

AI to Support Everyday Life for People with Dementia

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What is Dementia?



DEMENTIA

Umbrella term for loss of memory and other thinking abilities severe enough to interfere with daily life.

Alzheimer's:
60-80%

**Lewy Body
Dementia:**
5-10%

**Vascular
Dementia:**
5-10%

**Frontotemporal
Dementia:**
5-10%

**Others:
Parkinson's,
Huntington's**

Mixed dementia:
Dementia from more than one cause

Stages of Dementia



Mild

Moderate

Severe



Mild

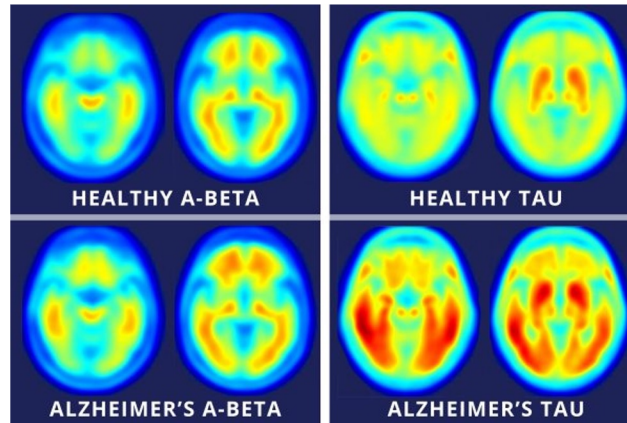
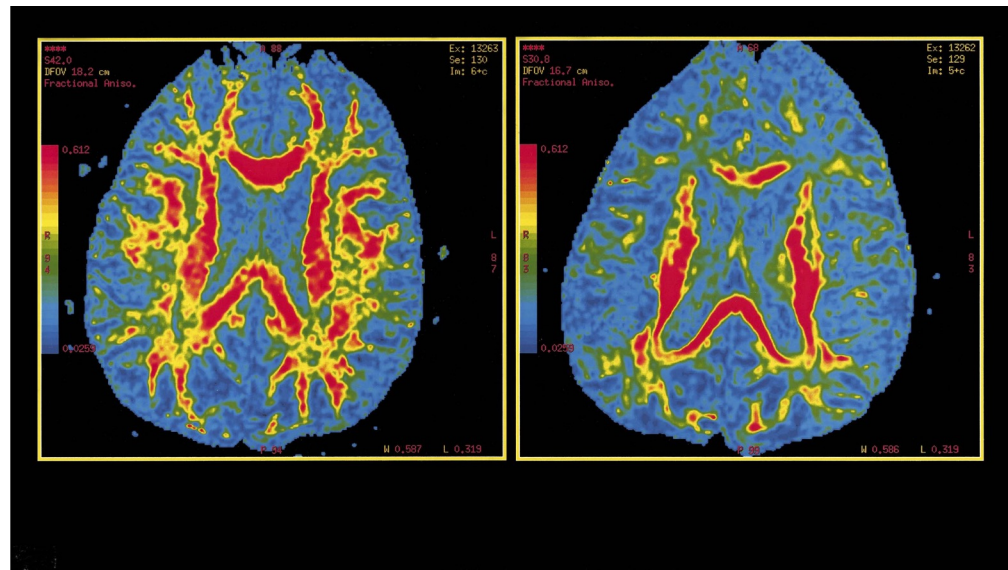
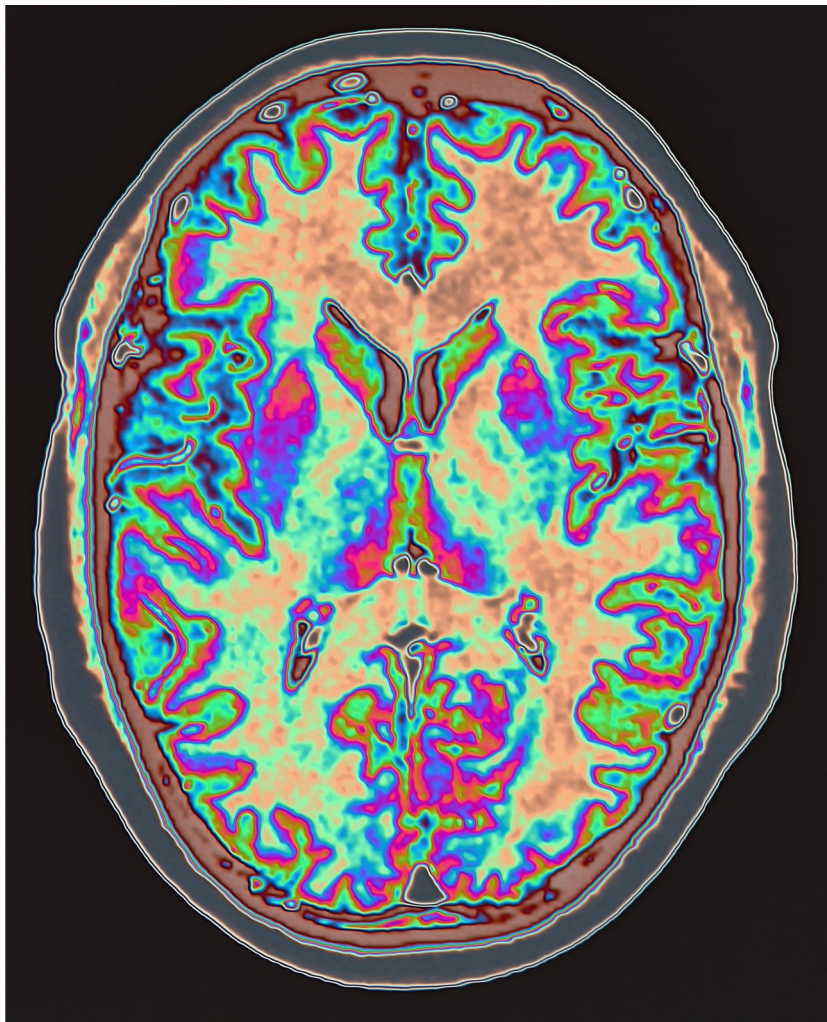
Moderate

55 million

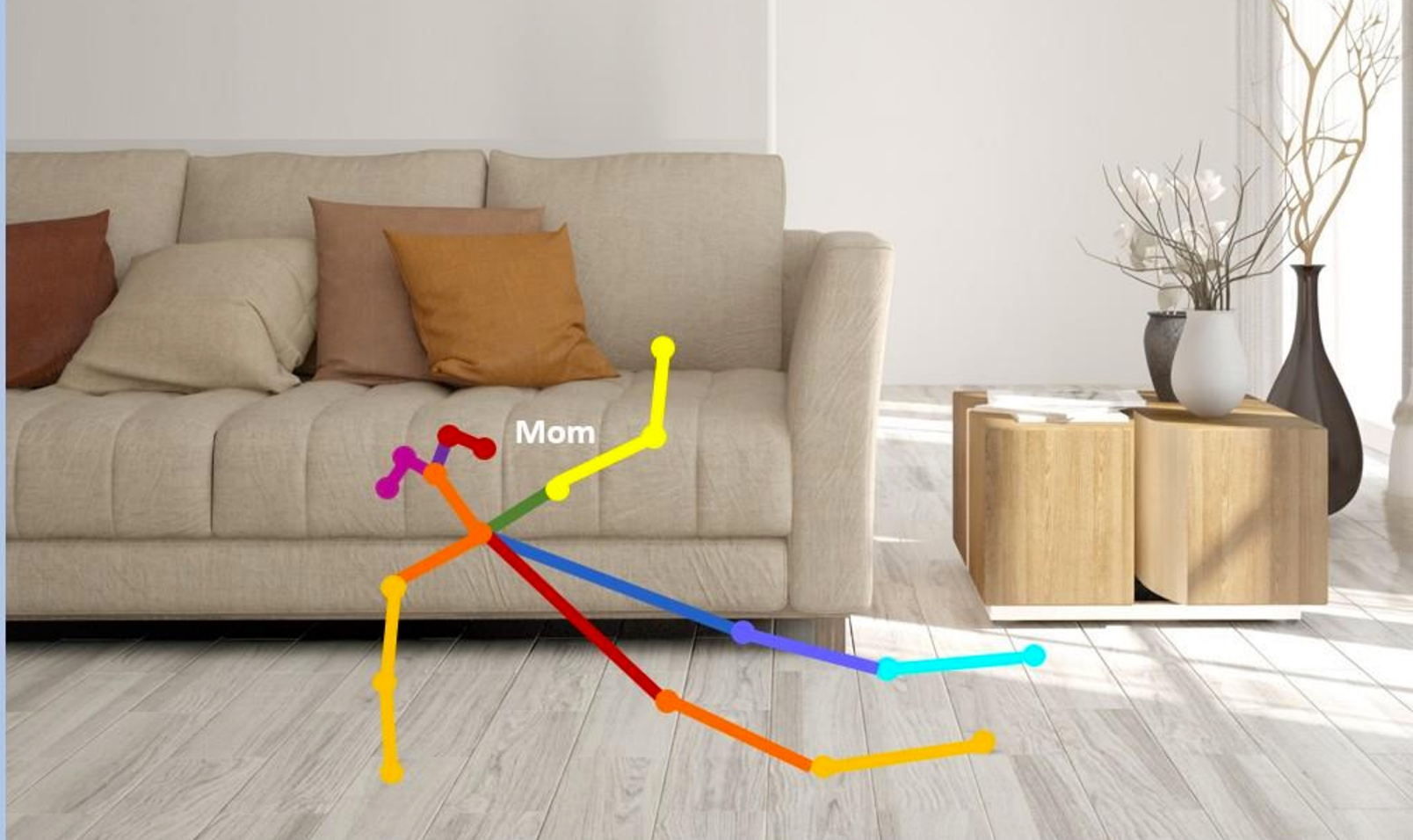
10 million new cases each year

World Health Organization





AI Imaging
For Early
Detection of
Alzheimer



Technology also has great potential to assist people in the mild to moderate stages of dementia.



Opportunities to design human-centered technologies, with high levels of human control and high levels of automation.



1 Current AI use by people with dementia



2 Promising future directions for AI and Dementia



1. Current AI use by people living with mild to moderate dementia



Research Questions

In what ways do tech-savvy people with mild to moderate dementia use AI in their daily life?

Emma Dixon, Anne Marie Piper, and Amanda Lazar. “Taking care of myself as long as I can”: How People with Dementia Configure Self-Management Systems. CHI’21.

Arthur's daily routine with AI



8:30 PM

7:00 AM

"Arthur,
your tea
is ready"

"Flash
briefing"



7:30 AM

Arthur's daily routine with AI

mindful exercise
to "get rid of the
cobwebs"



8:20 AM

9:00 AM



"Arthur, you
need to have
a shower or
you will
smell."

"so I can
take Alexa
out with me"



9:30 AM

"Your bus
arrives in
20
minutes."

Arthur's daily routine with AI



Arthur says he has designed a system, which “keep[s] me in that routine” that he has established to work within the context of his daily life and social relationships

1 Current AI use by people with dementia



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Research Questions

R1: What challenges do people with mild to moderate dementia experience when using technology?

R2: How could AI systems be used to address these challenges?

- Emma Dixon, and Amanda Lazar. “The Role of Sensory Changes in Everyday Technology Use by People with Mild to Moderate Dementia.” In The 22nd International ACM SIGACCESS Conference on Computers and Accessibility, 1–12. ASSETS '20. New York, NY, USA: Association for Computing Machinery, 2020.
- Emma Dixon, Jesse Anderson, Diana Blackwelder, Mary L. Radnofsky, and Amanda Lazar. “Barriers to Online Dementia Information and Mitigation.” In CHI Conference on Human Factors in Computing Systems, 1–14. New Orleans LA USA: ACM, 2022.
- Engineer, Margi, Sushant Kot, and Emma Dixon. “Investigating the Readability and Linguistic, Psychological, and Emotional Characteristics of Digital Dementia Information Written in the English Language: Multitrait-Multimethod Text Analysis.” JMIR Formative Research 7, no. 1 (October 25, 2023): e48143. <https://doi.org/10.2196/48143>.
- Dixon, Emma, Jesse Anderson, Diana C. Blackwelder, Mary L. Radnofsky, and Amanda Lazar. “The Human Need for Equilibrium: Qualitative Study on the Ingenuity, Technical Competency, and Changing Strategies of People With Dementia Seeking Health Information.” Journal of Medical Internet Research 24, no. 8 (2022): e35072.
- Dixon, Emma, Rain Michaels, Xiang Xiao, Yu Zhong, Patrick Clary, Ajit Narayanan, Robin Brewer, and Amanda Lazar. “Mobile Phone Use by People with Mild to Moderate Dementia: Uncovering Challenges and Identifying Opportunities.” In *The 24th International ACM SIGACCESS Conference on Computers and Accessibility*. ASSETS '22. Athens, Greece: Association for Computing Machinery, 2022.

Accessibility Barriers to Technology



Findings: Fluctuations in Sensory Ability Affecting Reading

8:00 AM: Font Size 14

4:00 PM: Font Size 24

“8 o'clock in the morning, I might be able to read font size 14, by 4 o'clock in the afternoon I'm up to font size 24. Now if that was on paper, I would have had to stop reading hours ago.” - P1

Findings: Fluctuations in Cognitive Ability Affecting Reading

Text-based content could be “hard to decipher” [Velma].

- Word count
- Jargon
- Changes in reading comprehension
- Specific fonts making people motion sick

“It’s not that I’m not interested... I’ll find something, and then I’ll have trouble understanding... what the words - what they’re saying... And then like, I’ll go back five or six times. And I might get to... the meaning of one word.”
- Arnold

Findings: Challenges with Traditional Keyboards



- P9 uses Alexa to record auditory journals
- Pr13 uses traditional assistive devices (Dragon Speak)

Findings: The need for audible words not sounds

To add context for notifications on his phone P1 uses “an audible word that tells me what it [the notification] is.”



Difficulty Navigating to Apps and Features

“Maneuvering through the phone... as it becomes more useful I think it can become more challenging because there's more stuff squeezed in there and finding it all and maneuvering through it all can be a challenge.”

– Thomas

Time Pressure, High Stress and Fatigue Impairing Task Execution

“[I] was very **cognitively exhausted** and I was waiting for a specific bus to come home... I **didn't have the cognitive wherewithal to figure anything else out.**”
– Eleanor



Opportunities for AI systems – as described by Participants

- Customizable user interfaces to address challenges with navigating the phone
 - making app icon more “recognizable” - Miranda
 - Providing “less options” - Malcolm

Opportunities for AI systems – as described by Participants

- Proactive technology assistance to address challenges with re-learning task flows
 - Preston proposed his phone could identify:
 - “Hey, he really hasn't used that stylus pen. Maybe we should send him another opportunity.”
 - and then provide “a tutorial” of how to use that feature.

In what use cases is AI
applicable to people with
dementia?

1. Health Information Seeking!



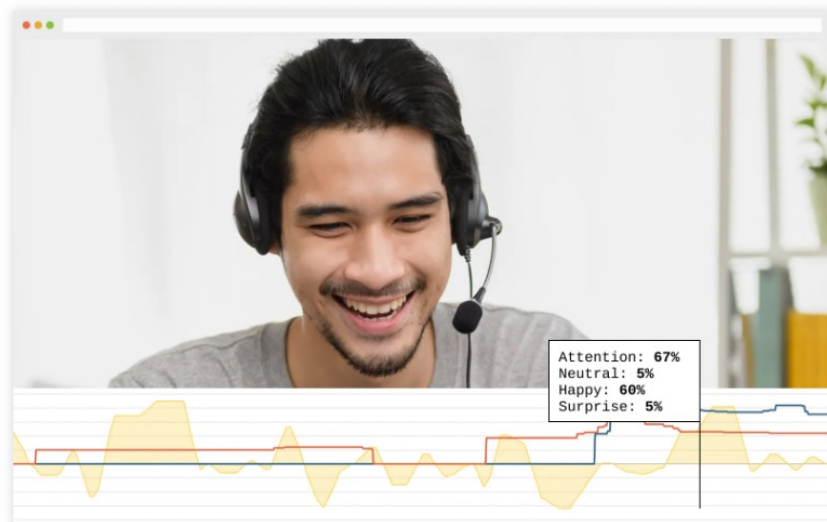
Health Information Seeking!



On-going work

Analyzing the cognitive load and emotional responses of people with dementia and healthy older adults to 4 types of digital dementia information:

1. A medical article
2. An advocacy article
3. A blog post – written by someone with dementia
4. A pseudoscience article



<https://www.realeye.io/features/online-webcam-facial-coding>

Opportunity for AI: Determining Setting Changes Necessary to Make Digital Health Information More Accessible



2. People with MCI and Dementia in the Workforce

- We are able to identify dementia earlier in the progression of the condition.
- 9% of people with dementia are living with younger onset dementia – under the age of 65 at diagnosis [WHO]
- This number is projected to increase significantly in the next decade.



On-going Work: Examining Workforce Assistive Technology for People with MCI and Early-Stage Dementia

- Interviews with people with MCI/Dementia who are working
- Assistive technology toolkit development and deployment



Toolkits could include: AI Text Summarization

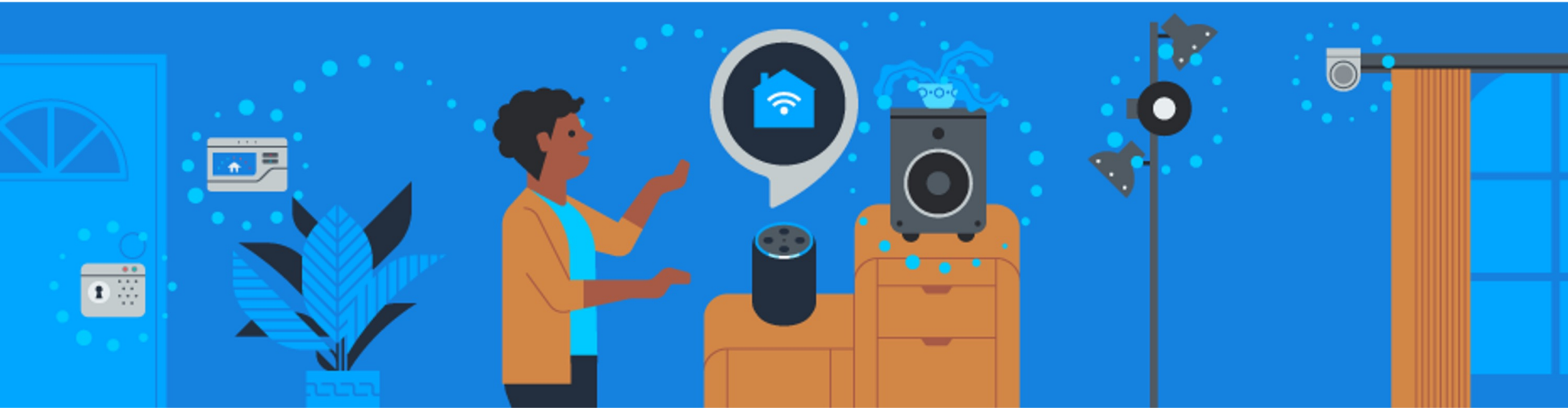
Abstract While many approaches to make neural networks more fathomable have been proposed, they are restricted to interrogating the network with input data. [...] In this work, we propose neural persistence, a complexity measure for neural network architectures based on topological data analysis on weighted stratified graphs. [...]

Intro [...] In this work, we present the following contributions: We introduce neural persistence, a novel measure for characterizing the structural complexity of neural networks that can be efficiently computed. [...]

Conclusion [...] However, this did not yield an early stopping measure because it was never triggered, thereby suggesting that neural persistence captures salient information that would otherwise be hidden among all the weights of a network [...]

TLDR We develop a new topological complexity measure for deep neural networks and demonstrate that it captures their salient properties.

Toolkits could include: Voice-based Interaction



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