MAI4CAREU

Master programmes in Artificial Intelligence 4 Careers in Europe

University of Cyprus

HUMAN-CENTERED INTELLIGENT USER INTERFACES - MAI648

Marios Belk

2022

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CONTENT 10

Conversational UIs

CONTENTS

- Definitions
- Chatbots
- Voice Assistants
- Voice UIs
- Historical Perspective
- Procedure for VUIs
- Designing VUIs
- Application Areas
- State-of-the-art Research in VUIs

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Learning Outcomes

- Know terms and definitions of conversational user interfaces
- Analyze how conversational user interfaces can improve usability and user experience
- Evaluate the challenges for designing conversational user interfaces

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Conversational UIs and Voice UIs

- What do you think is a conversational UI?

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Conversational UIs and Voice UIs

- What do you think is a voice UI?

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Conversational UIs and Voice UIs

- What's the difference?

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Great examples of conversational UIs

- Chatbots
- Voice assistants

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Chatbots

- Chatbots are AI-driven application that simulate a conversation with end-users
- Based on natural language processing mechanisms
- Chatbots communicate with end-users mainly by responding to users' questions aiming to provide assistance

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Chatbots

- Types of responses
  - Simple responses further to processing the users' questions
  - Personalized responses based on users' preferences and needs

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Benefits of having chatbots

- Provide automatic and quick and fast responses anytime
- Provide customer support during after hours
- Reduces the need of human helpdesk, instead the team can work on other complicated tasks within the team
- Help customers through the **business' marketing funnel**

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Types of chatbots

- **Support Chatbots** – provide quick support through Q&As
- **Skills Chatbots** – answer basic commands, like Amazon Alexa
- **Smart AI Chatbots** – provide answers to more complex questions through AI
- **Scripted Chatbots** – respond to scripted, commonly asked questions

Source: What Types of Chatbots are Best for Your Business Needs? - https://rockcontent.com/blog/types-of-chatbots/

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Voice assistants

- Voice assistant OR intelligent virtual assistant OR intelligent personal assistant
- *“Software agent that can perform tasks or services for an individual based on commands or questions” – Wikipedia*
- Provides communication between users and connected devices
  - smart home
  - smartphone-based helper

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Chatbots vs. voice assistants

- *The term "chatbot" is sometimes used to refer to virtual assistants generally or specifically accessed by online chat – Wikipedia*

- Chatbots used as information acquisition interfaces, like extracting product details
- Virtual assistants assist in conducting business, like reminding of meetings, managing to-do lists, taking down notes

Naveen Joshi (2018). Yes, Chatbots And Virtual Assistants Are Different! - https://www.forbes.com/sites/cognitiveworld/2018/12/23/yes-chatbots-and-virtual-assistants-are-different/?sh=417aed946d7d

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Chatbots vs. voice assistants

Chatbots

- Used as information acquisition tool
- Lack understanding human emotions
- Mostly scripted and do not maintain conversational flow

Voice assistants

- Provide assistance
- Can have empathy and understand human emotions
- Maintain conversational flow

Naveen Joshi (2018). Yes, Chatbots And Virtual Assistants Are Different! - https://www.forbes.com/sites/cognitiveworld/2018/12/23/yes-chatbots-and-virtual-assistants-are-different/?sh=417aed946d7d

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Voice UIs

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- *"Conversational UI **isn't a technology or piece of software**. It's a **paradigm** for interacting with technology that contextualizes the interaction in human terms first"*

AJ Burt (2019). Conversational UI: it's not just chat bots and voice assistants — a UX case study. https://uxdesign.cc/conversational-ui-its-not-just-chat-bots-and-voice-assistants-case-study-cb1865da306a

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Applications of Voice UIs

- Think about everyday applications and scenarios in which you interact with voice UIs

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Voice User Interfaces

In a nutshell…

- Computing machines that enable human-computer interaction though human voice

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Voice User Interfaces

- *“A voice-user interface (VUI) makes spoken human interaction with computers possible, using speech recognition to understand spoken commands and answer questions, and typically text to speech to play a reply. A voice command device (VCD) is a device controlled with a voice user interface.”*
- https://en.wikipedia.org/wiki/Voice_user_interface

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Voice User Interfaces

- *Voice user interfaces have been added to automobiles, home automation systems, computer operating systems, home appliances like washing machines and microwave ovens, and television remote controls.*
- *They are the primary way of interacting with virtual assistants on smartphones and smart speakers*
- https://en.wikipedia.org/wiki/Voice_user_interface

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Historical Perspective of Voice UIs

- 1950s. First generation of VUI.
  - Audrey - the Automatic Digit Recognizer, a system built by Bell Labs in 1952. It can recognize the digits zero to nine

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1952 Bell Labs Audrey. The photo shows only input and output controls but doesn’t show supportive electronics. (Image credit: Computerhistory)

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Historical Perspective of Voice UIs

- **1980s and 1990s.** Interactive voice response systems for telephony like Speechworks and Nuance
- Systems could recognize human voice over telephony calls and subsequenetly run the command given to them
  - Examples include getting flight information like flight status
  - make a hotel booking.

https://www.smashingmagazine.com/2022/02/voice-user-interfaces-guide/

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Historical Perspective of Voice UIs

- **2010s and 2020s.** Voice Uis powered by AI technology
- Examples of smart assistants
  - Apple Siri
  - Google Assistant
  - Microsoft Cortana
- Smart assistants can understand what the user is saying and offer suitable options

https://www.smashingmagazine.com/2022/02/voice-user-interfaces-guide/

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Another view on the evolution of VUIs

- 1952: Audrey by Bell Labs - recognizes the numbers from 0-9
- 1962: Shoebox by IBM - understands 16 English words
- 1970: Hidden Markov Model, which enabled speech recognition technology to predict speech
- 1971: US Department of Defense (DARPA) “Speech Understanding Research” program
  - The programme produced Harpy speech understanding system, which could understand over 1000 words

https://www.infostretch.com/blog/view-from-the-labs-voice-user-interfaces-a-short-history-and-a-bright-future/

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Another view on the evolution of VUIs

- 1984: Speechworks Automated Speech Recognition over Interactive Voice Response on telephone
- 1996: BellSouth launched VAL, first voice portal based on dial-in interactive voice recognition system
- 1997: Dragon Dictate, first software to enable recognition of continuous speech

https://www.infostretch.com/blog/view-from-the-labs-voice-user-interfaces-a-short-history-and-a-bright-future/

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Another view on the evolution of VUIs

- 2007: Siri was founded to enable natural human to machine interaction through voice interface
- 2008: Google launched Voice search app which enabled users to make queries using voice
- 2011: Siri launched with iPhone 4S integrated with iOS
- 2014: Amazon Echo launched
- 2016: Google Home launched

https://www.infostretch.com/blog/view-from-the-labs-voice-user-interfaces-a-short-history-and-a-bright-future/

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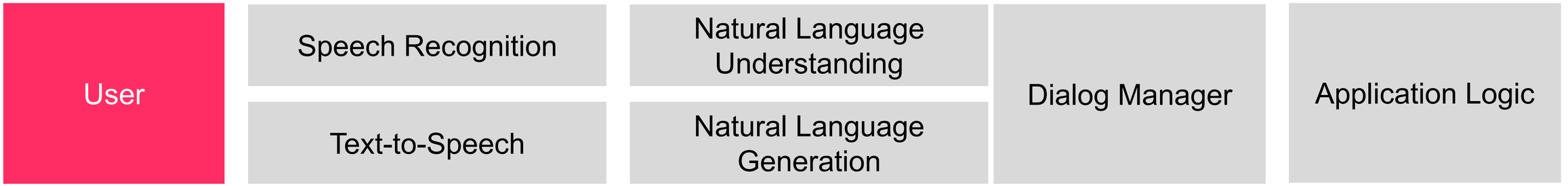
Voice UI Procedure



https://lekta.ai/
https://www.infostretch.com/blog/view-from-the-labs-voice-user-interfaces-a-short-history-and-a-bright-future/

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Voice UI Procedure

- **Activation:** VUIs are activated through keywords (or “wake words”)
  - E.g., “Alexa”
- **Speech Recognition:** The system converts vocal-based queries and/or commands into a textual form that can be processed by the system
- **Natural Language Understanding:** The transcribed text is processed by the system in order to give meaning to it, and accordingly understand the user’s intention

https://www.infostretch.com/blog/view-from-the-labs-voice-user-interfaces-a-short-history-and-a-bright-future/

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Voice UI Procedure

- **Action:** According to the user's intention, the system runs certain tasks
  - Examples include, performing an online search, connecting with third party services like getting the weather information
- **Natural Language Generation:** Once the information is found, the system communicates the information back go the user via speech synthesizer and text-to-speech

https://www.infostretch.com/blog/view-from-the-labs-voice-user-interfaces-a-short-history-and-a-bright-future/

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Speech Recognition

- Aims to filter out noise and capture the user's commands
- Main steps
  - Remove background noise and echo
  - Separate user's voice from other sounds in the room
  - Adjust to approximate the user's distance from the device

https://www.infostretch.com/blog/view-from-the-labs-voice-user-interfaces-a-short-history-and-a-bright-future/

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Natural Language Processing

- Enables the system to interact with the user naturally
- Aims to mimic a natural conversation with the user
- Systems process a large range of conversational input

https://www.infostretch.com/blog/view-from-the-labs-voice-user-interfaces-a-short-history-and-a-bright-future/

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IBM Watson wins Jeopardy

- Jeopardy! is an American television game show created by Merv Griffin. The show features a quiz competition in which **contestants are presented with general knowledge clues in the form of answers, and must phrase their responses in the form of questions - https://en.wikipedia.org/wiki/Jeopardy!**
  - Contestants are presented with answers and they need to respond with questions

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CONTENT 10

IBM Watson wins Jeopardy

https://www.youtube.com/watch?v=P18EdAKuC1U

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How to design a good VUI?

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CONTENT 10

Properties of a Good VUI

- **Design voice-first UIs**, hands-free and eyes-free UIs.
  - Even in case a device has a screen
  - Screens can complement the voice interaction
  - Some tasks might be inefficient to complete with voice only, like scrolling through the search results
- **Human-like, natural conversation**
  - Interaction should feel like an interaction with a human, not a robot
  - Conversation should resemble natural human conversation
  - Use everyday language

https://www.smashingmagazine.com/2022/02/voice-user-interfaces-guide/

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Properties of a Good VUI

- **Personalization**
  - Personalize the interaction
  - Examples?
- **Voice Tone**
  - Create good impressions
  - Give to the VUI a personality - create the right brand persona

https://www.smashingmagazine.com/2022/02/voice-user-interfaces-guide/

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Properties of a Good VUI

- **Context of Use**
  - Understand where and in which context the VUI will be used
- **Perceived Trust**
  - Privacy-preservation
  - Avoid offensive content
  - Avoid promotional content

https://www.smashingmagazine.com/2022/02/voice-user-interfaces-guide/

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Modern VUIs

- Examples of popular voice-based assistants
  - Alexa, Siri, Google assistant
- These systems use microphone-based devices that are connected to the internet
  - Thin clients
- AI runs on the cloud
- Can be customized
  - E.g., Amazon enables developers to create their own services – namely skills

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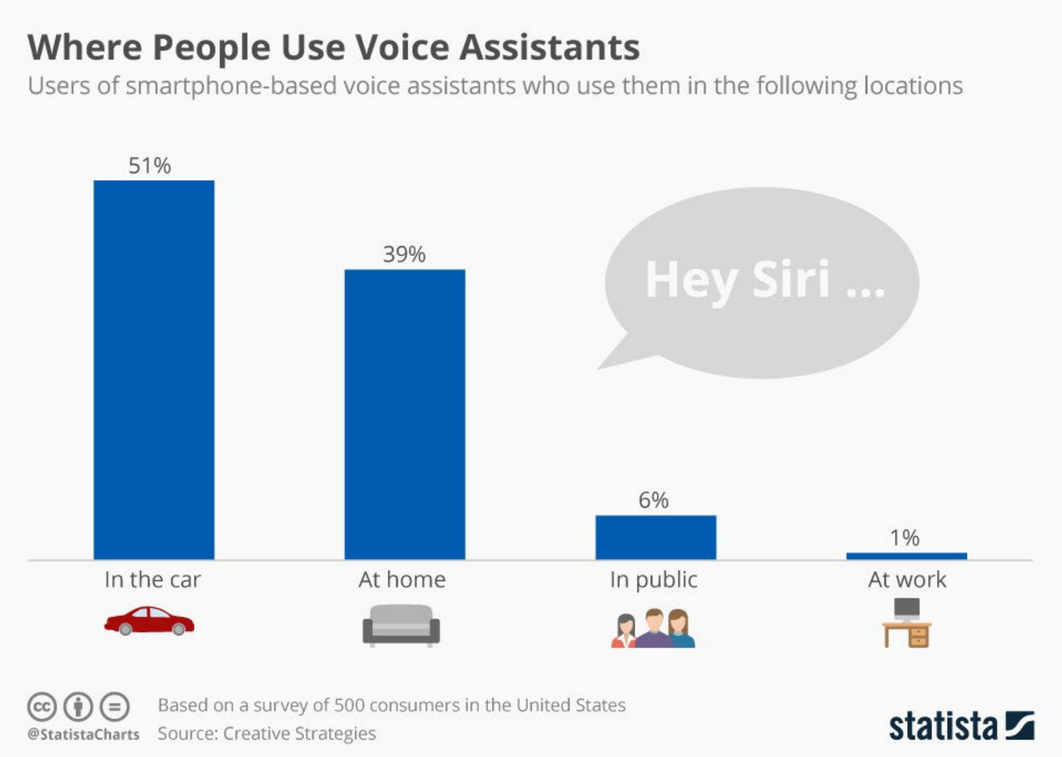
Popular Application Areas of VUIs



https://medium.muz.li/voice-user-interfaces-vui-the-ultimate-designers-guide-8756cb2578a1

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HCI principles when designing VUIs

- Think about the main principles we covered during the HCI-related class
- Which HCI principles can be applied in VUIs?
- Which HCI principles do not exist in VUIs?

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HCI principles when designing VUIs

- No affordances
- HCI principles that are important in VUIs
  - Consistent design, what design? Lexical
  - Feedback, can be visual, acoustic, spoken
  - Metaphors, how?
- Putting logical constraints in VUI
- Error tolerance in ambiguities

Andreas Butz. Intelligent User Interfaces (IUI). Voice User interfaces

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Design guidelines for VUIs

- Inform the users what they can do when they interact with the system
- Inform the users where they are
- Provide examples rather than instructions
- Limit the amount of information
  - Short-term memory of users
- Use visual feedback

Voice User Interfaces - https://www.interaction-design.org/literature/topics/voice-user-interfaces
Andreas Butz. Intelligent User Interfaces (IUI). Voice User interfaces

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Process to design VUIs

- Design a dialog structure
- Think of alternatives
  - structure
  - wording
- Try out your dialog
  - wizard of Oz technique
  - use outside people
- Refine, Revise, Repeat

From Andreas Butz. Intelligent User Interfaces (IUI). Voice User interfaces

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Challenges and opportunities when designing VUIs

- **1. Inform the user what the VUI can do**, what they can ask, etc.
- How does the user know what they can ask, how much information they will receive, can they make follow up questions?
- VUIs need to educate the users what more is possible
  - e.g., Apple Siri has list of possible questions the user can ask
  - Is it enough?

Arnita Saini (2016). Voice User Interfaces — 15 challenges and opportunities for design. https://uxdesign.cc/why-is-it-so-difficult-to-use-and-design-voice-uis-87f2976aa796

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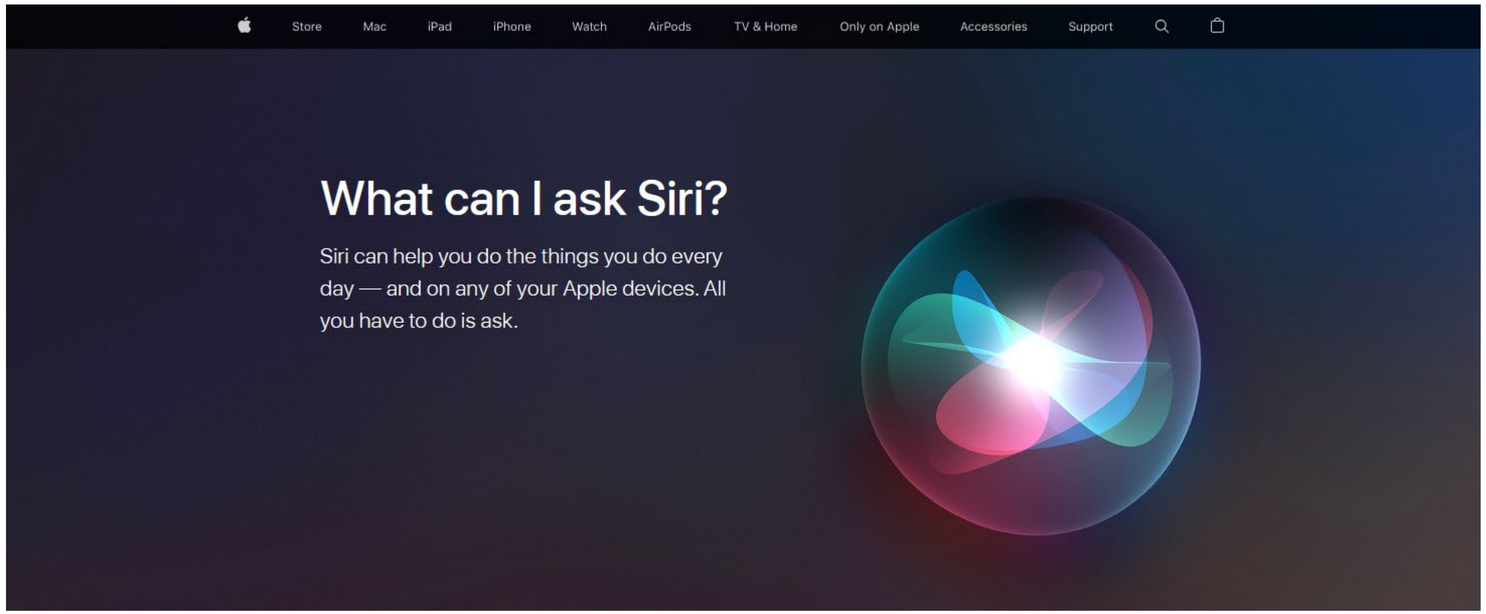

https://support.apple.com/siri

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Challenges and opportunities when designing VUIs

- **2. Inform the user what the VUI cannot do**
- **3. Visibility of system status**
  - Communicating the system's status
- **4. Error correction**
  - One way is to ask the user to say the whole sentence again
  - What else could be done?

Apple Siri

Arnita Saini (2016). Voice User Interfaces — 15 challenges and opportunities for design. https://uxdesign.cc/why-is-it-so-difficult-to-use-and-design-voice-uis-87f2976aa796

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Challenges and opportunities when designing VUIs

- **5. Error prevention**
- **6. Repeated activation**
  - Currently, applications have activation commands like “Alexa”, “Hey Siri”
  - However, in real-life we don’t call each other “Hey Mario” when we are in a conversation
  - Applications should keep a window open during a conversation
- **7. Short dialogues vs. accuracy of user intent**

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Challenges and opportunities when designing VUIs

- **8. Prototyping and testing**
  - No paper prototypes
  - Limited prototyping tools
- **9. Design guidelines**
  - Limited
  - Check out Amazon guidelines
    - https://developer.amazon.com/en-US/docs/alexa/custom-skills/voice-design-best-practices-legacy.html

Arnita Saini (2016). Voice User Interfaces — 15 challenges and opportunities for design. https://uxdesign.cc/why-is-it-so-difficult-to-use-and-design-voice-uis-87f2976aa796

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Challenges and opportunities when designing VUIs

- **10. Voice UI design documentation**
  - Difficult to cover all possible scenarios
- **11. Difficult to cover all possible visual interaction scenarios in voice interaction scenarios**
- **12. Designing regional and personalized assistants**
  - Accent and common phrases
  - *Try to ask Siri, “Hey Siri, call Argyris”*

Arnita Saini (2016). Voice User Interfaces — 15 challenges and opportunities for design. https://uxdesign.cc/why-is-it-so-difficult-to-use-and-design-voice-uis-87f2976aa796

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Challenges and opportunities when designing VUIs

- **13. The social awkwardness**
  - Do you remember of a time in which it was odd when people talked with headphones?
  - VUIs are still not totally embedded in our lives, yet
- **14. Hard to find niche use-cases**

Arnita Saini (2016). Voice User Interfaces — 15 challenges and opportunities for design. https://uxdesign.cc/why-is-it-so-difficult-to-use-and-design-voice-uis-87f2976aa796

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Special Topics in VUI

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- Sven Mayer, Gierad Laput, and Chris Harrison. 2020. Enhancing Mobile Voice Assistants with WorldGaze. In Proceedings of the 2020 CHI Conference on Human Factors in Computing Systems (CHI '20). Association for Computing Machinery, New York, NY, USA, 1–10. DOI: https://doi.org/10.1145/3313831.3376479

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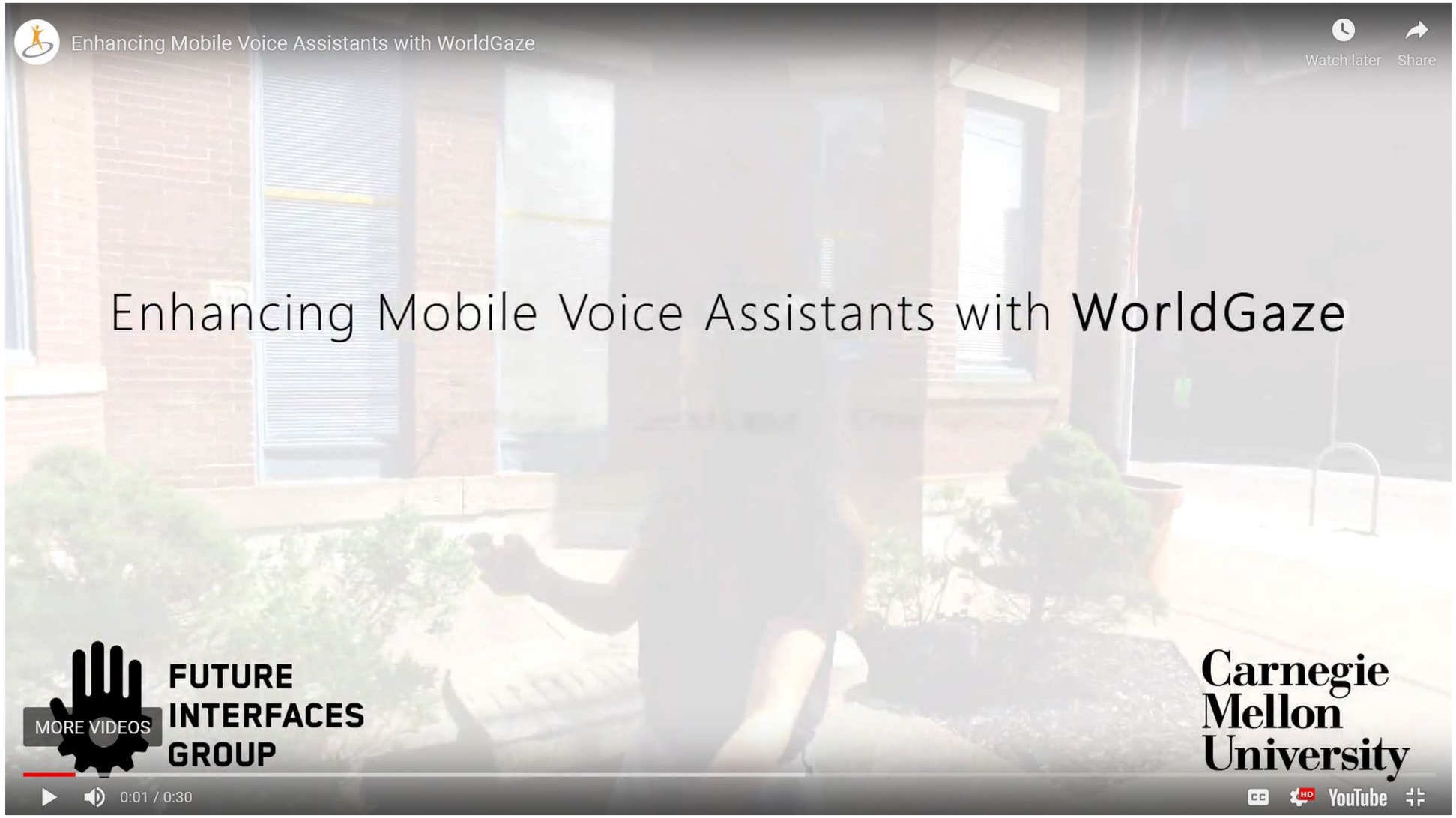

https://www.youtube.com/watch?v=3R_eynG5Vps&t=1s

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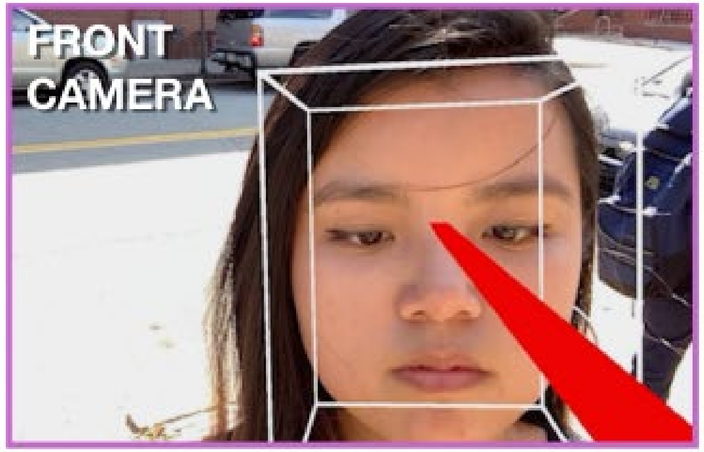
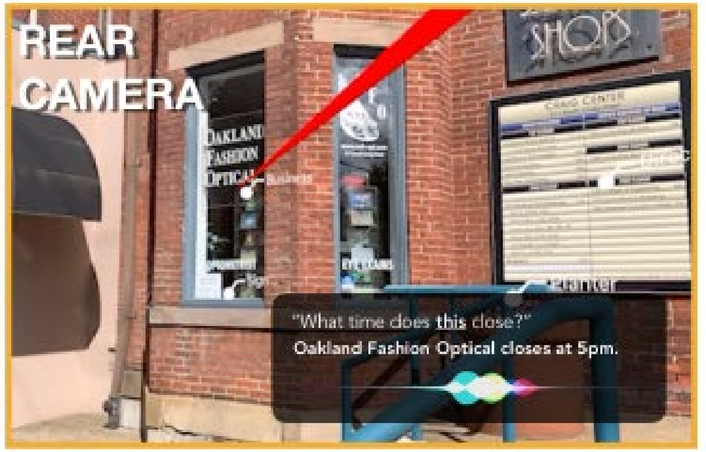
CONTENT 10

WorldGaze





- WorldGaze simultaneously opens the front and rear camera on smartphones. The front camera is used to track the user's 3D head vector, which is then raycast into the world as seen by the rear camera. This allows users to intuitively define an object or region of interest using their head gaze, which voice assistants can utilize for more precise and natural interactions (right bottom).

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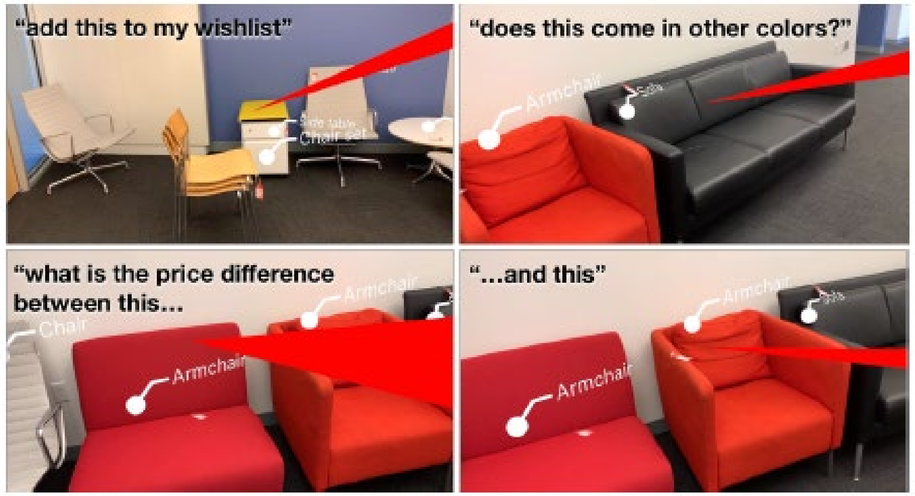
CONTENT 10

WorldGaze



- In retail settings, WorldGaze-augmented shopping apps could allow users to rapidly retrieve item information

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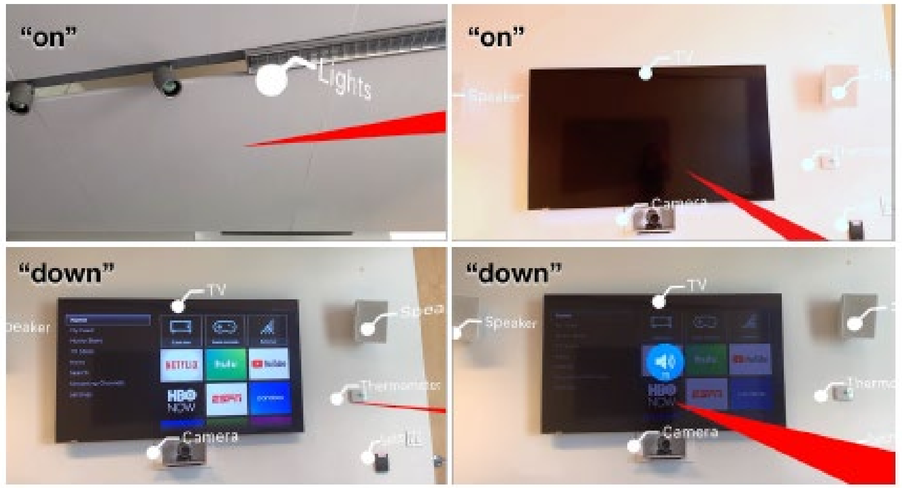
CONTENT 10

WorldGaze



- WorldGaze could be especially useful in settings with many IoT appliances, where extra context could be used to resolve otherwise ambiguous verbs, like go, play or start

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CONTENT 10

Voicemoji

- Mingrui Ray Zhang, Ruolin Wang, Xuhai Xu, Qisheng Li, Ather Sharif, and Jacob O. Wobbrock. 2021. Voicemoji: Emoji Entry Using Voice for Visually Impaired People. In Proceedings of the 2021 CHI Conference on Human Factors in Computing Systems (CHI '21). Association for Computing Machinery, New York, NY, USA, Article 37, 1–18. https://doi.org/10.1145/3411764.3445338

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CONTENT 10

LightWrite

- Zihan Wu, Chun Yu, Xuhai Xu, Tong Wei, Tianyuan Zou, Ruolin Wang, and Yuanchun Shi. 2021. LightWrite: Teach Handwriting to The Visually Impaired with A Smartphone. In Proceedings of the 2021 CHI Conference on Human Factors in Computing Systems (CHI '21). Association for Computing Machinery, New York, NY, USA, Article 32, 1–15. https://doi.org/10.1145/3411764.3445322

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CONTENT 10

Sources

- Intelligent User Interfaces (IUI) Block 1: Voice User interfaces Session 1: Introduction, Terminology, Concepts LMU München, Medieninformatik Prof. Dr. Andreas Butz WS2020/21
- Arnita Saini (2016). Voice User Interfaces — 15 challenges and opportunities for design. https://uxdesign.cc/why-is-it-so-difficult-to-use-and-design-voice-uis-87f2976aa796

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Thank you.

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