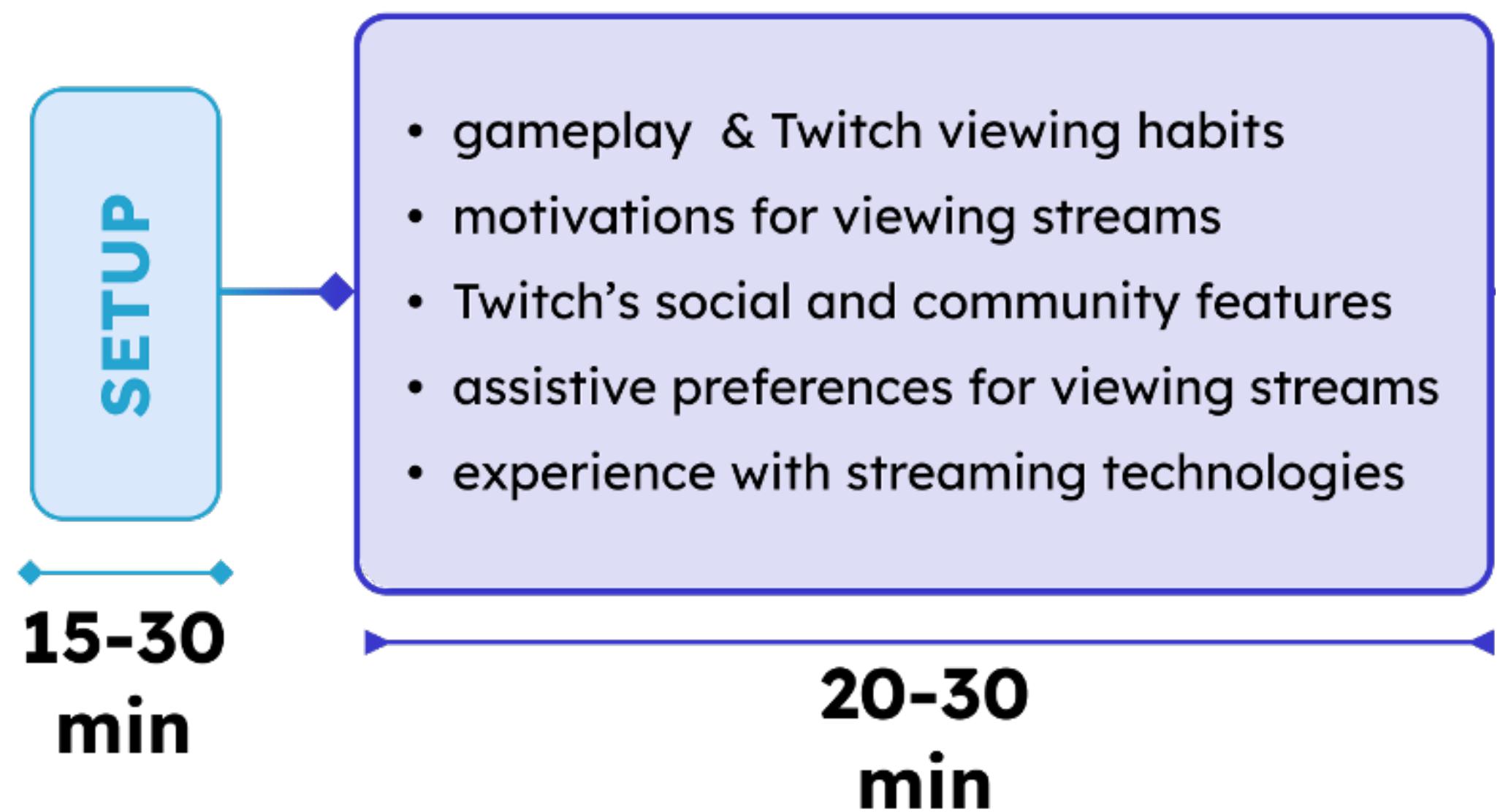
Research questions

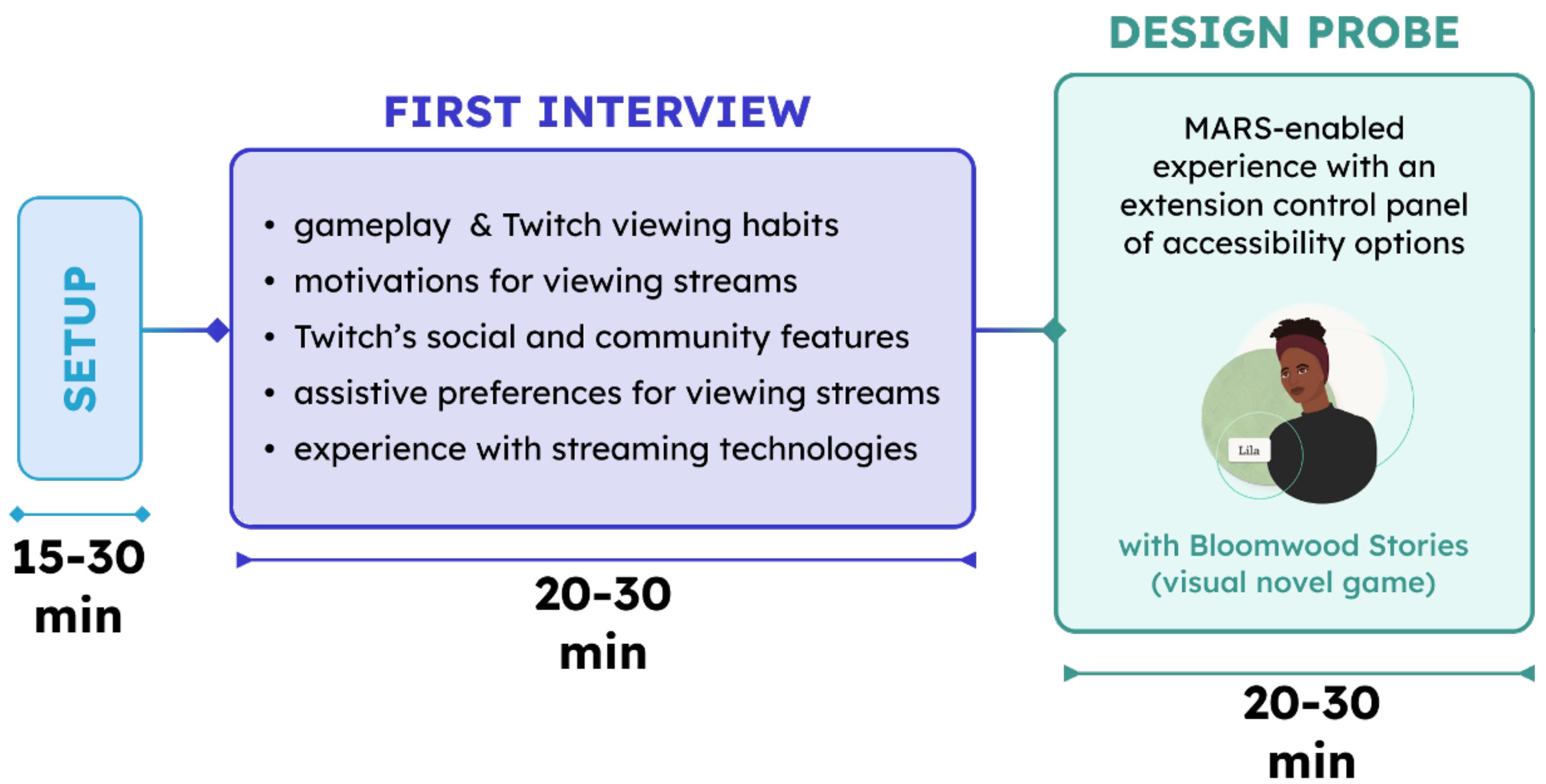
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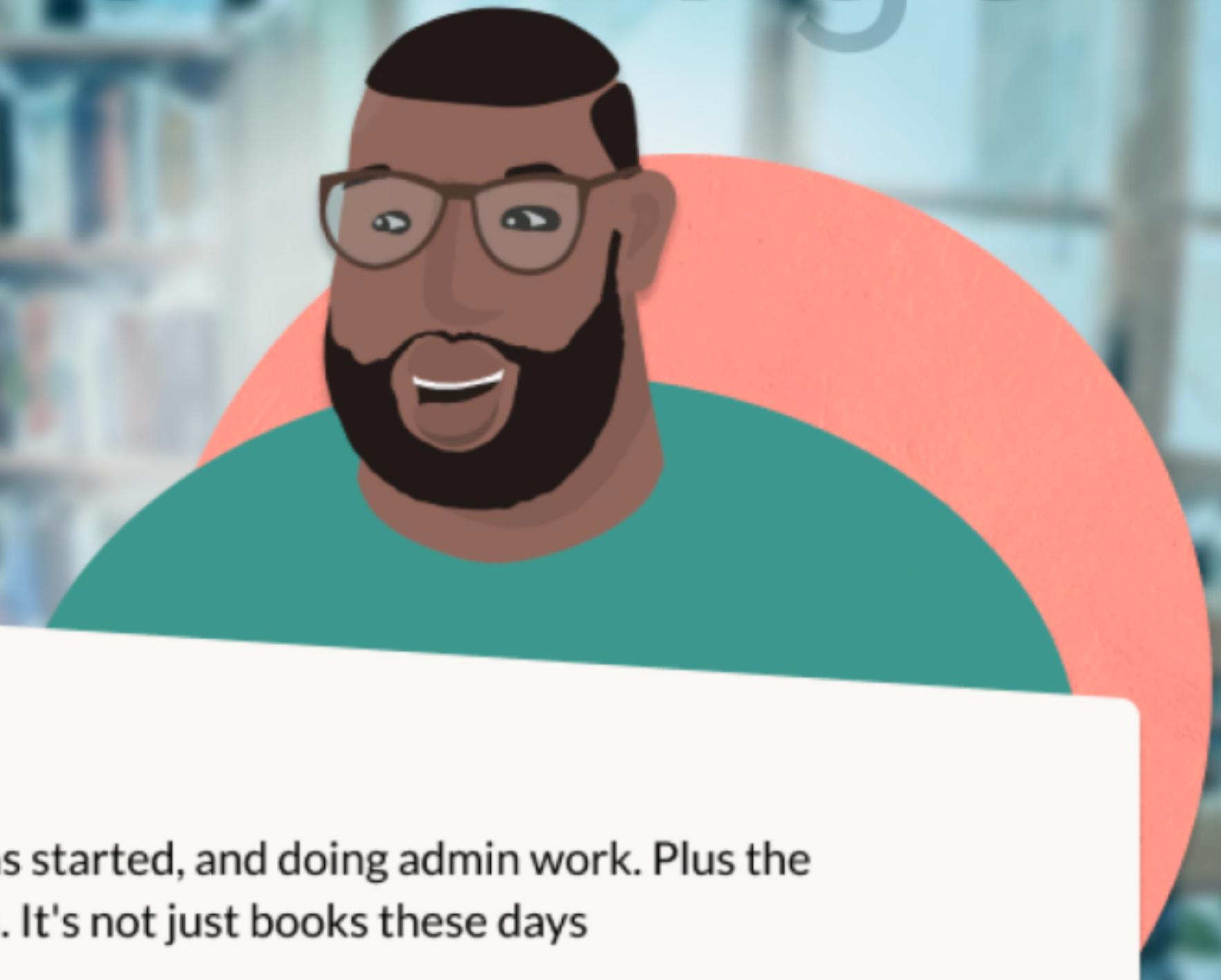
FIRST INTERVIEW





 BACK

Bloomwood Library



Rashad:

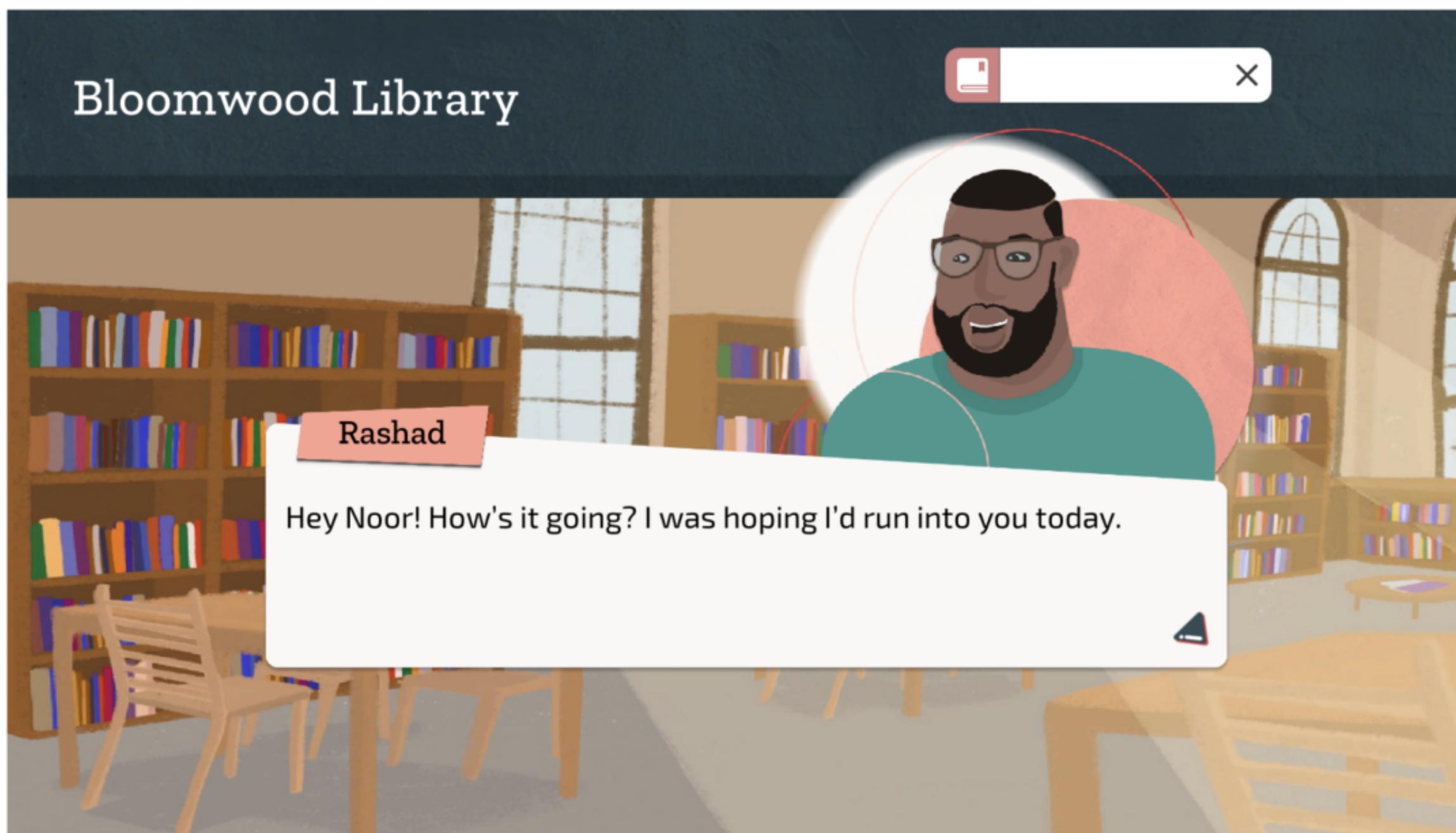
I do know. I've been here trying to get more programs started, and doing admin work. Plus the library has basically become a hub for social services. It's not just books these days

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

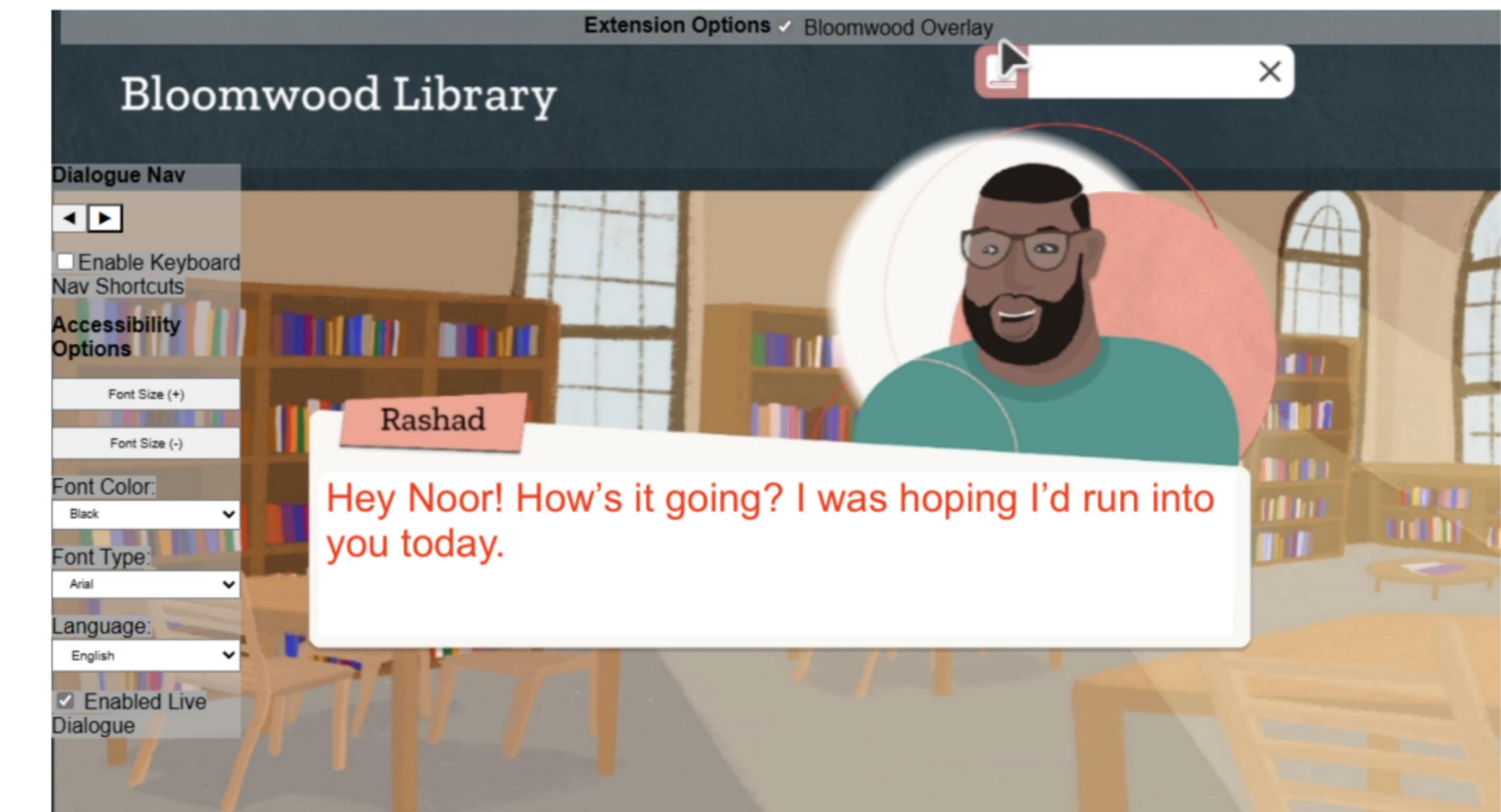
Yes, but let me check my contacts and get back to you?

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

Our prototype and design probe



Gamer interface, to gamer

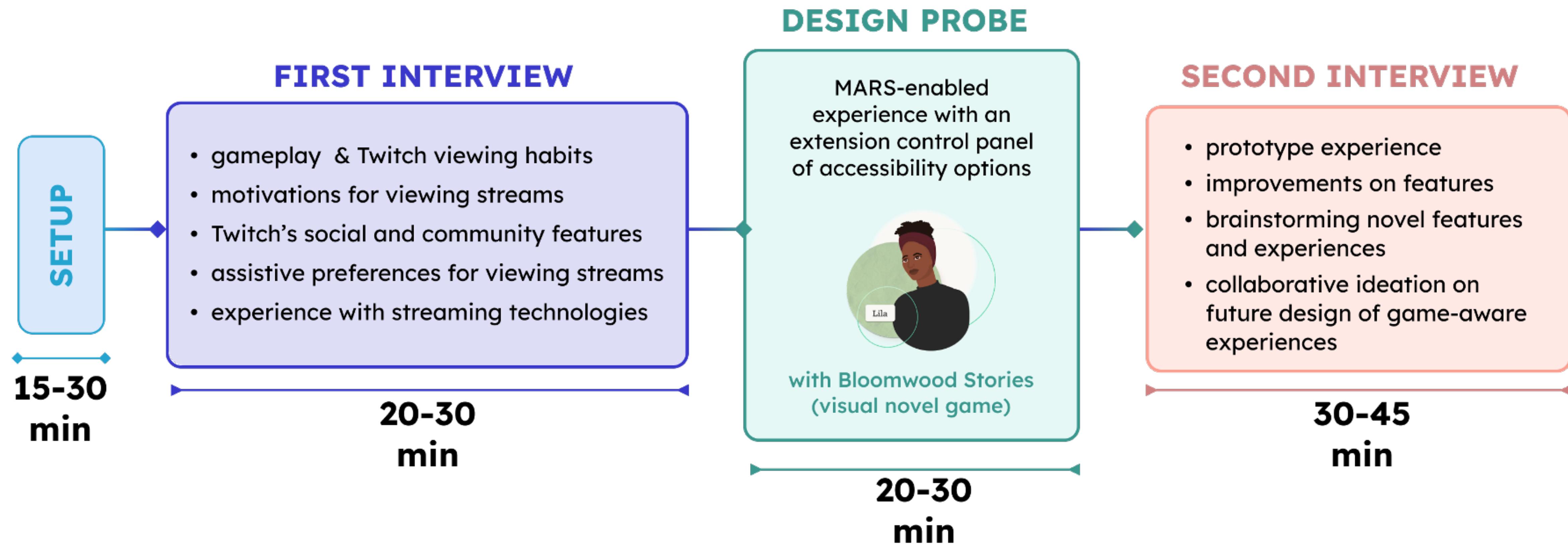


Stream interface, to viewers

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;<div></div></button>
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>
```



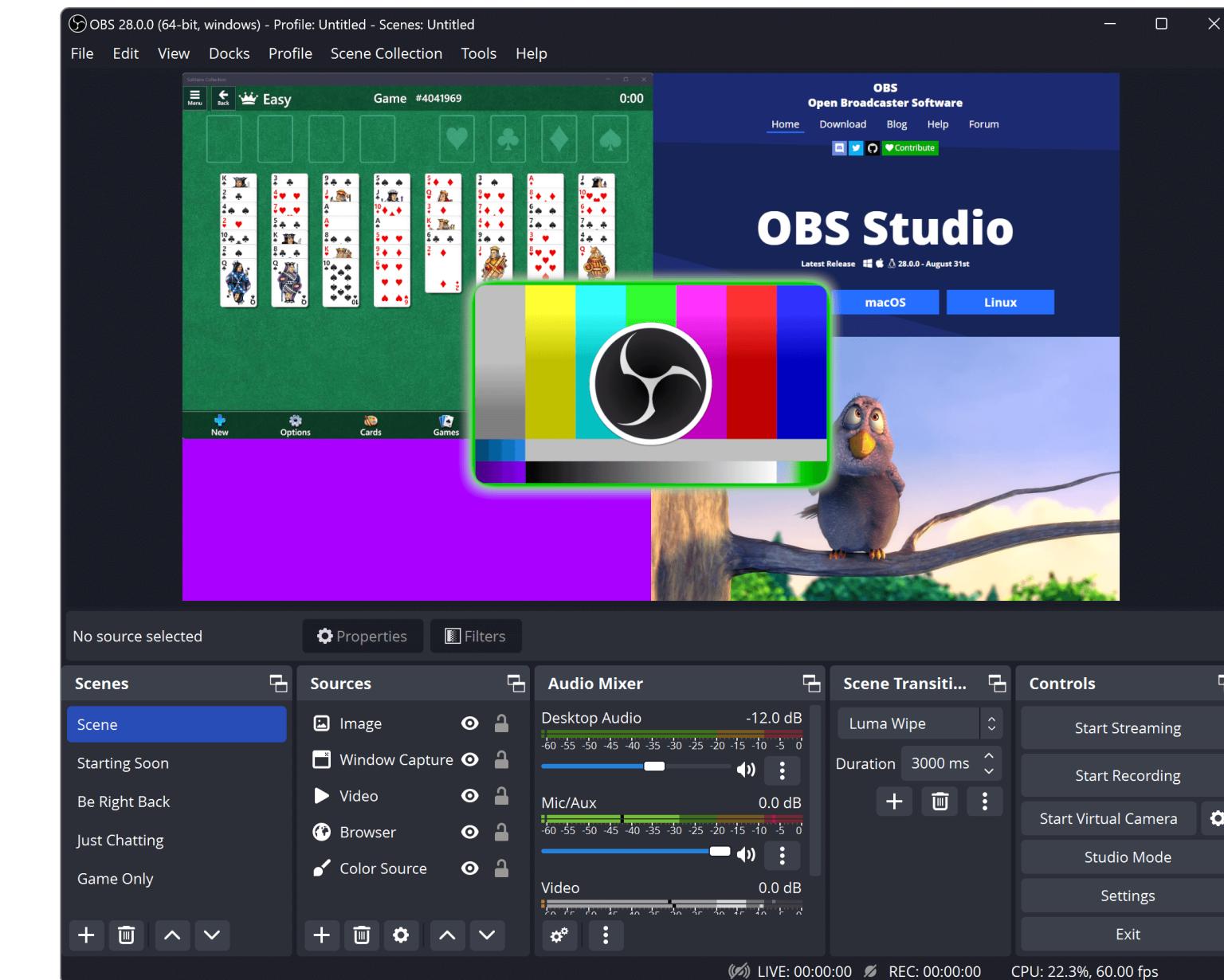
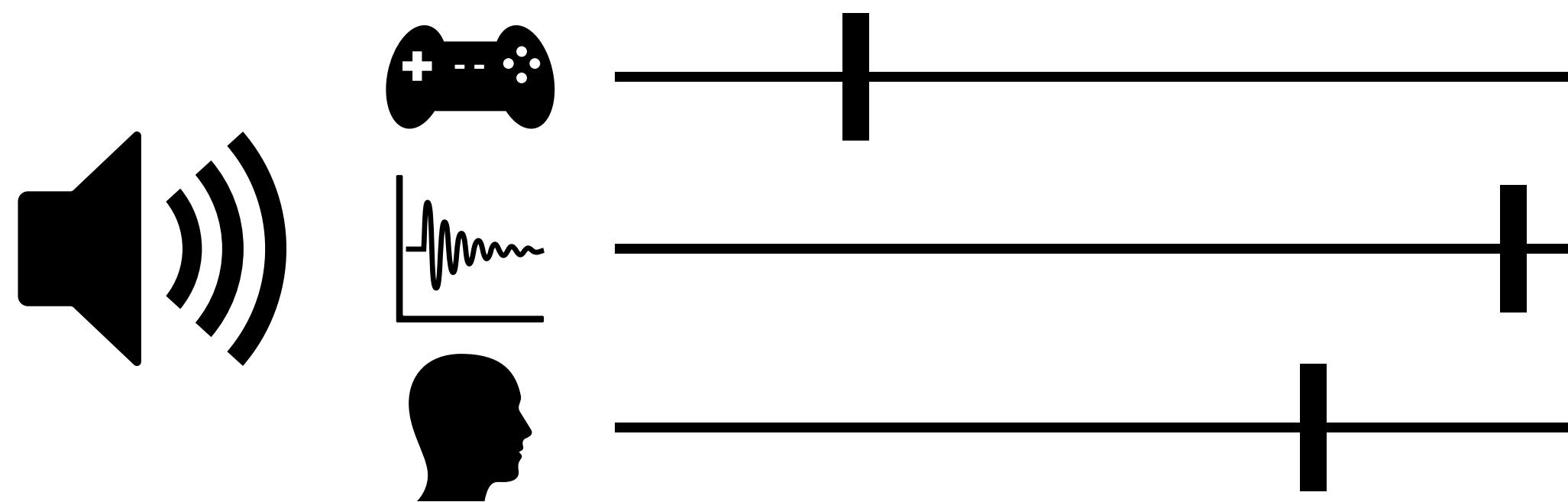


Results I think are the most awesome:
**Dreaming of customization and imagining
what access to game data can enable**

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



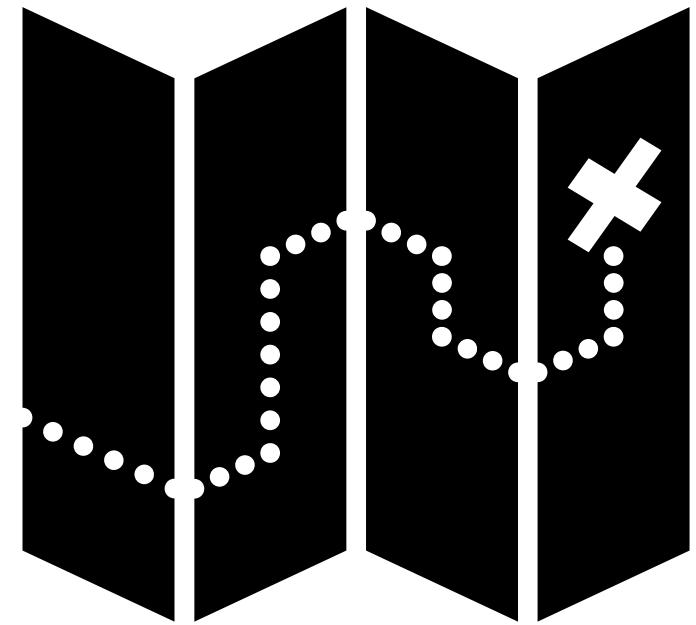
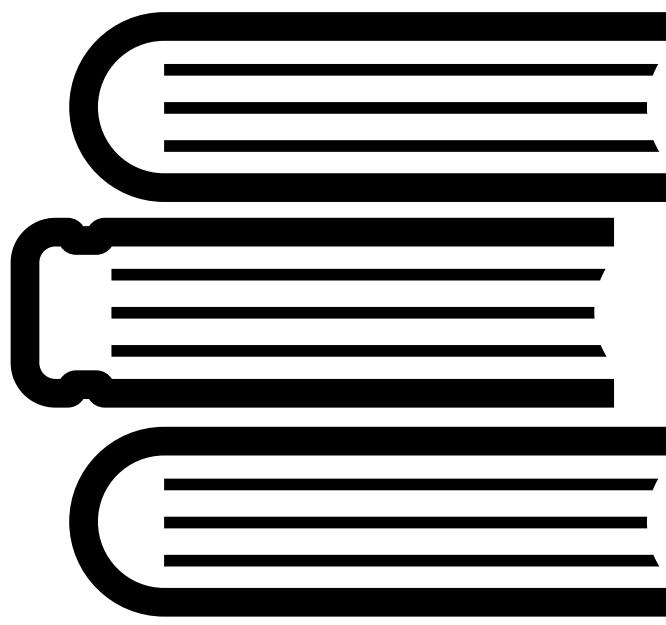
Apply vision accessibility preset

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

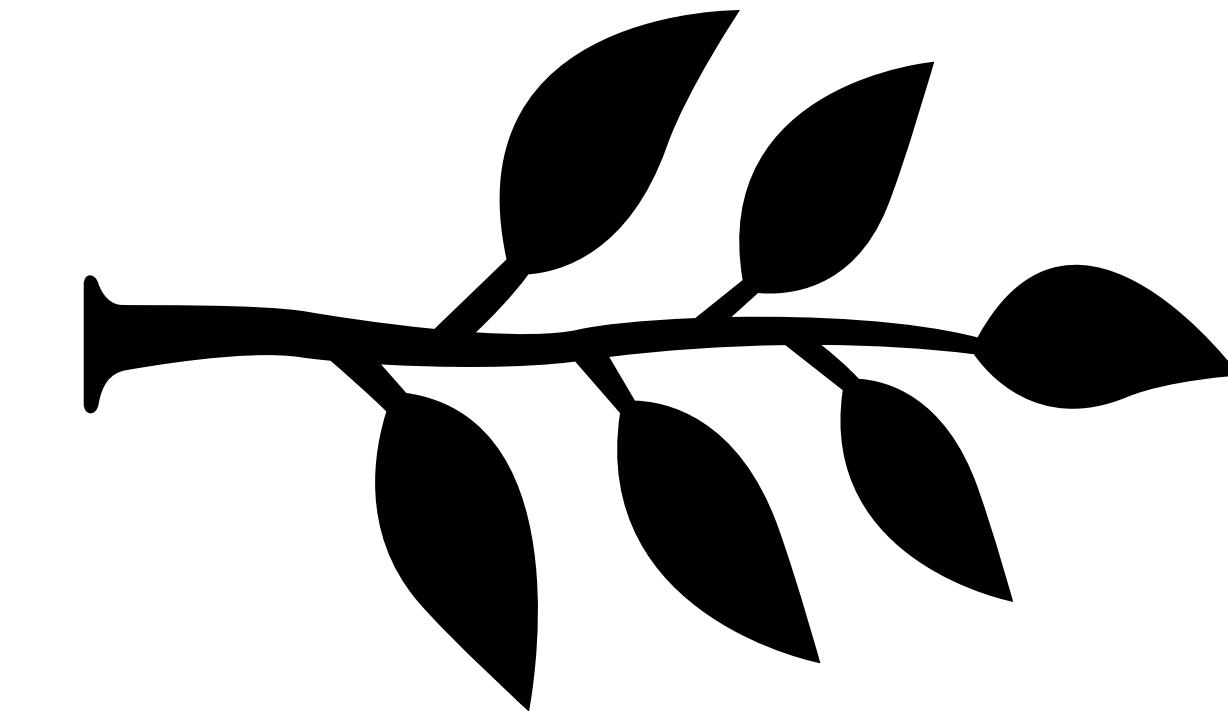
- **Options:** On or Off
- Text-to-Speech
- High Contrast Display
- HUD Scale > Large
- Lock-On Aim > Auto-Target
- Traversal and Combat Audio Cues
- Navigation and Traversal Assistance
- Ledge Guard
- Enhanced Listen Mode
- Invisible While Prone > Unlimited
- Skip Puzzle Option
- Various adjustments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



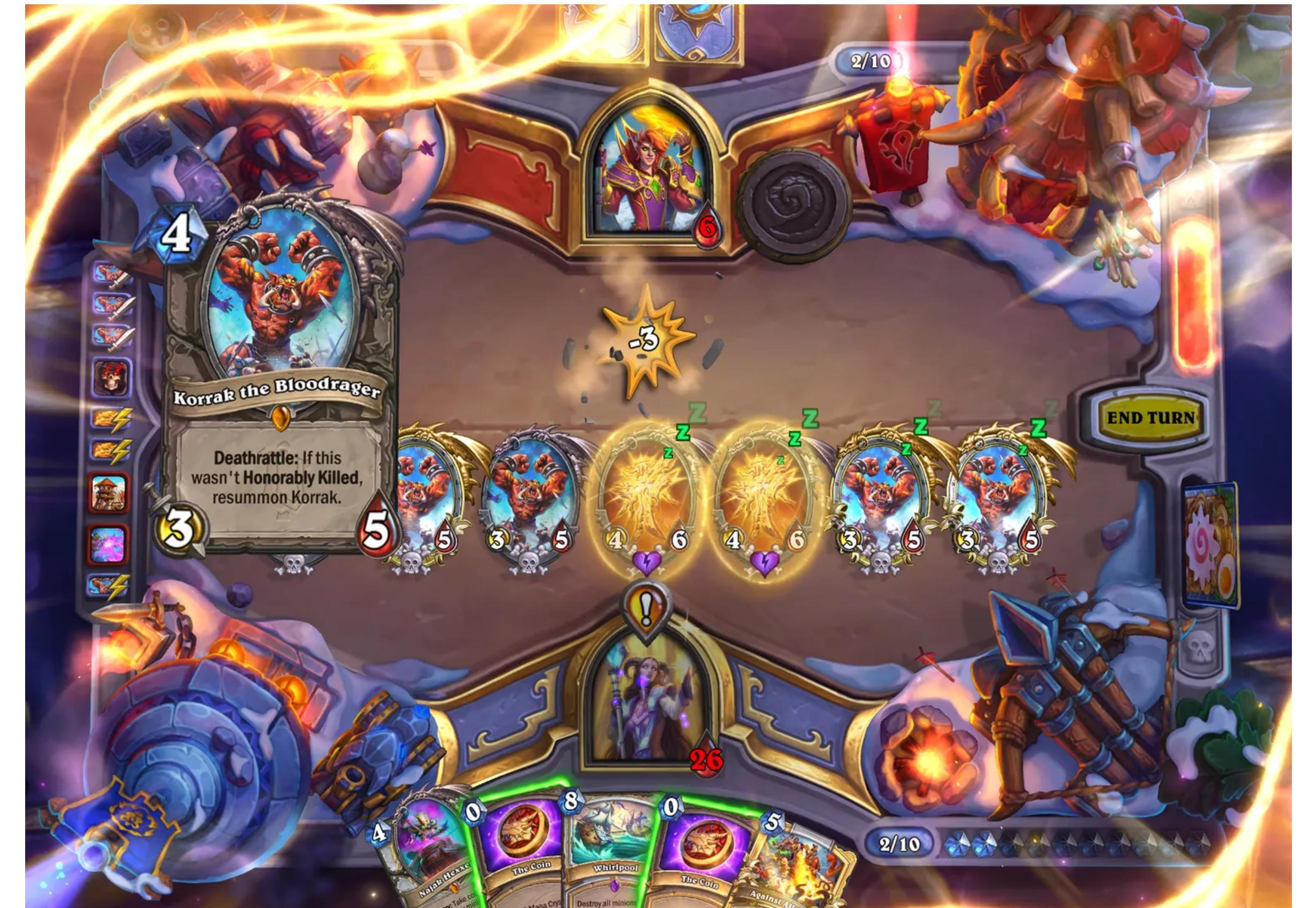
Explore a game's menus, world,
and interface



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

The image shows a digital interface for an evidence journal. At the top, there are tabs for "Evidence" and "Info", with "EN" selected. Below the tabs, there's a section titled "Ghost Types" with a list of 24 items numbered 1 to 24. To the right of this list is a section titled "Evidence" containing several checkboxes. At the bottom, there's a summary statement and a grid of names under three headings: "Spirit", "Wraith", and "Phantom".

Using the evidence were found, we believe the ghost is a		
Spirit	Wraith	Phantom
Poltergeist	Banshee	Jinn
Mare	Revenant	Shade
Demon	Yurei	Oni
Yokai	Hantu	Goryo
Myling	Onryo	The Twins
Raiju	Obake	The Mimic
Moroi	Deogen	Thaye

Ghost Types

Select a ghost type below to view more information:

1. Spirit
2. Wraith
3. Phantom
4. Poltergeist
5. Banshee
6. Jinn
7. Mare
8. Revenant
9. Shade
10. Demon
11. Yurei
12. Oni
13. Yokai
14. Hantu
15. Goryo
16. Myling
17. Onryo
18. The Twins
19. Raiju
20. Obake
21. The Mimic
22. Moroi
23. Deogen
24. Thaye

Evidence

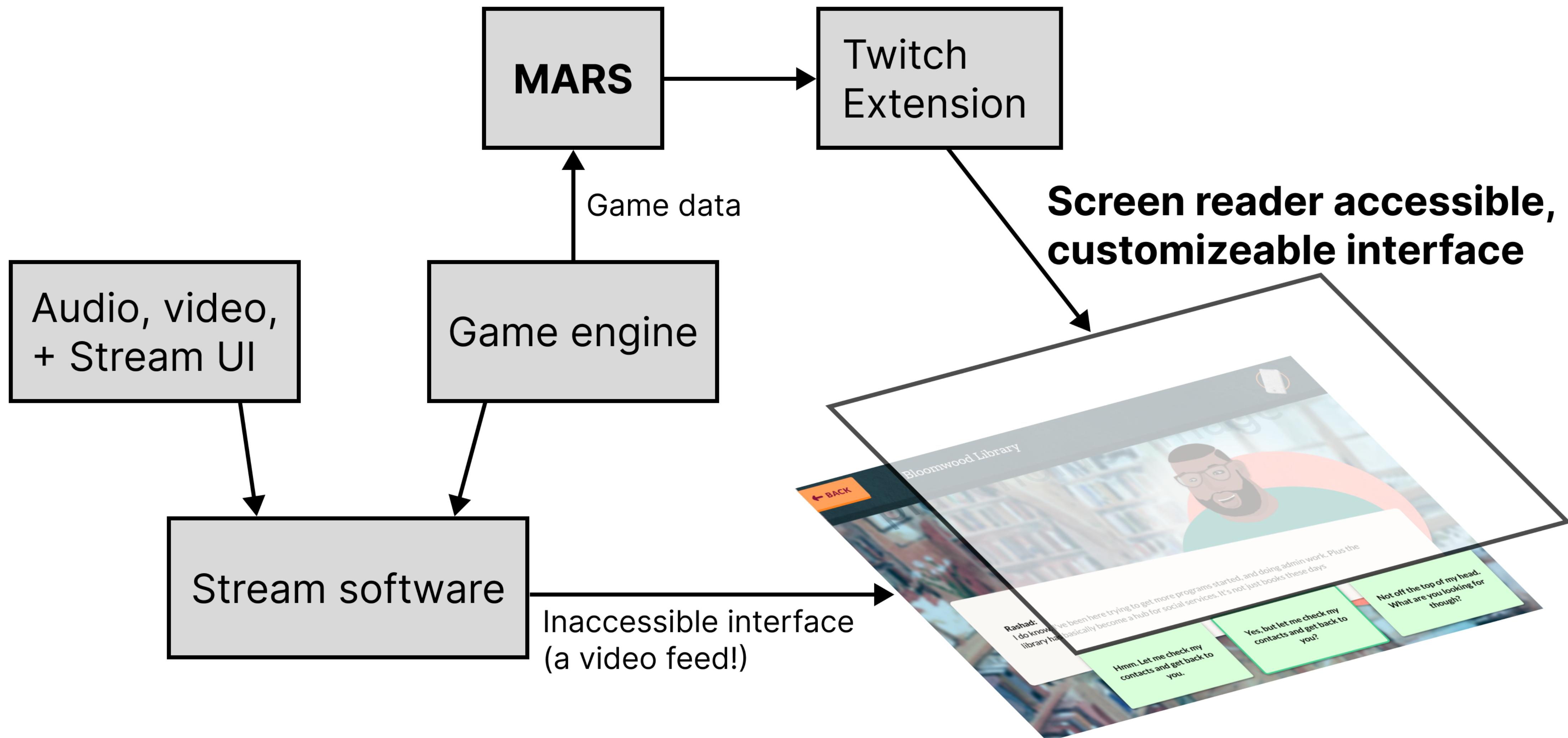
EMF Level 5 DOTS Projector
 Fingerprints Ghost Orb
 Ghost Writing Spirit Box
 Freezing Temperatures

Using the evidence were found, we believe the ghost is a

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!

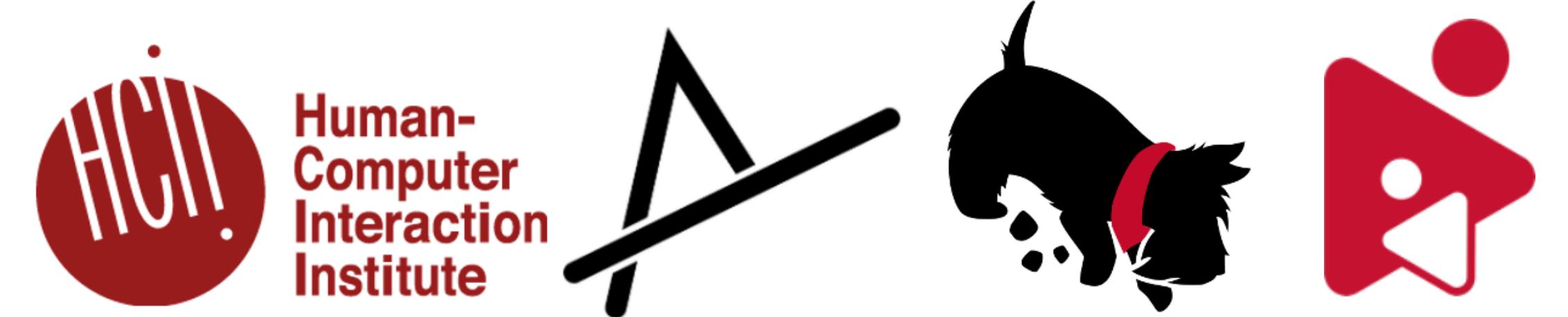
- What kinds of prototypes and new systems can we imagine? What problems could this technology solve?
- What if we took every accessibility feature of a game and made those same options available to stream viewers?
- What can we do with game data to enable new kinds of interactivity between streamers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

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Presented by Frank Elavsky, PhD Student



hcii.cmu.edu, axle-lab.com, dig.cmu.edu, cmu-ctp.github.io