Media streaming in the functional world

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How do you stream media in Elixir?

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Let's solve a real-life problem! Or kind of...

Drum

Drum

+ It does bam bam

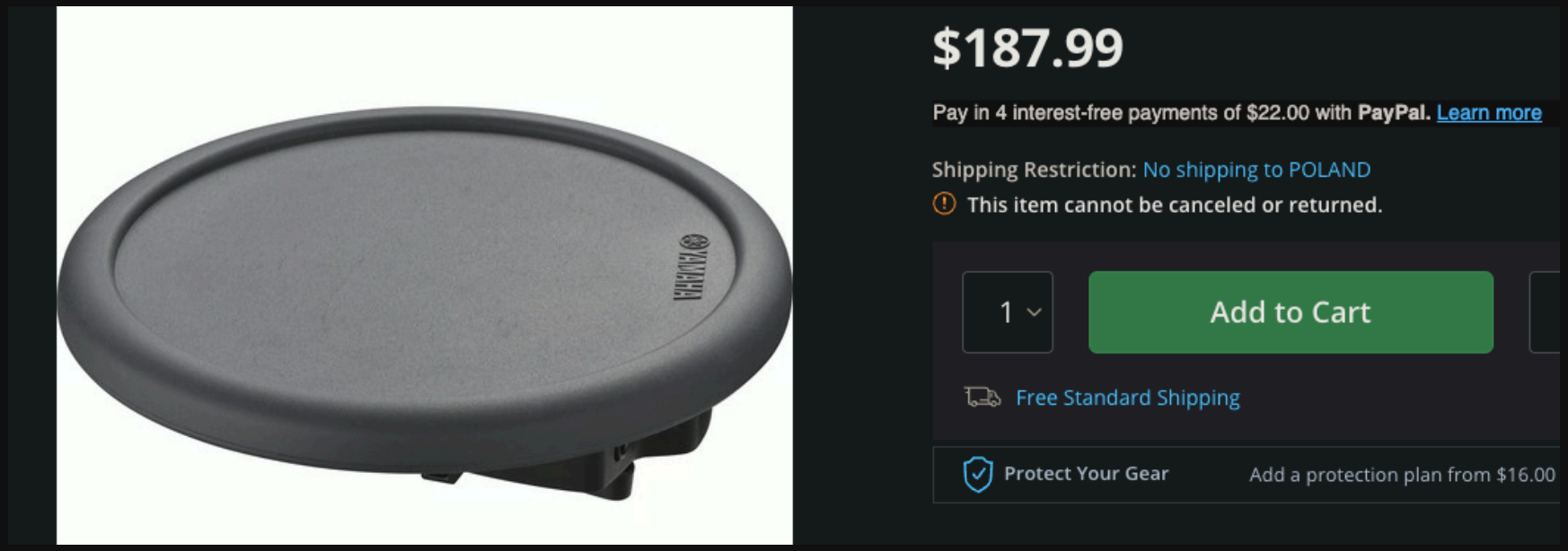
Drum

+ It does bam bam

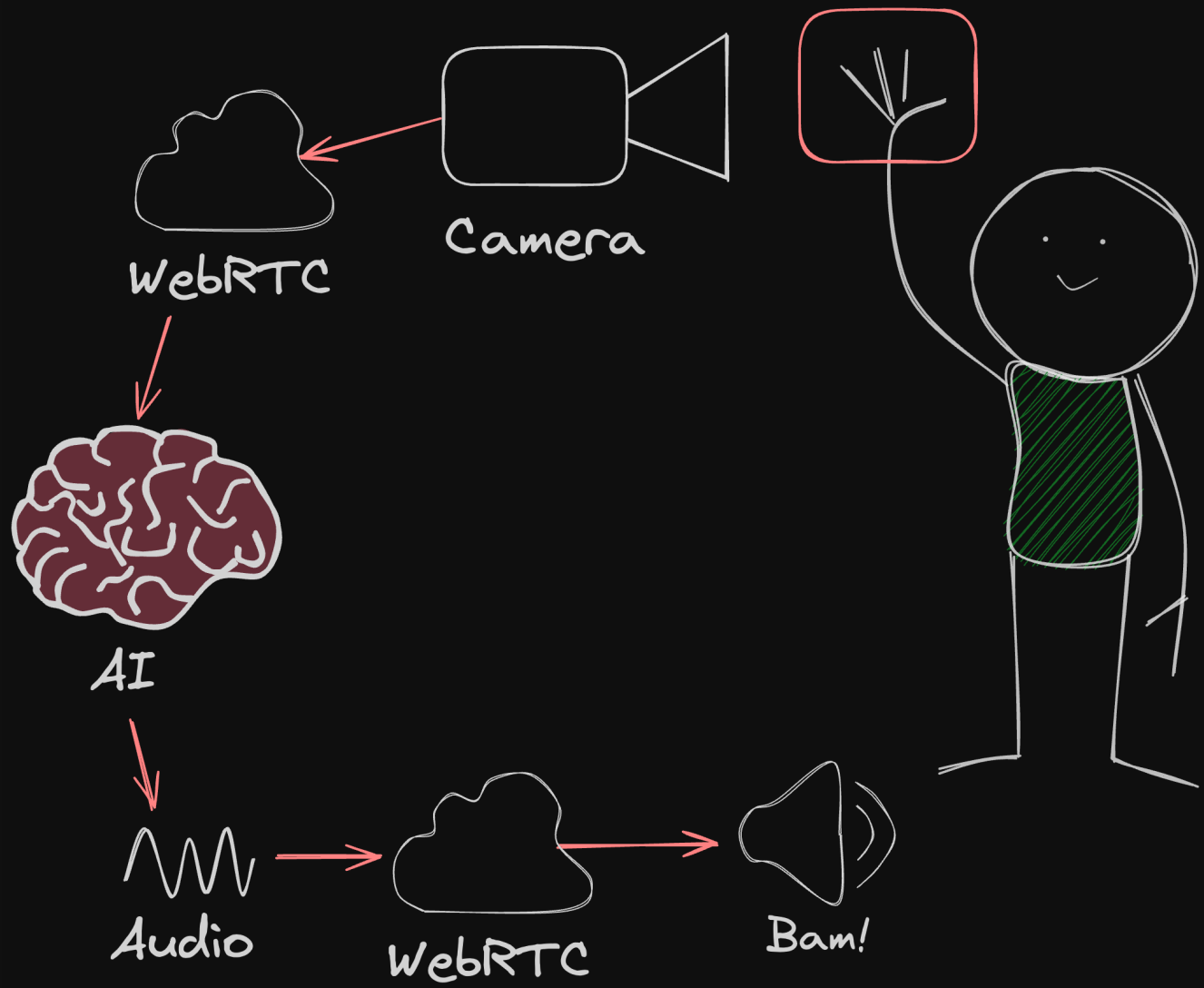
- It takes a lot of space

Small drum == not cool

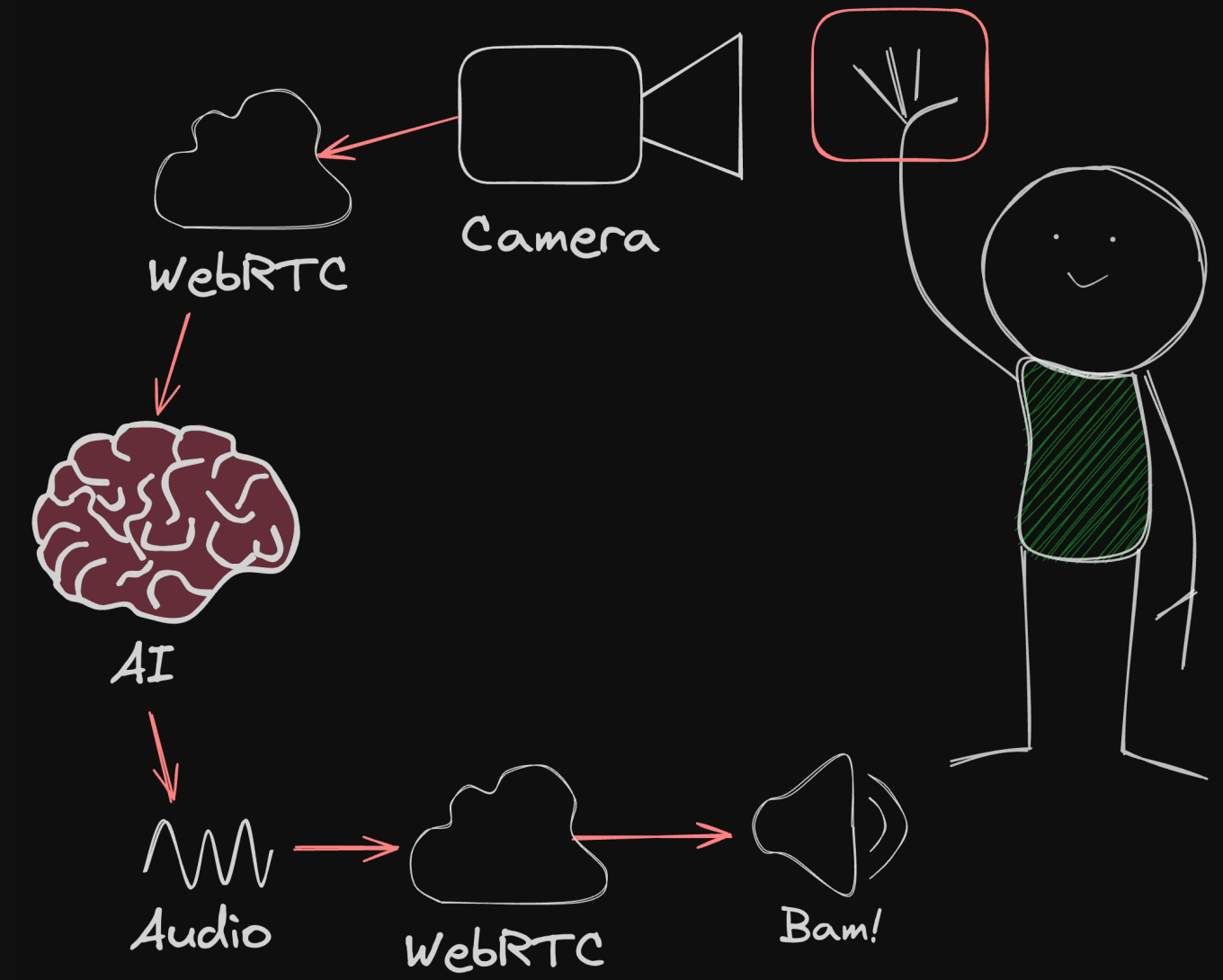
Digital drum == too expensive



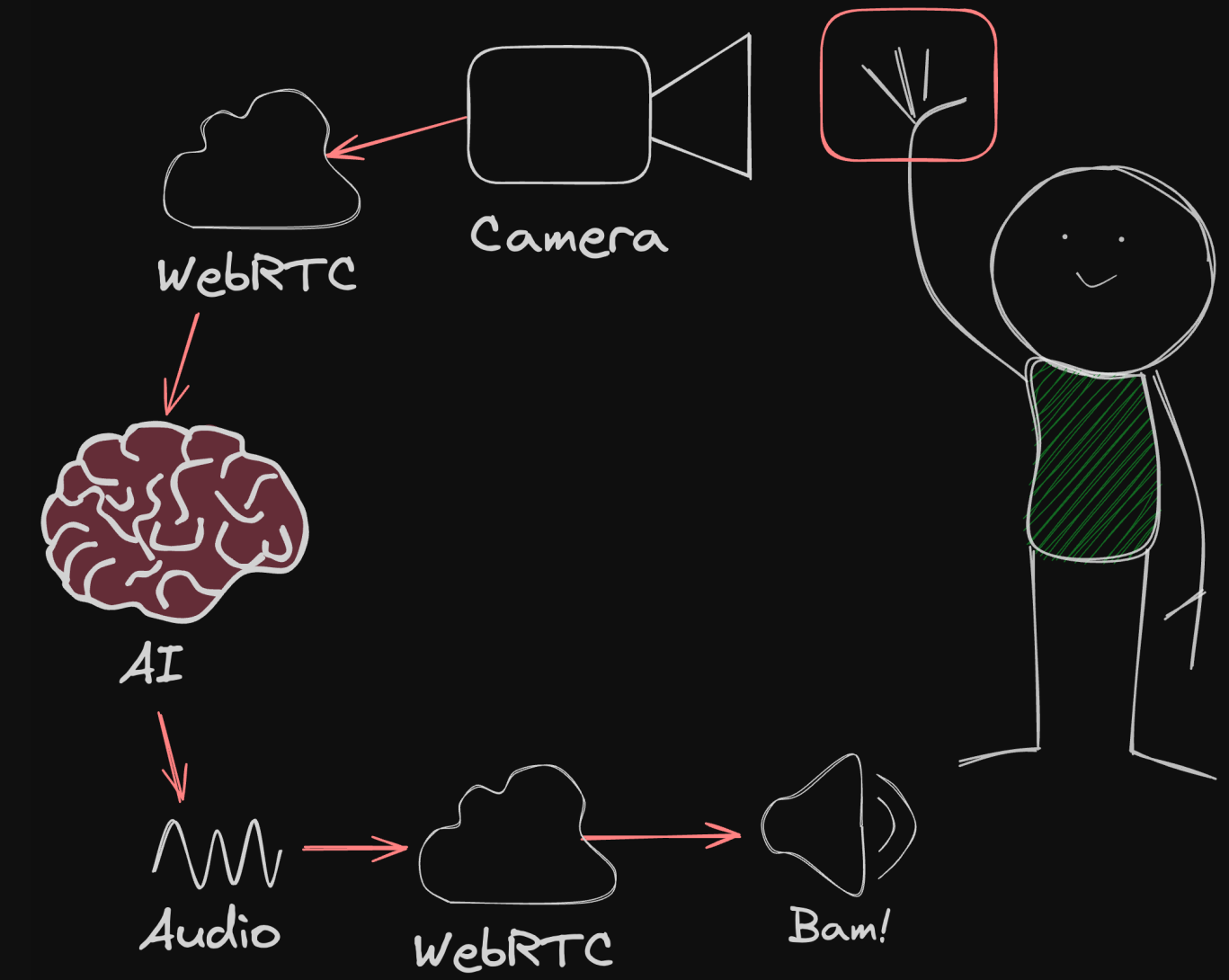
Let's make a virtual drum!


WebRTC
Camera
AI
Audio
WebRTC
Bam!

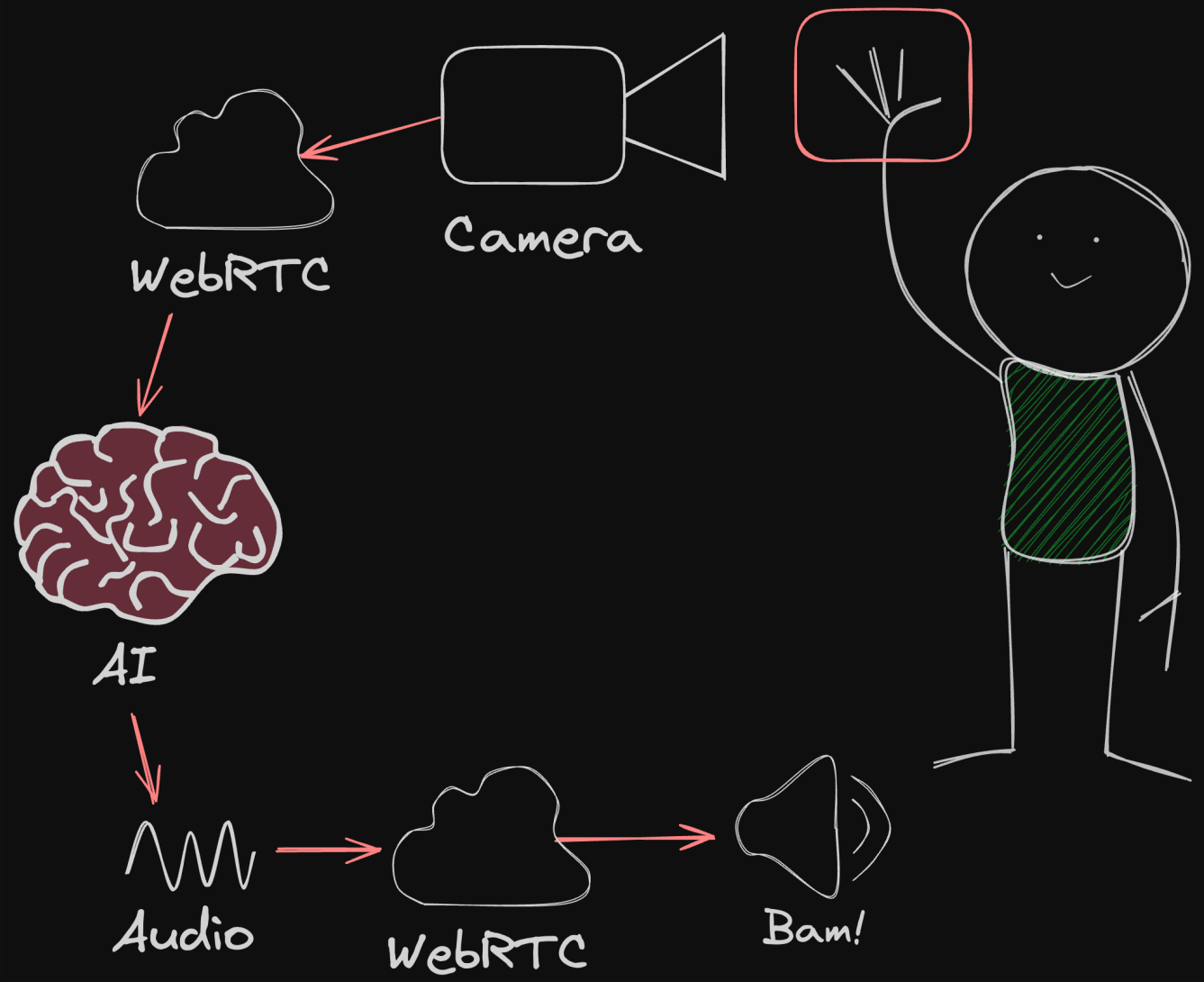
- Record hand movements with camera



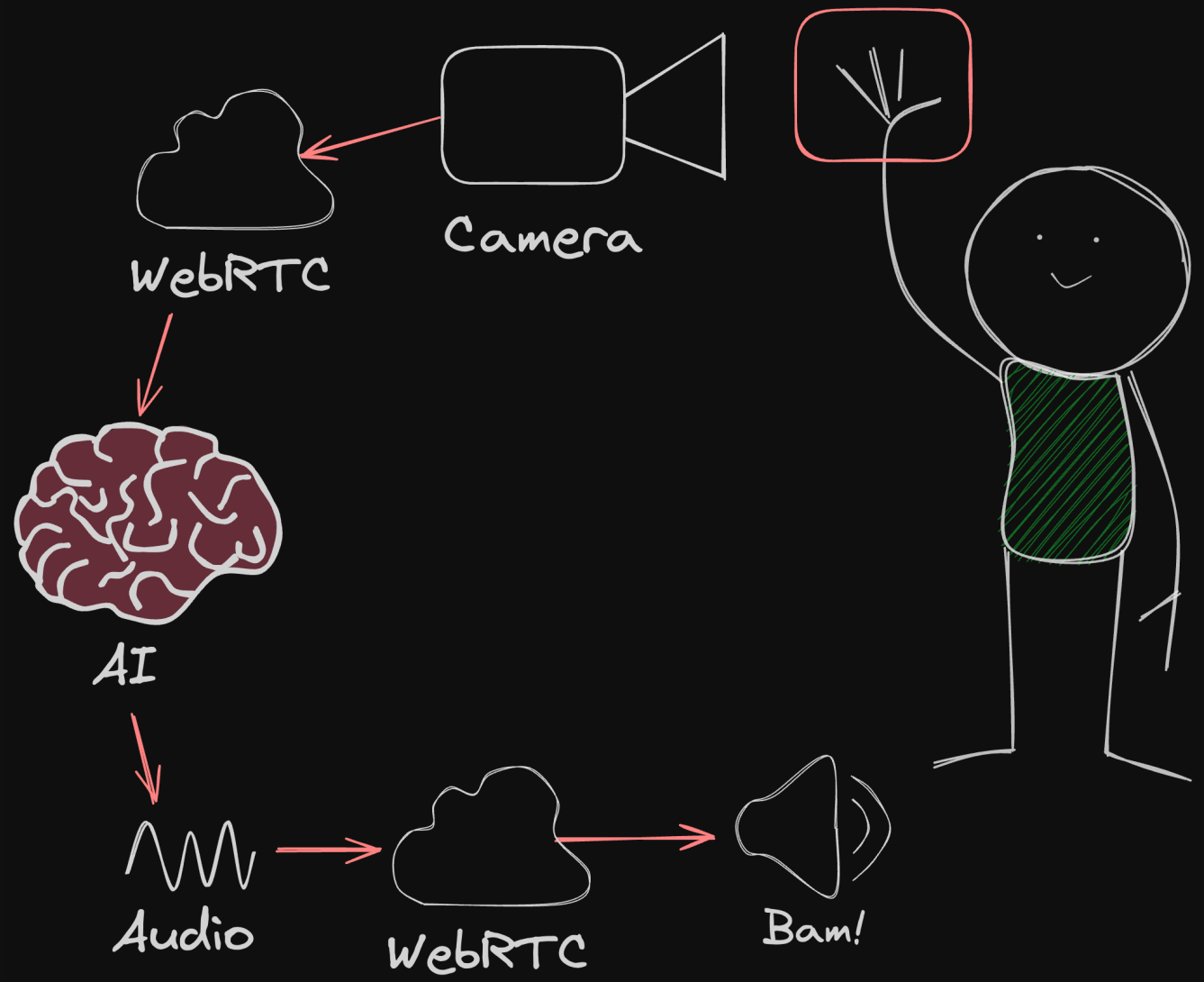
- Record hand movements with camera
- Stream it over WebRTC



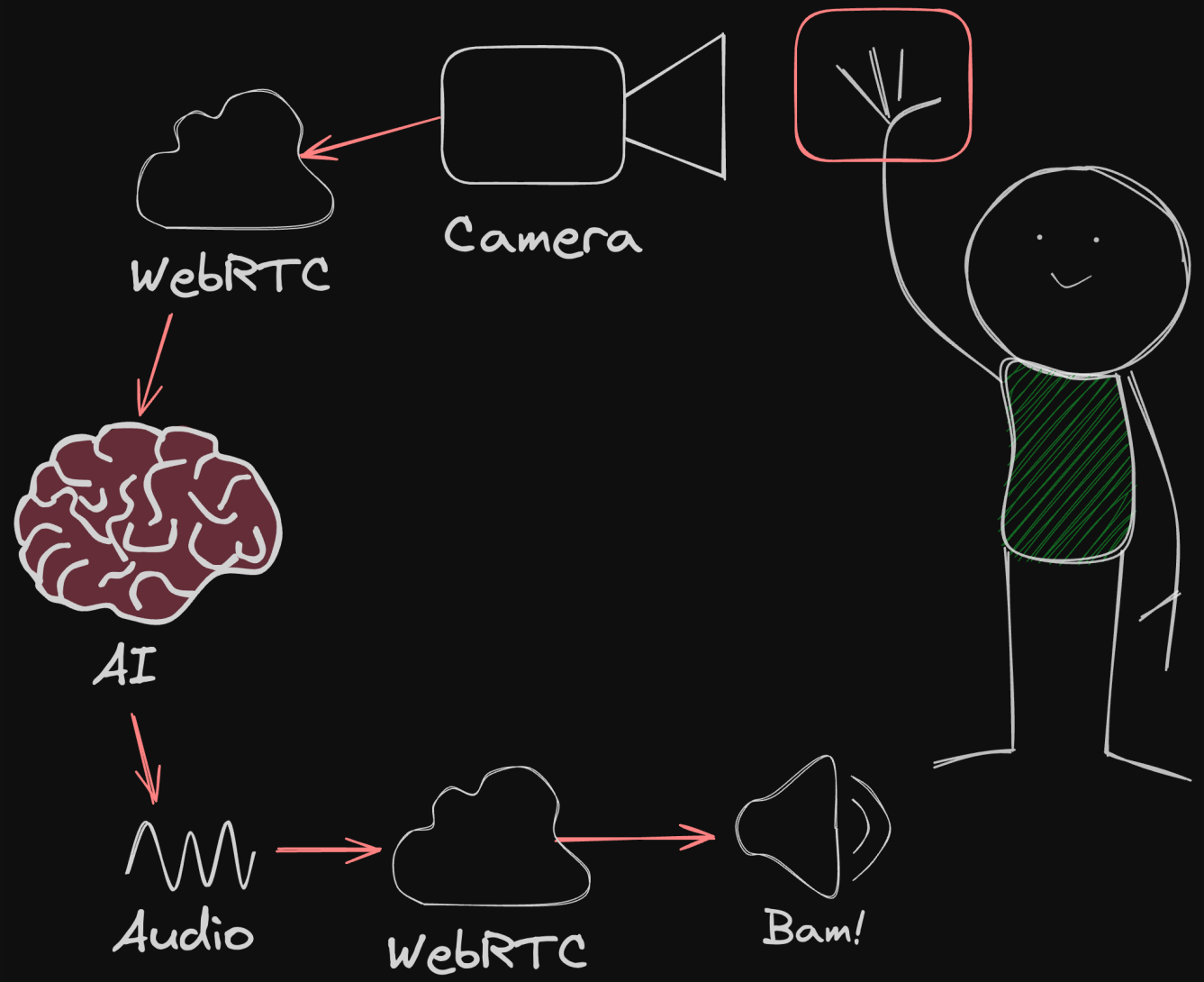
- Record hand movements with camera
- Stream it over WebRTC
- Detect hand position with AI



- Record hand movements with camera
- Stream it over WebRTC
- Detect hand position with AI
- Emit *bam* whenever hand moves down



- Record hand movements with camera
- Stream it over WebRTC
- Detect hand position with AI
- Emit *bam* whenever hand moves down
- Stream the sound back



Project Bam Bam - client

- Use `getUserMedia` to get the video from the browser

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- Use `getUserMedia` to get the video from the browser
- Use JS WebRTC API to send it to the server

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- Use `getUserMedia` to get the video from the browser
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- Use JS WebRTC API to receive audio from the server

Project Bam Bam - client

- Use `getUserMedia` to get the video from the browser
- Use JS WebRTC API to send it to the server
- Use JS WebRTC API to receive audio from the server
- Put it into the HTML `<audio/>` element

Project Bam Bam - server ingress

- Receive video over WebRTC

Project Bam Bam - server ingress

- Receive video over WebRTC
- Parse the video

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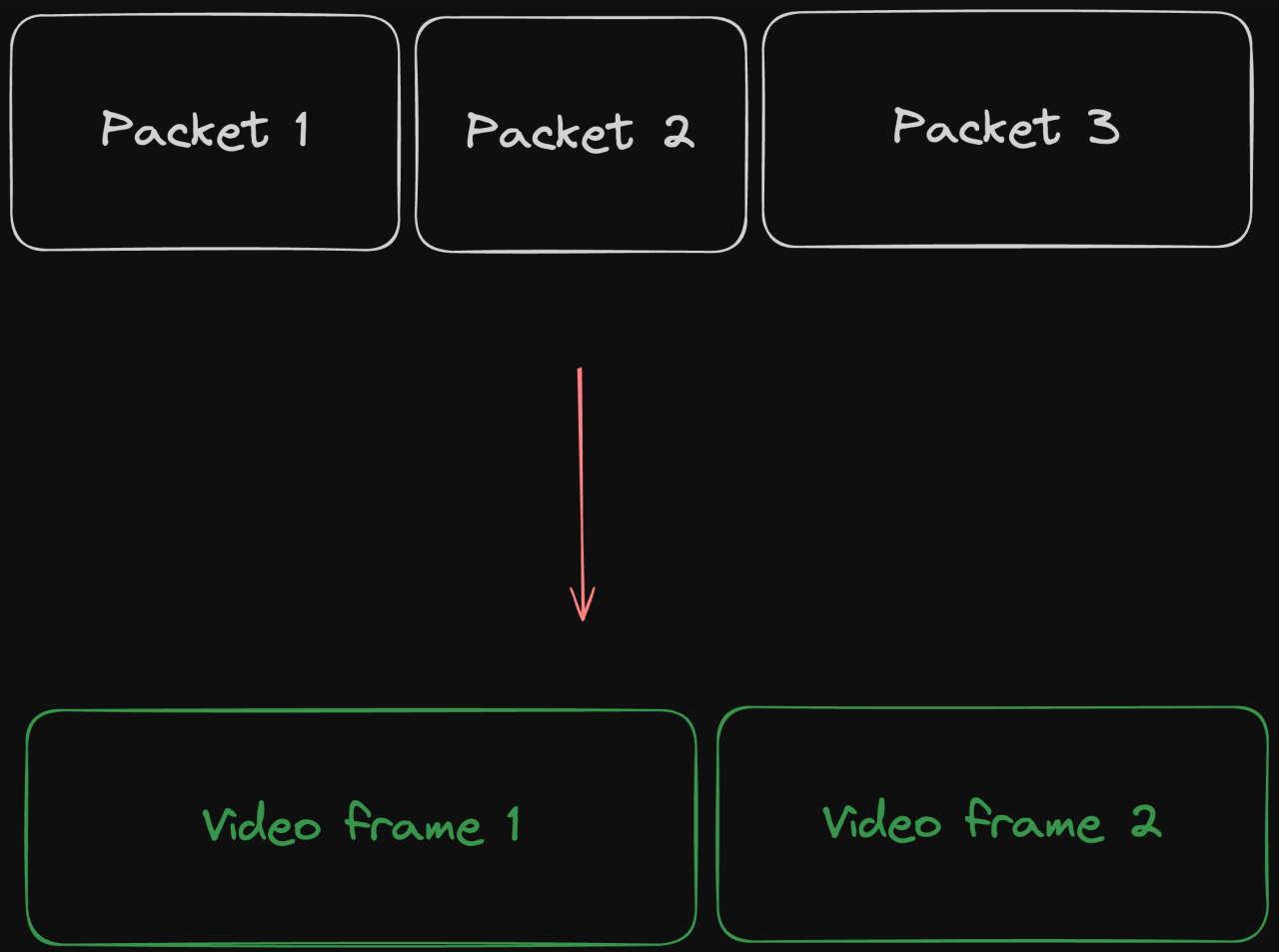

Project Bam Bam - server ingress

- Receive video over WebRTC
- Parse the video
- Decode the video

Project Bam Bam - server ingress

- Receive video over WebRTC
- Parse the video
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- Convert the video from YUV to RGB

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Image source: https://deeprender.ai/blog/yuv-colour-and-compression

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Project Bam Bam - server ingress

- Receive video over WebRTC
- Parse the video
- Decode the video
- Convert the video from YUV to RGB
- Detect hand movement

Project Bam Bam - server egress

- Generate BAM sounds

Project Bam Bam - server egress

- Generate BAM sounds
- Fill gaps with silence

Project Bam Bam - server egress

- Generate BAM sounds
- Fill gaps with silence
- Encode the audio

Project Bam Bam - server egress

- Generate BAM sounds
- Fill gaps with silence
- Encode the audio
- Send the audio via WebRTC

Let's get to it!

Project Bam Bam - outcomes

- With WebRTC we can stream media at very low latency
- Membrane helps accessing and manipulating media in a functional way
- Elixir makes parallelism manageable
- Bridging media streaming with AI opens up a ton of possibilities

WebRTC & low latency

	Sending a file	Low-latency media streaming
Packet loss	Always retransmit	Maybe drop it, FEC
Congestion decection	On packet loss	Constant monitoring
Recovering from congestion	Slow down	Reduce quality
Transport protocol	TCP	Custom stack on top of UDP