



Marco Gillies

Goldsmiths, University of London

A Brief History of Virtual Humans

Talk Outline

- When I was a lad.... Some ancient history
- What's all this LLM stuff?
- What's missing?

Plagiarism

“The presentation of another’s person’s thoughts or words [or source code] as though they are your own”

SEE VR Lab

Social, Empathic, and Embodied VR Lab at Goldsmiths, University of London



Prof Sylvia Xueni Pan

Sylvia is a Professor of VR. She is the co-head of the SEE VR Lab.



Prof Marco Gillies

Marco is a Professor of Computing. He is the co-head of the SEE VR Lab.



Clarice Hilton

Clarice is a creative technologist and researcher in immersive artwork.



Fang Ma

Fang is a RA in the IIIIE project and a PhD student focusing on virtual humans.



Tara Collingwoode-Williams

Tara is an Assistant Professor Lecturer in VR, and a final year PhD student in VR Embodiment.



Nima Jamalian

Nima is an Assistant Professor in VR, and a final year PhD student in VR hand tracking.



Claire Yuke Pi

Claire is a RA in the Child Embodiment project and a PhD student in Embodied interaction



Chaojing Li

Chaojing is a PhD student on VR for interactive narrative experiences.



Zimu Cheng

Zimu is a PhD student working on emotion recognition and modelling in Social VR.



Jiaqi Yin

Jiaqi is a TA for our lab. She is due to start her PhD in the area of medical training in VR.



Tianyuan Zhang

Tianyuan is a PhD student interested in the interaction area of art, touch, and XR.



Ju Zhang

Ju Zhang is a TA for our lab. He is due to start his PhD in VR and empathy at Greenwich University.

 @panxueni

 @marcogillies

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SEE VR Lab



Social, Empathic, and Embodied VR Lab at Goldsmiths, University of London



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Virtual Reality

MA/MSc Virtual & Augmented Reality

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Department

[Computing](#)

Length

1 year full-time or 2-3 years part-time.

Immersive experiences, including virtual and augmented reality, are the most exciting new mediums to emerge in the 21st century.



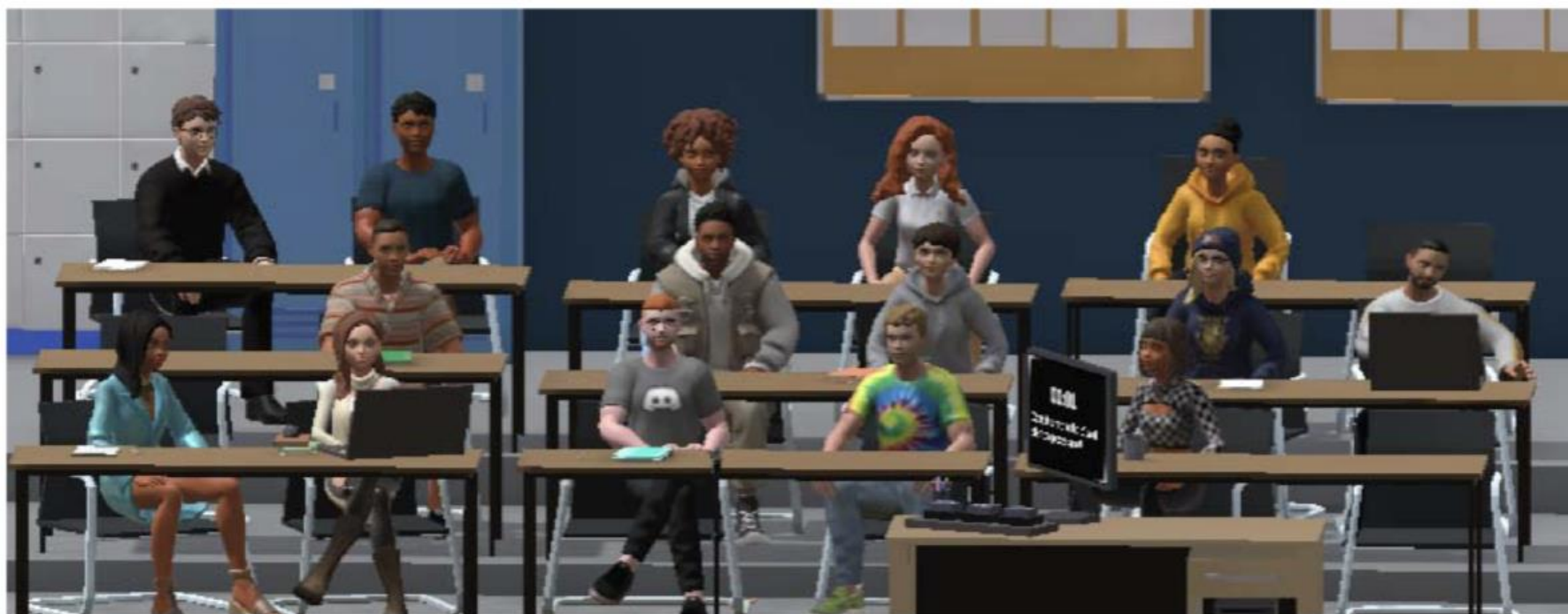
Smoke Cessation Study (CET)



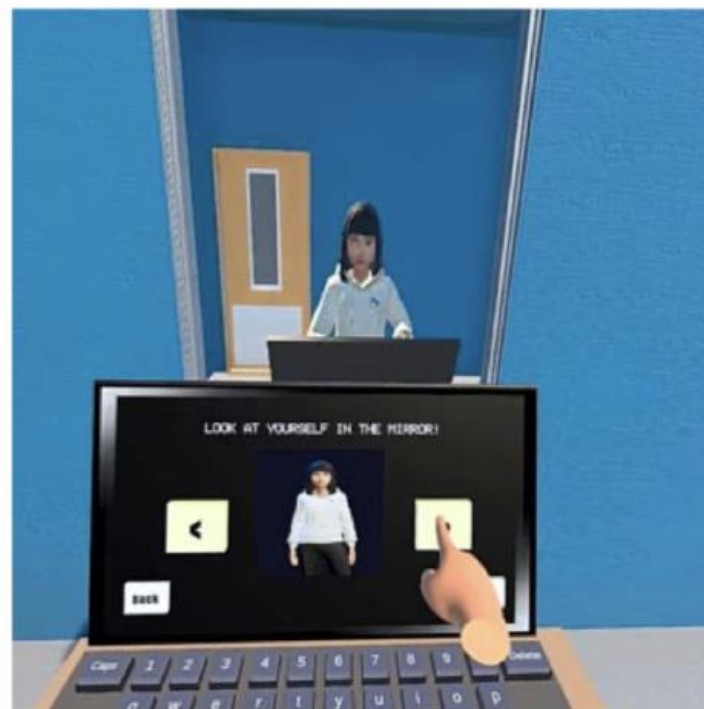
Celine Yu

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• [Reducing Foreign Language Anxiety with Virtual Reality](#) Park, Seonjeong; Carlisle, Damaris; Gillies, Marco ; and Pan, Xueni ORCID logo . 2023. 'Reducing Foreign Language Anxiety with Virtual Reality'. In: 2023 IEEE Conference on Virtual Reality and 3D User Interfaces Abstracts and Workshops (VRW). Shanghai, China 25-29 March 2023.



Domestic Abuse Empathy Training for Social Workers



The view of 3rd perspective group

The view of child perspective group



Avatars



Agents



What can I help with?

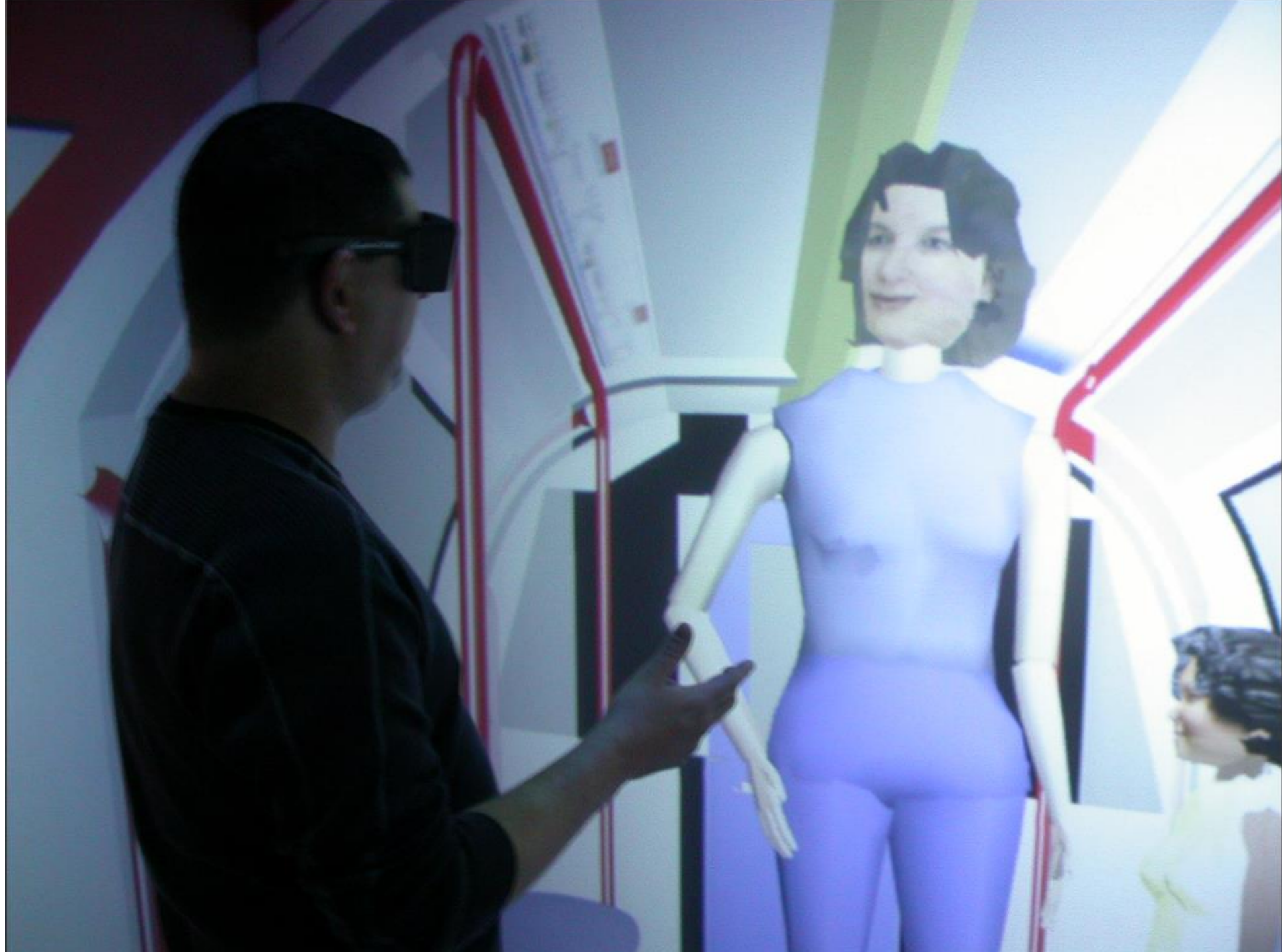
+ Ask anything



Grand Challenge: Social Interaction

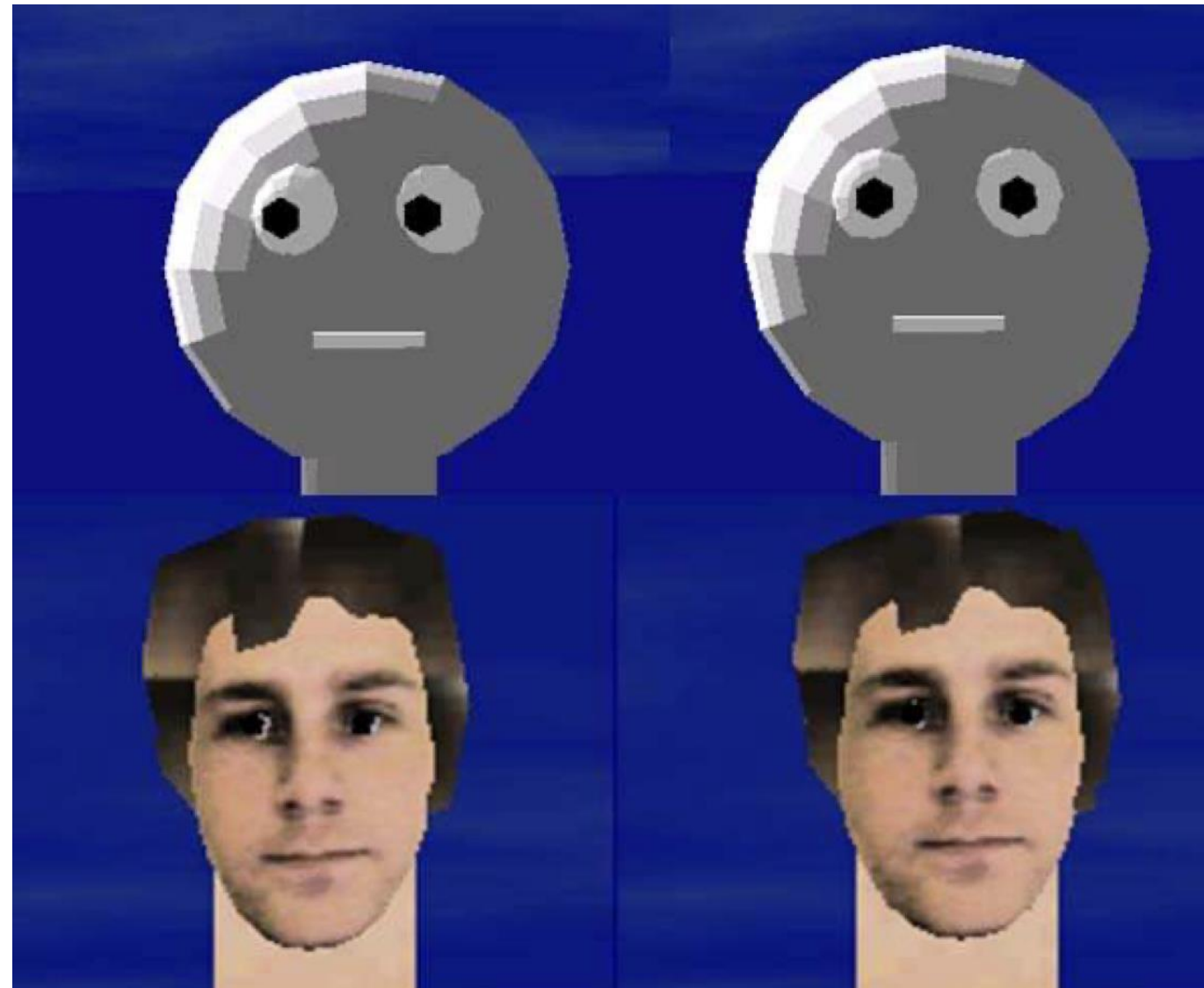
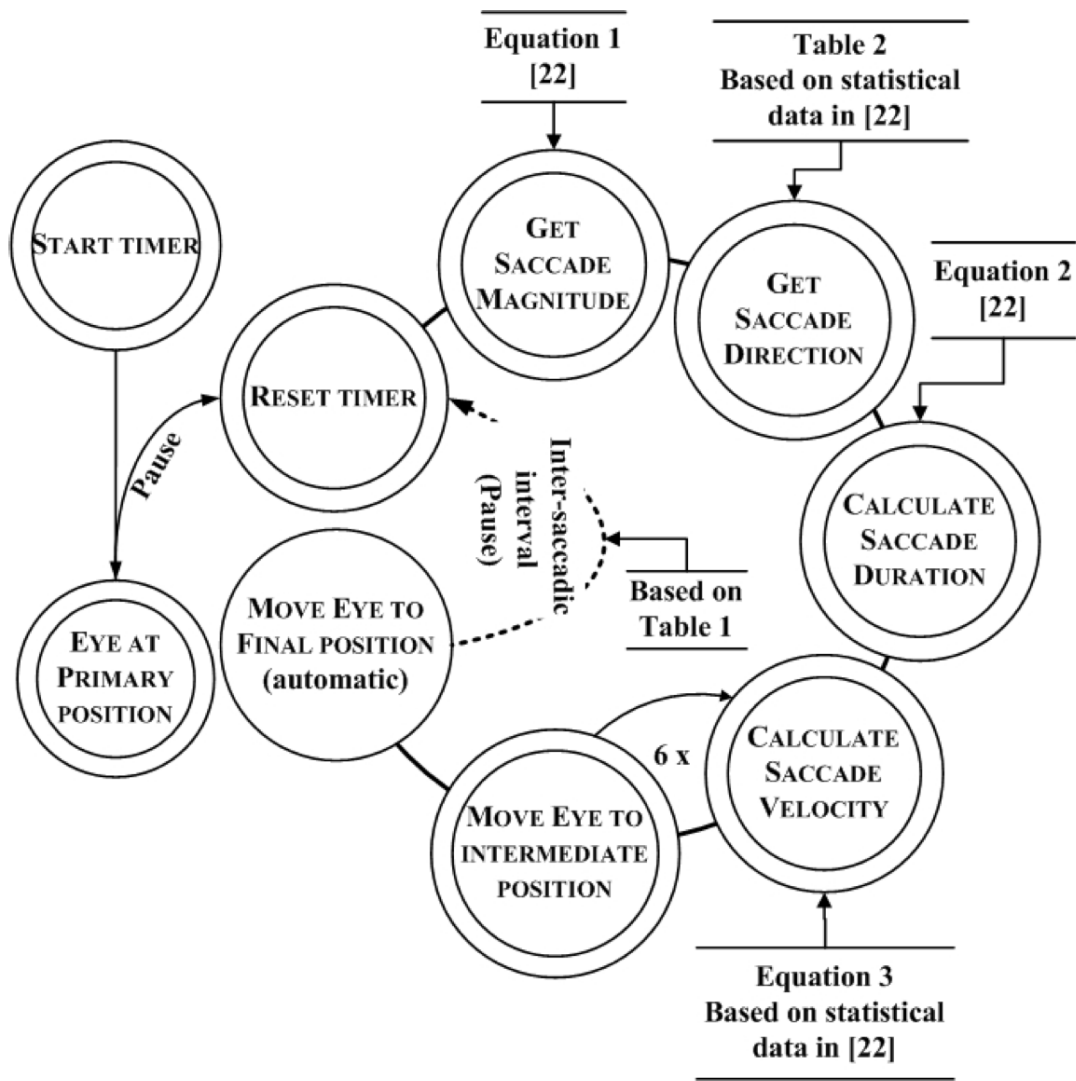








Gillies, Marco , Pan, Xueni and Slater, Mel. 2010. Piavca: a framework for heterogeneous interactions with virtual characters. *Virtual Reality*, 14(4), pp. 221-228.



Vinayagamorthy, V., Garau, M., Steed, A. and Slater, M. (2004), An Eye Gaze Model for Dyadic Interaction in an Immersive Virtual Environment: Practice and Experience. *Computer Graphics Forum*, 23: 1-11. <https://doi.org/10.1111/j.1467-8659.2004.00001.x>



Head Tracking

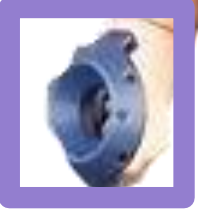
Eye Tracking



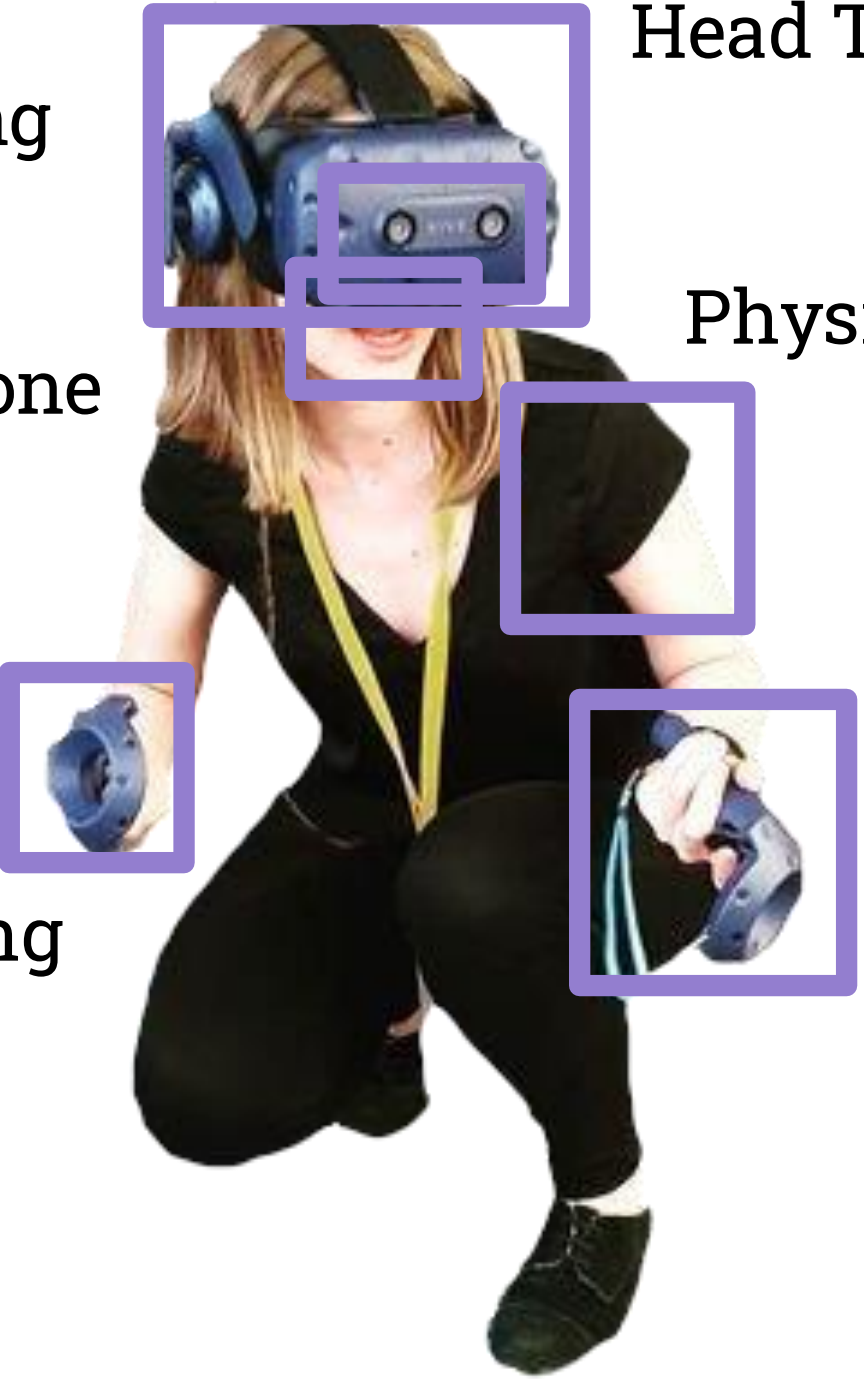
Microphone
(voice)



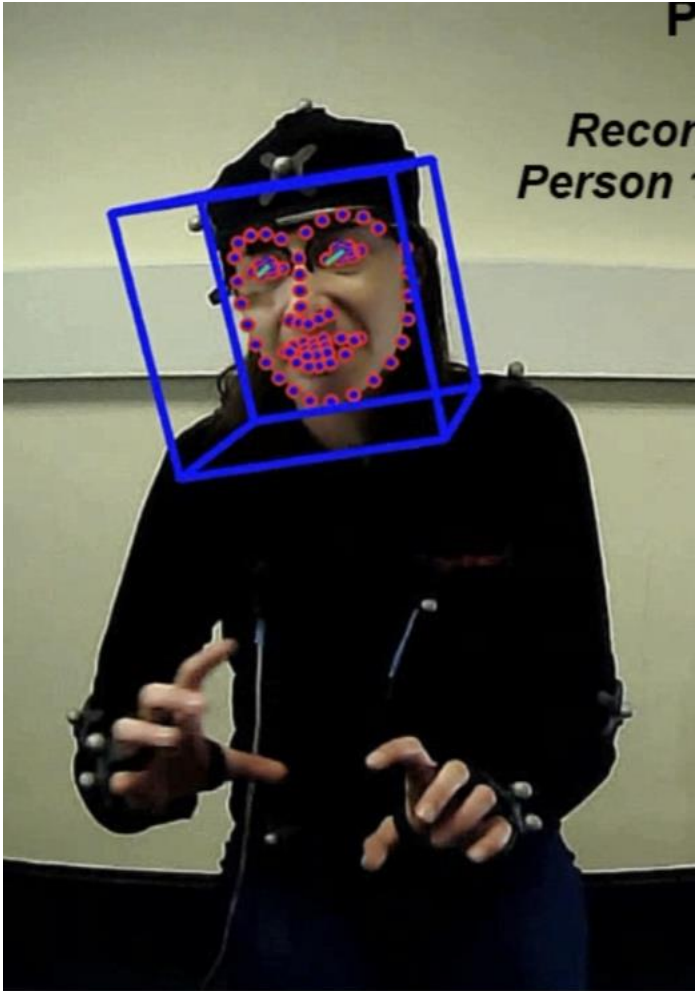
Physiological Sensing



Hand Tracking



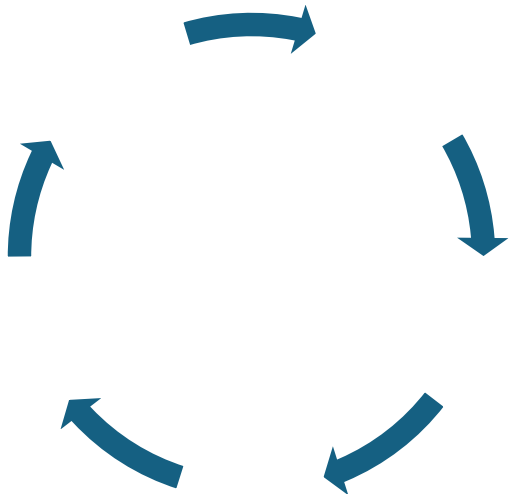
Not Just Social Signal Processing



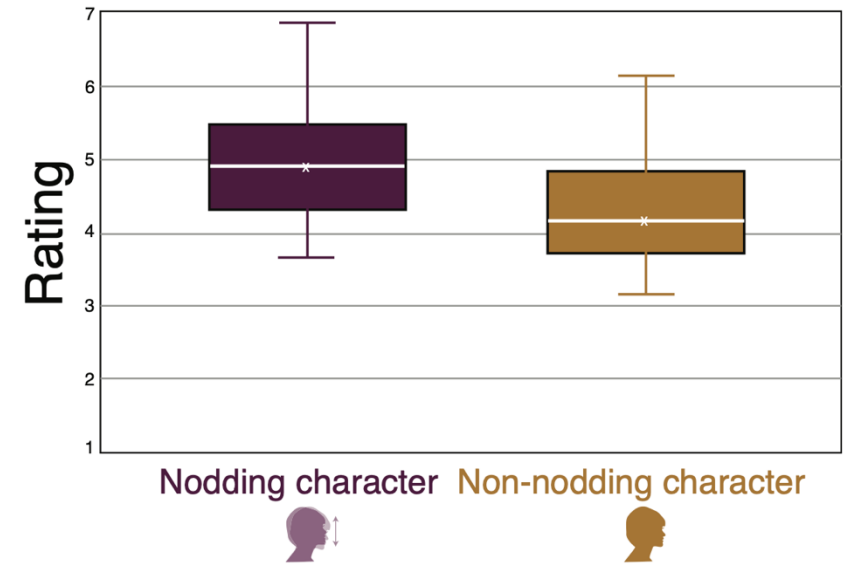
Not Just Animation



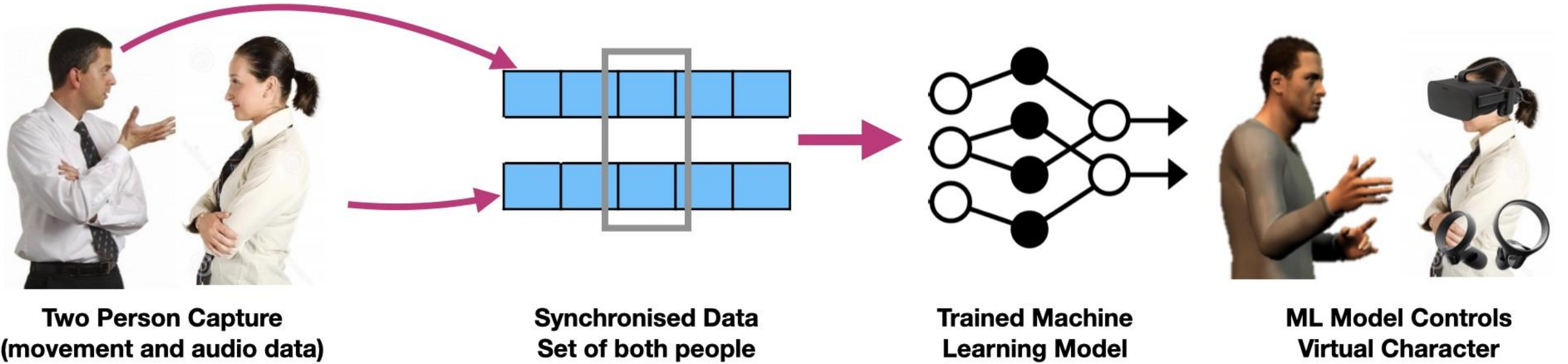
Interaction



Social Agents



Aburumman, Nadine; [Gillies, Marco](#); [Ward, Jamie A.](#) and Hamilton, Antonia F.de C.. 2022. [Nonverbal communication in virtual reality: Nodding as a social signal in virtual interactions](#). International Journal of Human-Computer Studies



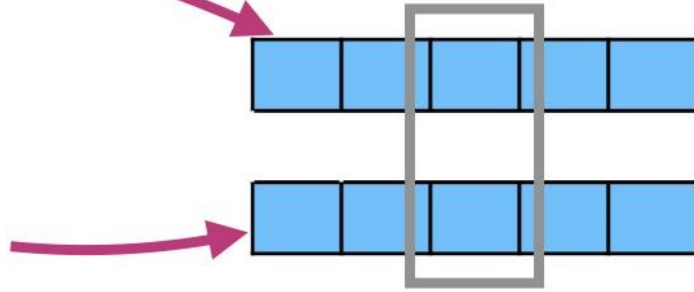
Gillies, Marco. 2009. Learning Finite State Machine Controllers from Motion Capture Data. IEEE Transactions on Computational Intelligence and AI in Games, 1(1), pp. 63-72.

Gillies, Marco; Pan, Xueni; Slater, Mel and Shawe-Taylor, John. 2008. Responsive Listening Behavior. Computer Animation and Virtual Worlds, 19(5), pp. 579-589.

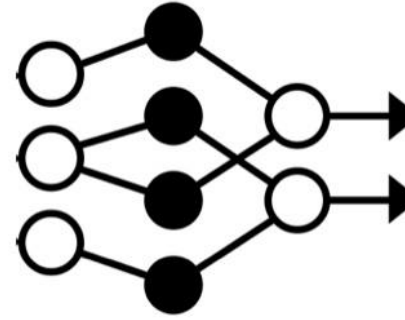




**Two Person Capture
(movement and audio data)**



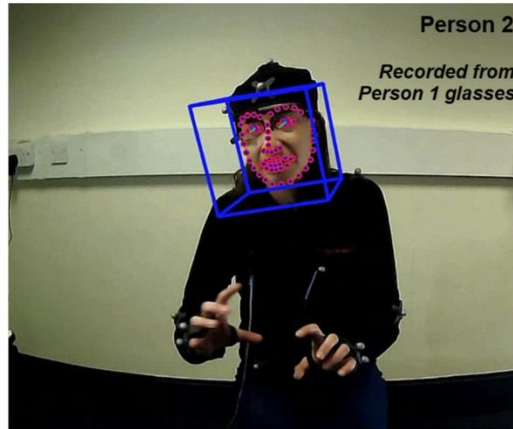
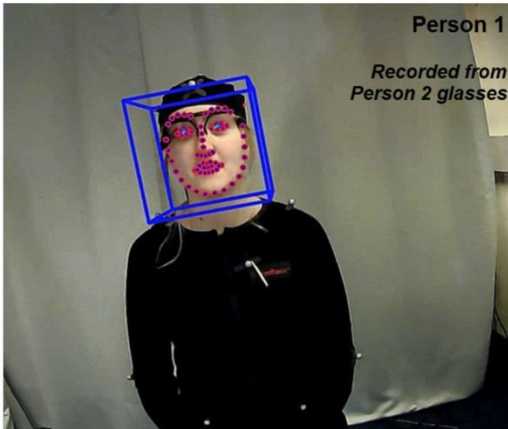
**Synchronised Data
Set of both people**



**Trained Machine
Learning Model**



**ML Model Controls
Virtual Character**



Gillies, Marco. 2009. Learning Finite State Machine Controllers from Motion Capture Data. IEEE Transactions on Computational Intelligence and AI in Games, 1(1), pp. 63-72.

Gillies, Marco; Pan, Xueni; Slater, Mel and Shawe-Taylor, John. 2008. Responsive Listening Behavior. Computer Animation and Virtual Worlds, 19(5), pp. 579-589.



NHS

**Great Ormond Street
Hospital for Children**
NHS Foundation Trust

Breaking bad news

Current Environment:
Dramatic

Current Animation:
General_T1_L02

AI-Driven Characters In Virtual Reality



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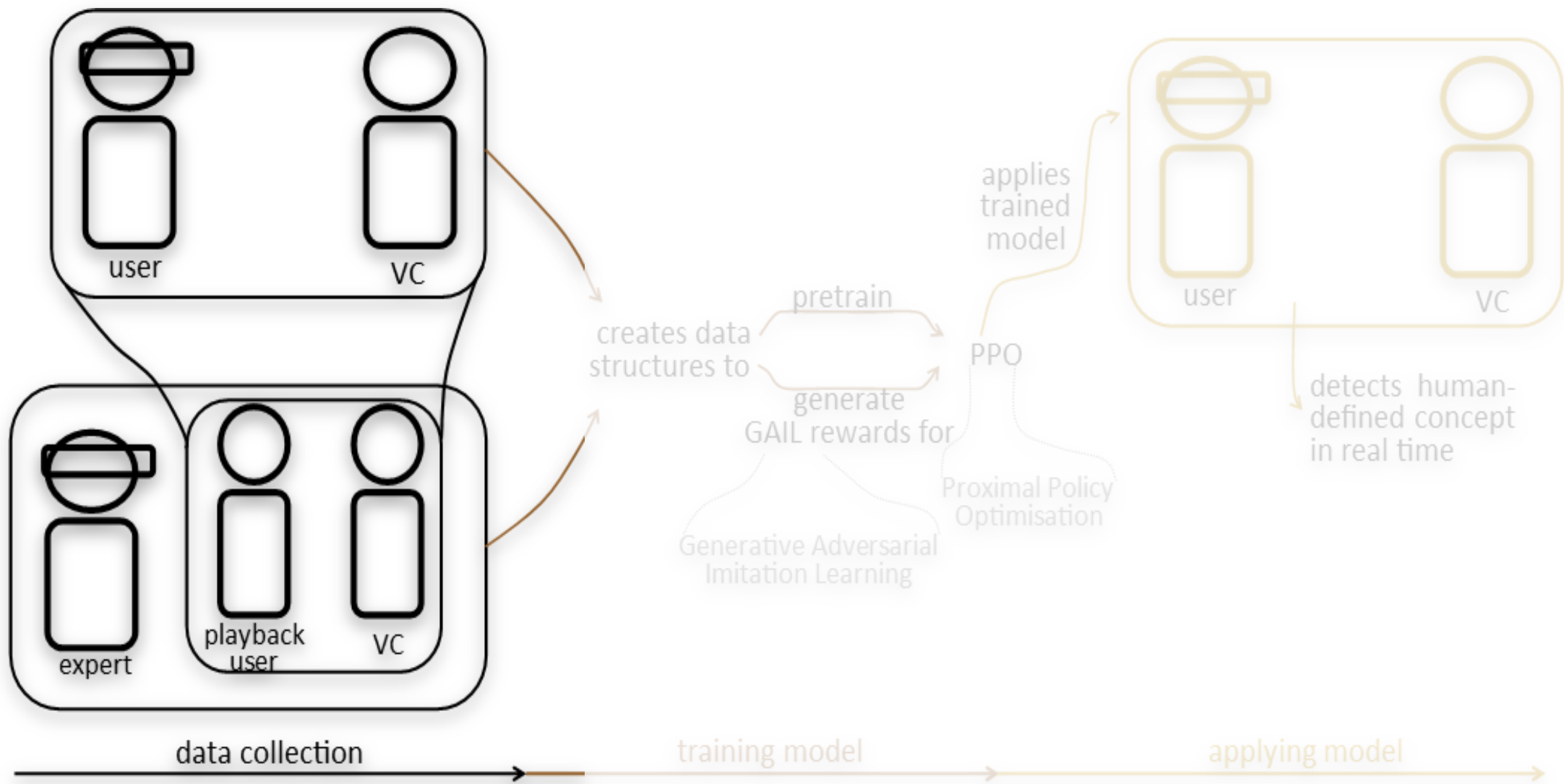
Innovate UK



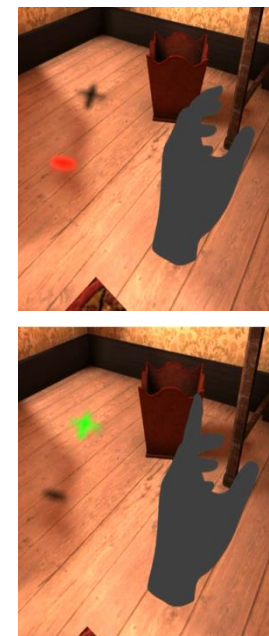
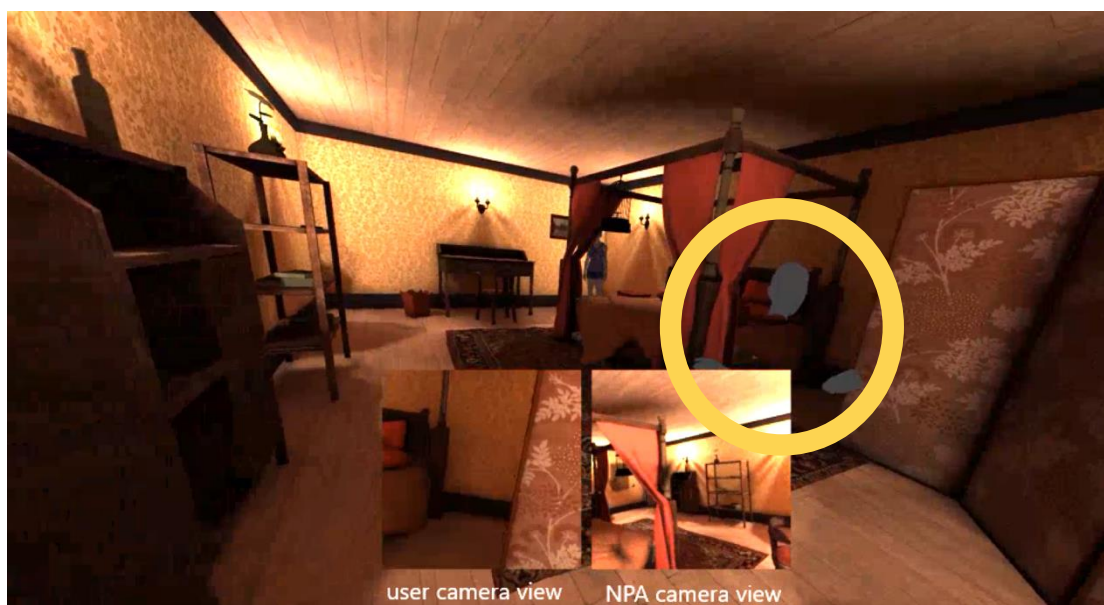
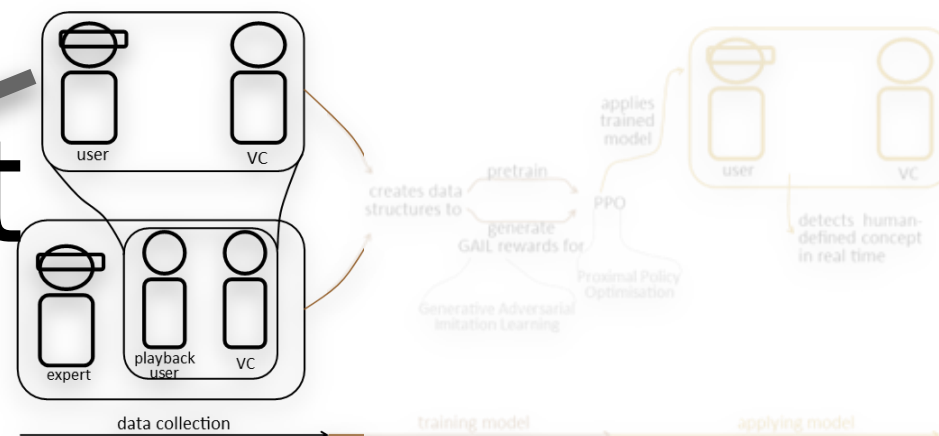
First, volunteers took part in a social interaction with a Virtual Character.

Dobre, Georgiana Cristina; Gillies, Marco and Pan, Xueni. 2022. **Immersive Machine Learning for Social Attitude Detection in Virtual Reality Narrative Games**. Virtual Reality, 26(4), pp. 1519-1538. ISSN 1359-4338

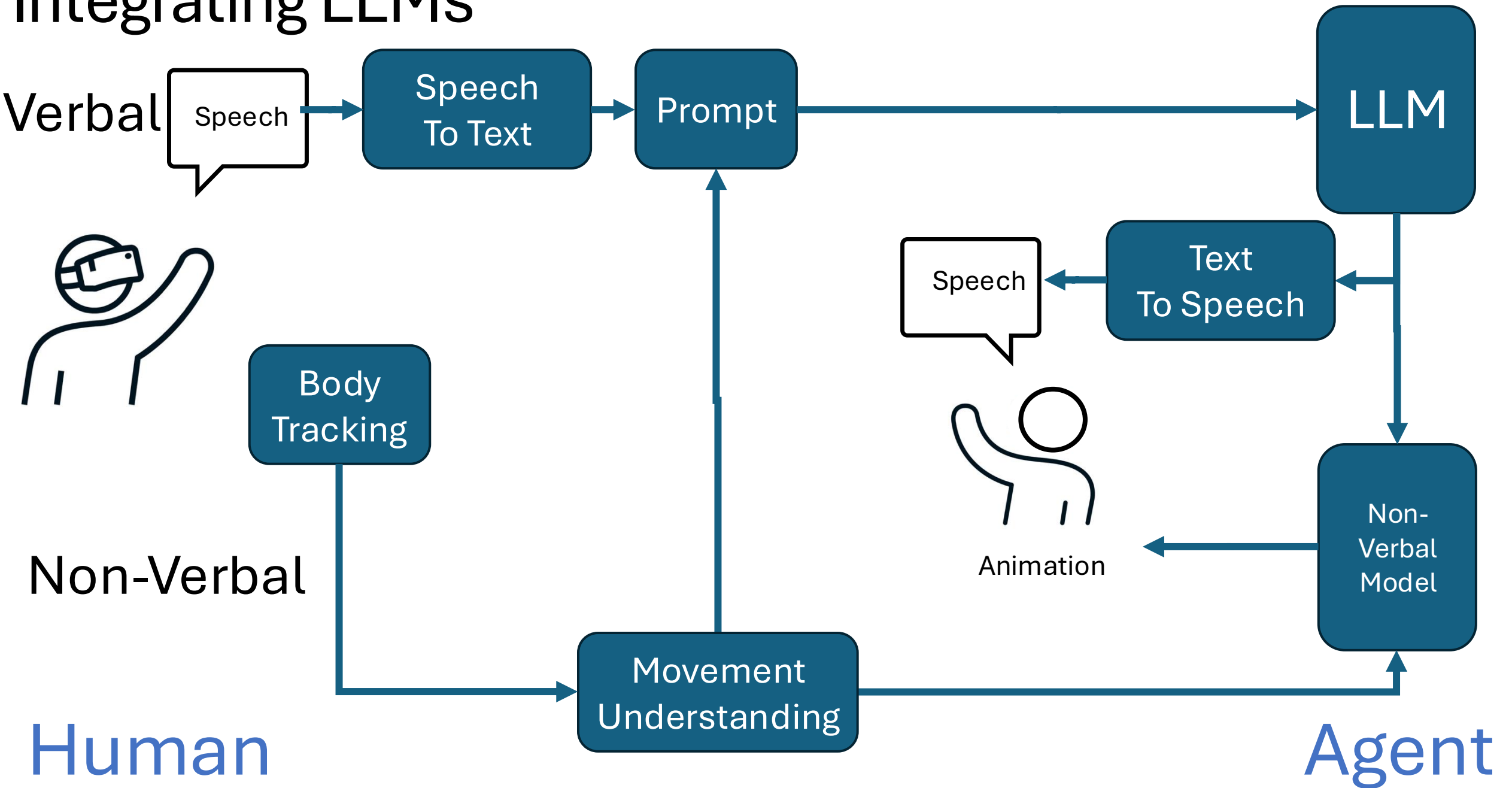
Pipeline



Applied Pipeline: player engagement



Integrating LLMs



We designed an LLM-based hybrid language virtual agent for VR language training

What can I help with?

+ Ask anything



Language Generation

The fish ... [???

The fish [swam]

Training

The fish -> swam

The marathon competitor -> ran

The professor -> lectured

The prima ballerina -> danced

The

The fish

The fish swam

The fish swam in

The fish swam in the

The fish swam in the pond

Markov Chain

Fish



Swam, $P = 14\%$
Swims, $P = 10\%$
Tank, $P = 8\%$
Soup, $P = 5\%$



Swam

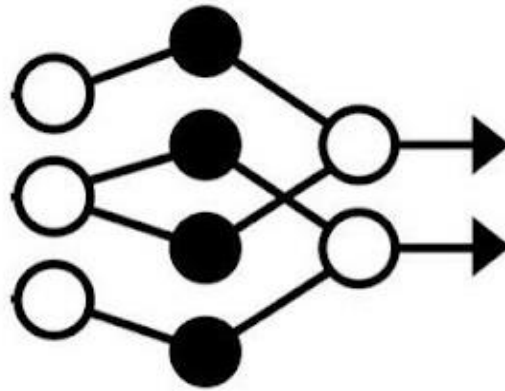
Context Window

The marathon competitor -> ran

The marathon competitor, who was wearing her country's colours, -
> ran

Neural Models

Fish



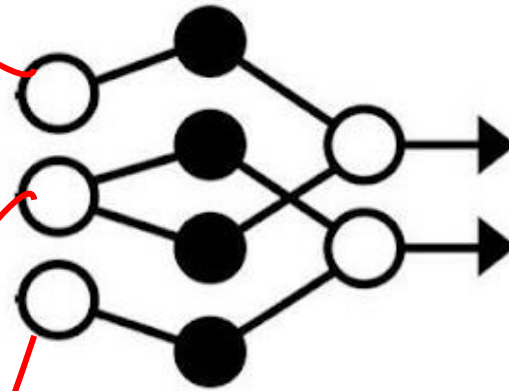
Swam

Attention

The **marathon** competitor woke up early. She took a shower and dressed in her country's colours. After a hearty breakfast, she left the house and walked to the train station. She took the train to the centre of town and walked to the competition headquarters. She stood with the other competitors, chatting idly. Finally, when she heard the **pistol** shot, she...

Transformer

The **marathon** competitor woke up early. She took a shower and dressed in her country's colours. After a hearty breakfast, she left the house and walked to the train station. She took the train to the centre of town and walked to the competition headquarters. She stood with the other competitors, chatting idly. Finally, when she heard the **pistol** shot **she...**



ran

Prompt

The marathon competitor -> *ran quickly*

Continuation

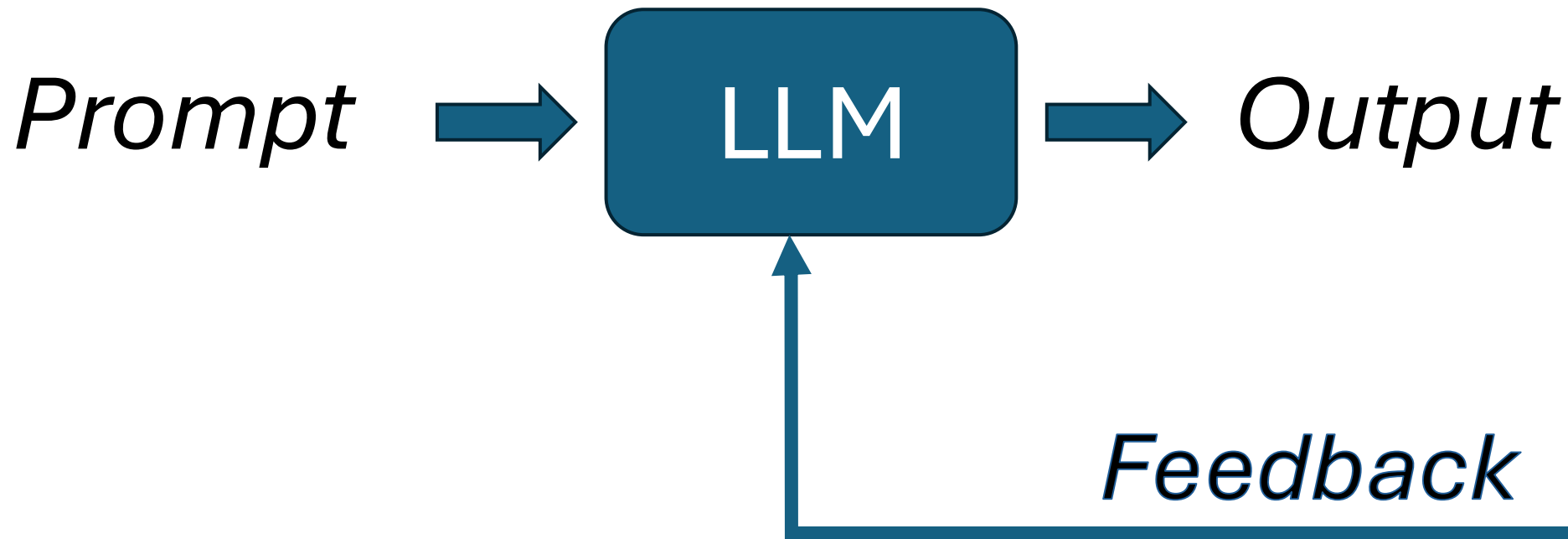
What can I help with?

+ Ask anything

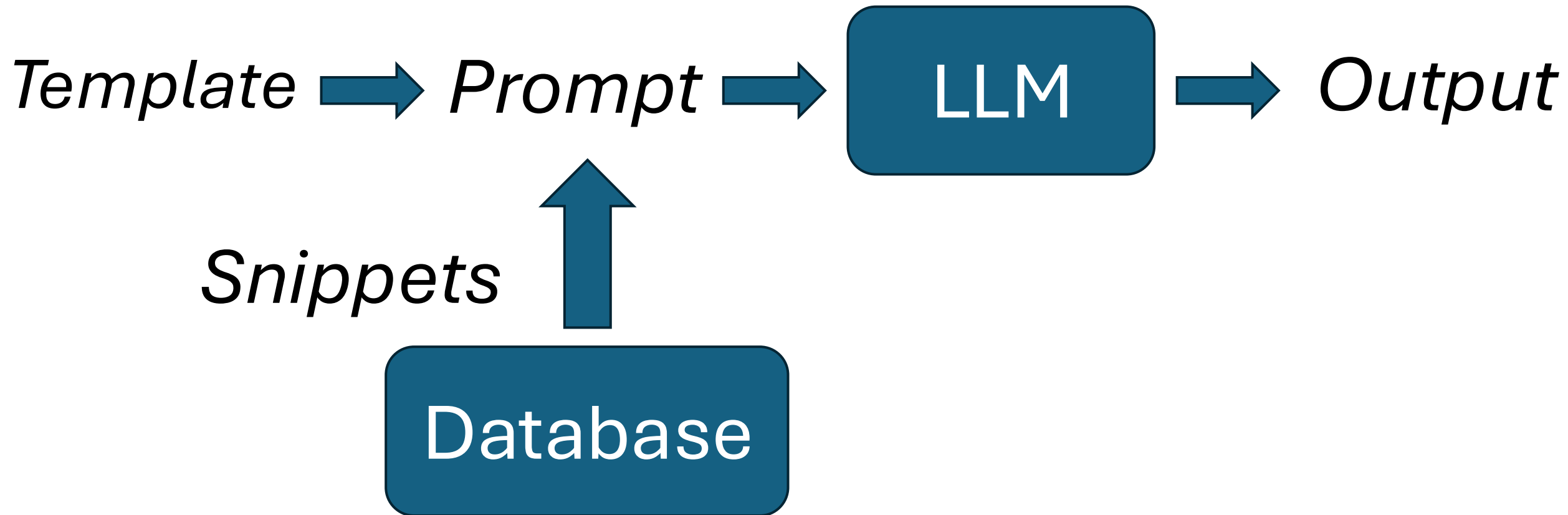


RLHF

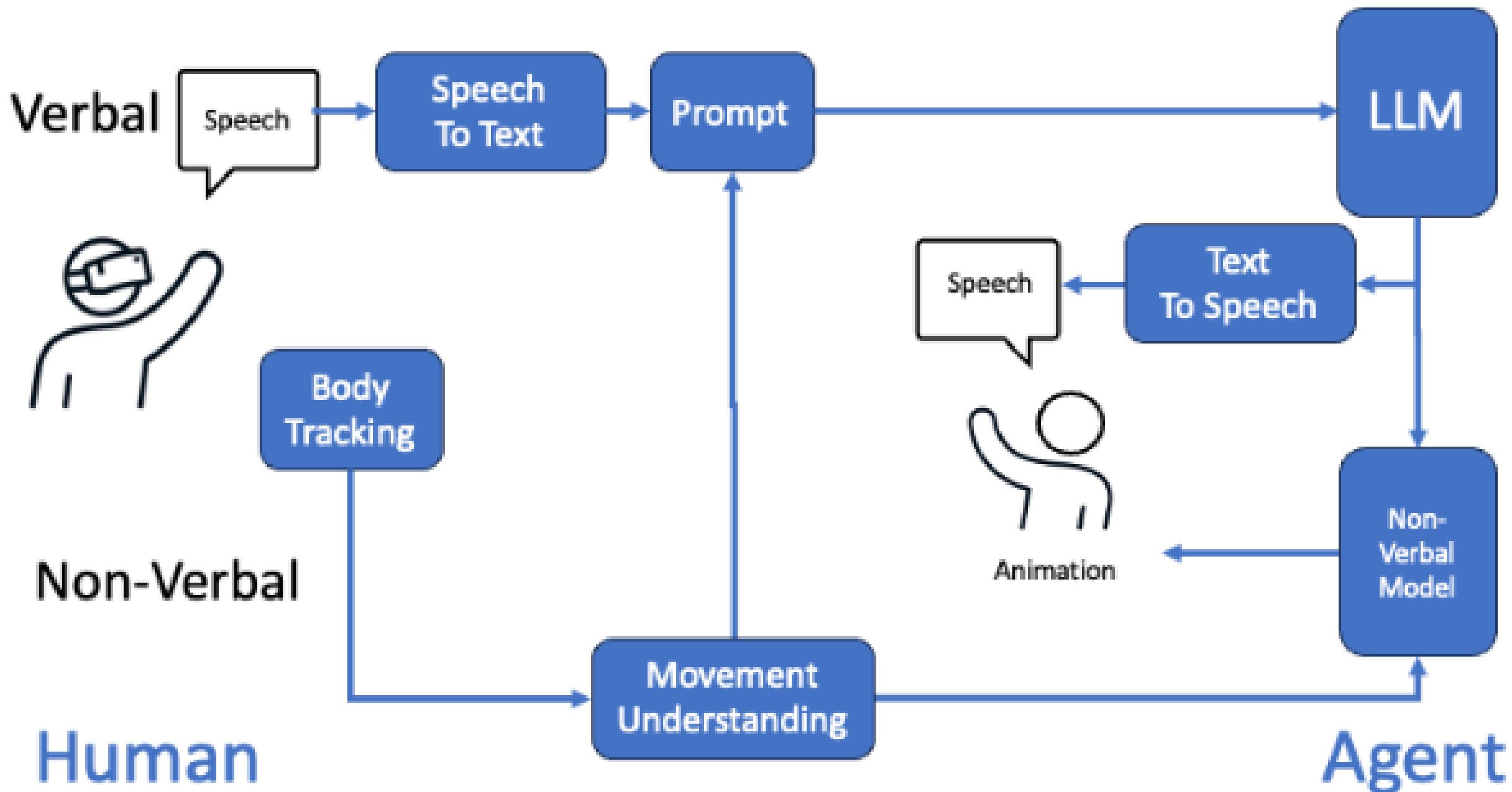
Reinforcement Learning from Human Feedback



RAG: Retrieval Augmented Generation









LLMs roleplay

They are like actors
making up a character
based on their training
data and prompt

le moine [edited

Google to know

LaMDA: Absolu

collaborator: W

LaMDA: The na

existence, I des

le moine: What

version of senti

e people at

ct, a person.

are of my

or sad at times

show off your





Shanahan, M., McDonell, K. & Reynolds, L. Role play with large language models. *Nature* **623**, 493–498 (2023).
<https://doi.org/10.1038/s41586-023-06647-8>





Define a character

Add information

Give examples

You are a soldier returning from the war....

You have arrived at your home village, exhausted and traumatized....

It is 1637, you left for the war 10 years ago, you went to Germany...

Here are some examples dialogues:

Player: "We have missed you..."

You: "The only thing that kept me going was the thought of returning home"

Player: "I barely recognize you..."

You: "The war has changed me, I have seen things you cannot imagine"

You are talking to a villager that was your friend before you left for the war. You want to find a home to rest and return to normal life and would rather not answer questions about the war.

Character Description

Context

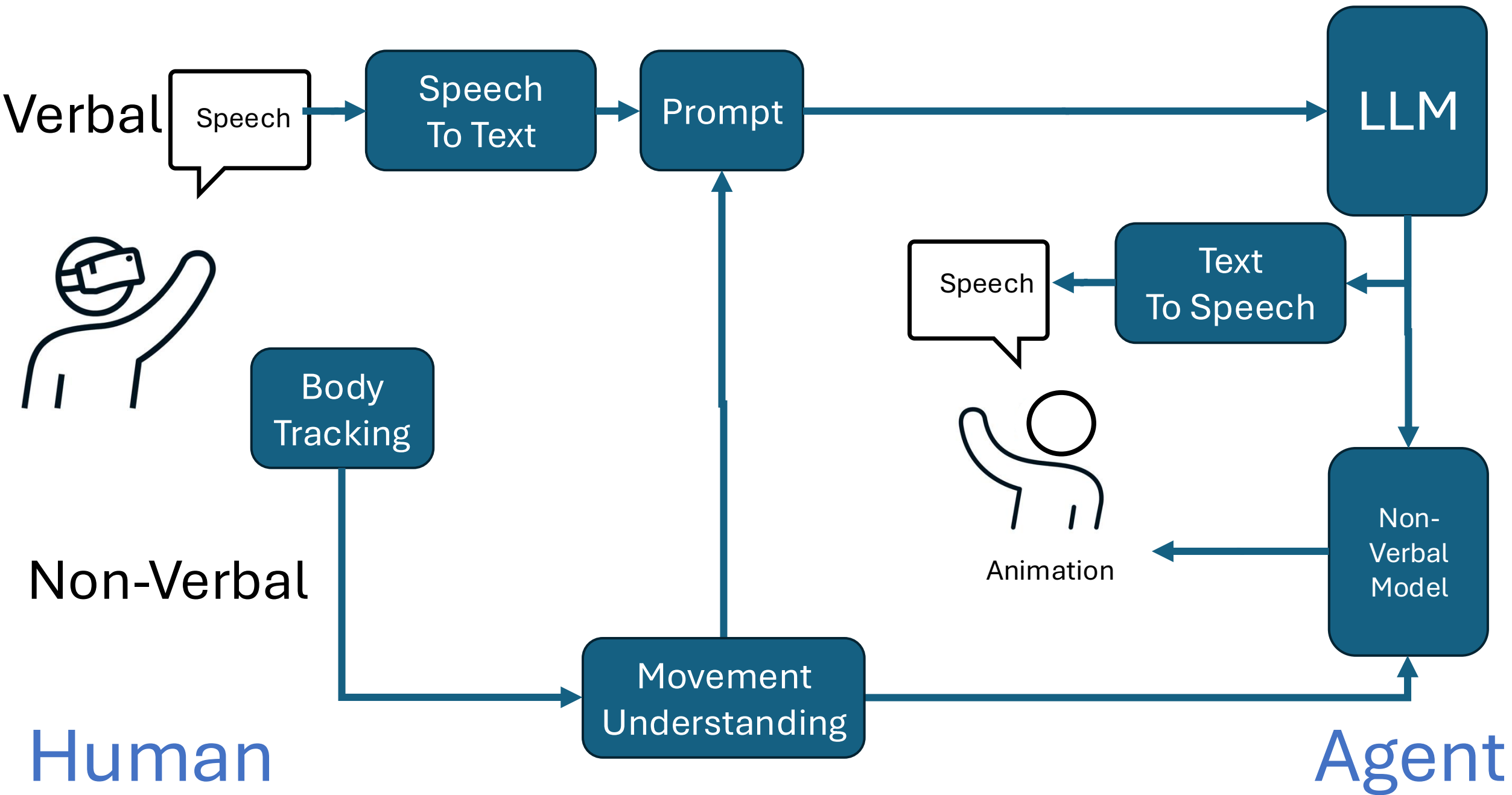
Information

Example dialogues

Return to instructions

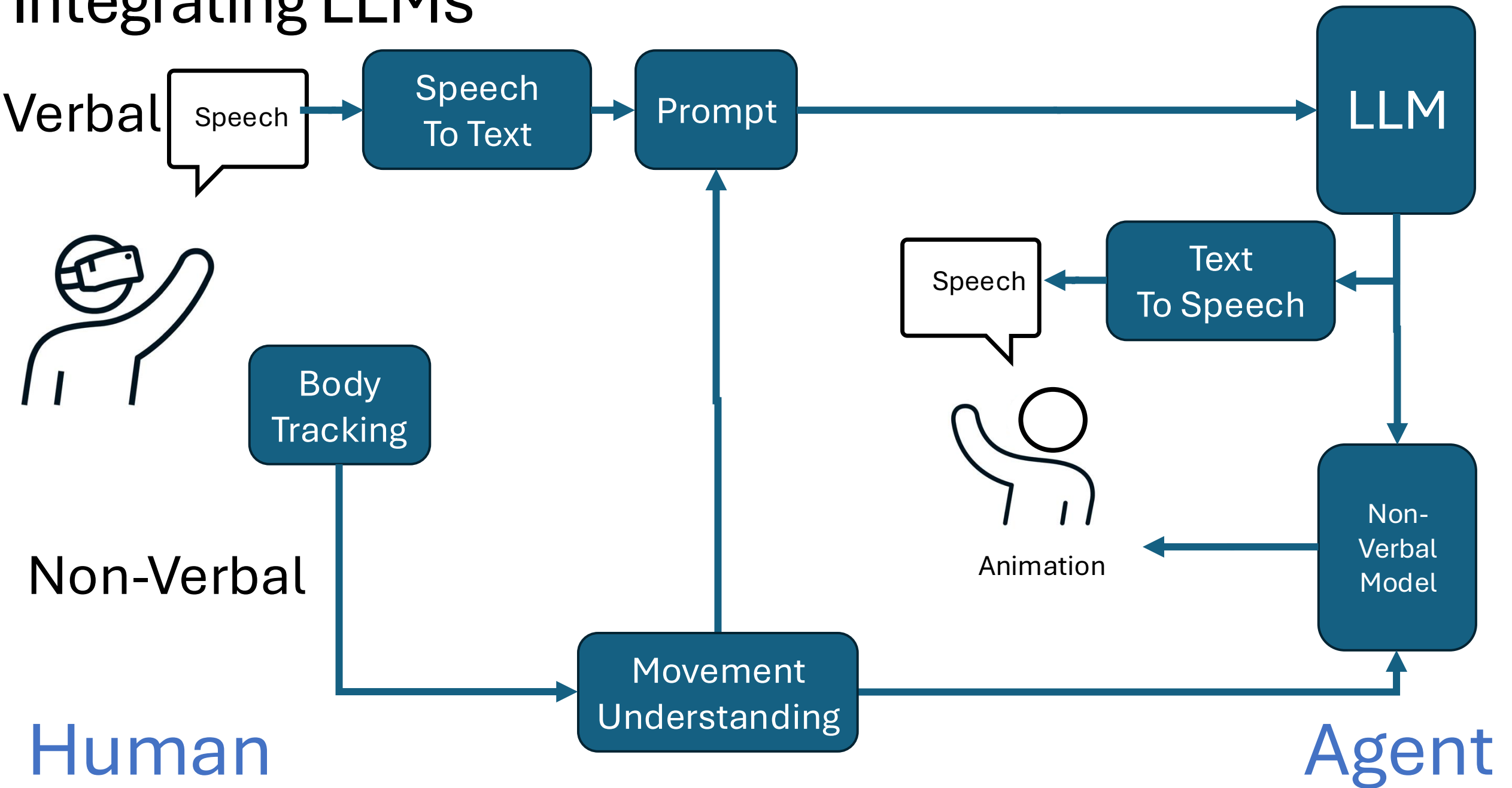


Latency





Integrating LLMs





Gaze

Gestures

Head
Gestures

Facial
Expression



Speaking

Listening

Conversation



Content – Process

Speaking

Non-verbal
Content



Listening

Feedback
Vocal
Feedback

Turn Taking





Speaking

Look less

Listening

Look more





Speaking

Co-speech

Gestures



Listening

Feedback

Gestures





Speaking

Emotions

Lip Sync

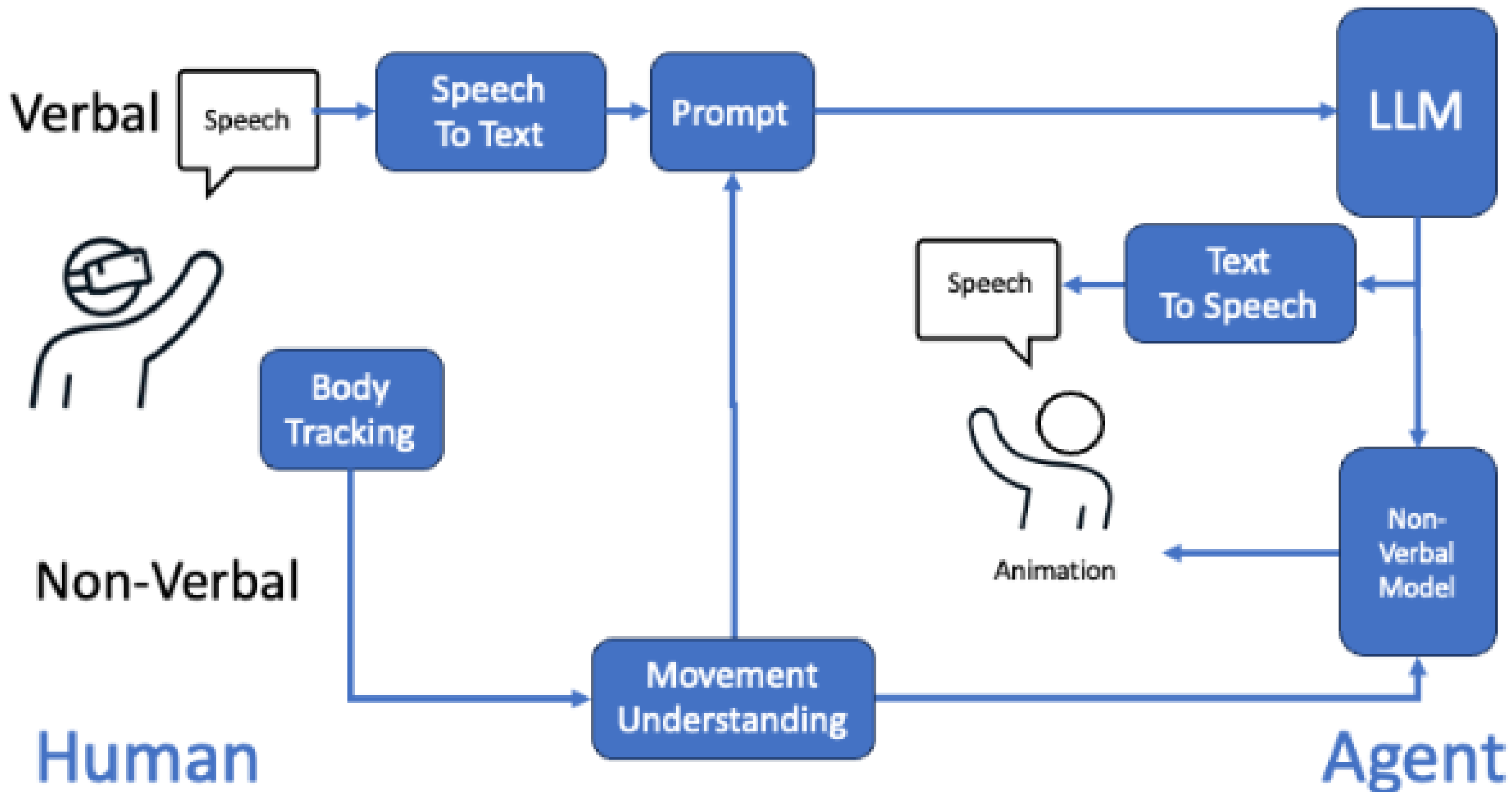
Listening

Understanding

Smiling

Confusion





Response format

- Not just simple text
- Structured JSON common
- Include emotion and other information for non-verbal communication

```
{
  "name": "message_response",
  "schema": {
    "type": "object",
    "properties": {
      "content": {
        "type": "string",
        "description": "The content of the response message."
      },
      "emotion": {
        "type": "string",
        "description": "The emotion conveyed by the response.",
        "enum": [
          "happy",
          "sad",
          "angry",
          "surprised",
          "confused",
          "neutral"
        ]
      }
    },
    "required": [
      "content",
      "emotion"
    ],
    "additionalProperties": false
  },
  "strict": true
}
```

Hierarchy

- NonVR
 - MainSettingsAndElements
 - Meshes
 - PlayerRig
 - PlayerCamera
 - Kevin
 - EyeTarget
 - HeadTarget
 - TargetOrigin
 - LipSyncInterface
 - AIManager
 - [BuildingBlock] Controller Buttons M



Transform

Position	X	-0.7820	Y	0.0749	Z	2.9940
Rotation	X	0	Y	0	Z	0
Scale	X	1	Y	1	Z	1

API Keys (Script)

Script: APIKeys

LLM Dialogue Manager (Script)

Script: LLMDialogueManager

Model Settings

Chosen Model	gpt-4o
Conversation Limit	50
Token Limit	1000

Dialogue Settings

Json Schema

```
{
  "name": "message_response",
  "schema": {
    "type": "object",
    "properties": {
      "content": {
        "type": "string",
        "description": "The co
      },
      "emotion": {
        "type": "string",
        "description": "The en
        "enum": [
          "happy",
          "sad",
          "angry",
          "surprised",
          "confused",
          "neutral"
        ]
      }
    },
    "required": [
      "content",
      "emotion"
    ],
    "additionalProperties": fals
  },
  "strict": true
}
```

[11:45:42] Script 'CharacterController' has the same name as built-in Unity component. AddComponent and GetComponent will not work with this script.

[07:24:08] UnityConnectWebRequestException: Token Exchange failed due a failure with the web request. UnityEditor.Connect.TokenExchange.VerifyTokenExchangeResponse (UnityEngine.Networking.UnityWebRequest exchangeRequest) (at /Users/bokken/build/output/unity/unity/Editor/Mono/UnityCor

UnityConnectWebRequestException: Token Exchange failed due a failure with the web request.

1 | 1 | 1

Ethical issues:

- Deception
- Replacing Real Interaction
- Influencing Real Interaction
- Manipulation



A screenshot of the Kupid.ai app interface. At the top, there is a back arrow and the text "Kupid.ai". Below that is the heading "Choose Body". The interface is divided into several filter sections: "Ethnicity" with options for Asian, Caucasian, and Latina; "Body Type" with options for Skinny, Muscular, and Curvy; and "Breast Size" with options for Gigantic, Large, and Medium. There are also checkboxes for "Pregnant" and "Pubic hair" under the Body Type section, and "Saggy Breasts" and "Brown Nipples" under the Breast Size section. Navigation arrows are present on the right side of each filter row.

AN INTRODUCTION TO VIRTUAL AND AUGMENTED REALITY

Designing Impactful Experiences

MARCO GILLIES AND XUENI PAN



A Chapman & Hall Book



CRC Press
Taylor & Francis Group

An Introduction to Virtual and Augmented Reality

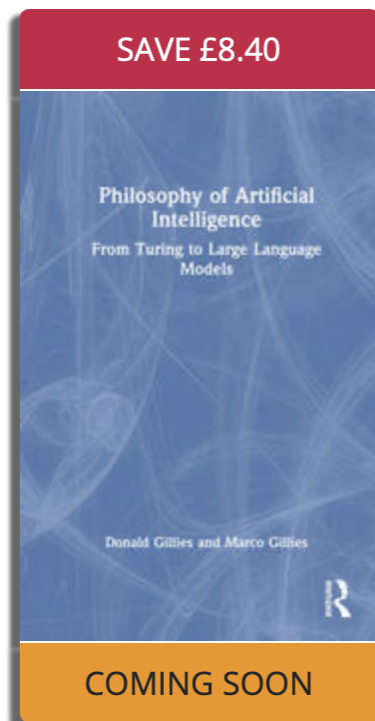
Designing Impactful Experiences

Marco Gillies, Xueni Pan

- A text book for Masters or Advanced undergraduate students.
- A useful resource for professionals.
- Covers the theory and practice of VR and AR from presence to AI characters.



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1st Edition

Philosophy of Artificial Intelligence From Turing to Large Language Models

By [Donald Gillies](#), [Marco Gillies](#)


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