

Thesis Project Portfolio

The development of a wearable device to increase slow-wave activity in Alzheimer's Disease patients

(Technical Report)

Future of walkable communities: Universities as models for walkable urban design

(STS Research Paper)

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Sociotechnical Synthesis

Alzheimer's disease affects 5.8 million people in the United States, affecting their memory and cognitive abilities. The technical project serves as a possible tool for this disease through a wearable device, which acoustically stimulates patients during slow-wave sleep to improve their memory. The sociotechnical paper examines how universities use policies and plans to create walkable urban design in their respective cities. The connection of these two projects are non-obvious, but are connected through sleep and memory. One of the public health benefits of walkable urban design is sleep quality, therefore there are also improvements in memory. Urban design then serves as a sociotechnical tool for Alzheimer's disease and memory loss. These projects show that one tool is a novel technology, while the other is a sociotechnical tool. While both tools could be used to improve the livelihoods of those with Alzheimer's, it's important to consider their social implications on different groups.

The technical project is to create a prototype wearable device to mitigate the onset of Alzheimer's disease and mild cognitive decline through acoustic stimulation, which has been shown to enhance slow-wave sleep and this enhancement has led to improved memory. Alzheimer's disease is characterized by a decrease in cerebrospinal fluid activity in the brain as people age. Due to disrupted sleep cycles, cerebrospinal fluid activity decreases and plaques can build up within the brain, leading to slower connections and a loss of brain function. By increasing slow wave activity, therefore increasing cerebrospinal fluid activity and clearing plaque buildup, this device will serve as a novel tool to slow down the progression of Alzheimer's disease through the usage of acoustic stimulation. The team so far has created computer aided designs and 3D printed a couple of prototypes, which have been ideated for technical constraints as well as comfortability issues. Caretaker questionnaires and interviews have broadened our understanding of Alzheimer's disease and older adult sleep habits to further

ideate our prototypes in regards to the needs of our target population. The next steps involve integrating a brain computer interface and electrodes to our designs, as well as interviewing our target population for device comfortability and useability.

The sociotechnical research paper examines how universities use policies and plans to create walkable urban design in their respective cities through the lens of social construction of technology. Educational outlines, sustainability models, and environmental organizations alignments at the University of Pennsylvania, George Washington University, and Northeastern University are used as data and then analyzed for trends, specifically how these plans affect universities' urban design and relevant social groups. These universities provide improved public health and economic growth through walkable urban design, but they also cause displacement of low-income people in the area. The social construction of technology delves into how different groups shape technology, in this case urban design, and which groups get to interact with or are restricted from the usage of certain technologies. Through these new findings, advocates for walkable urban design could push university-like urban design to the forefront, while considering the displacement of communities.

The technical paper and sociotechnical research paper work simultaneously to provide different tools to decrease memory loss in older adults. They consider the decision-making of these solutions and how some are pushed to the forefront, while less technical and more social solutions are not the first considerations in the areas of science and engineering. Sometimes it's important to consider sociotechnical solutions that try to tackle the root of an issue. This simultaneous work helps emphasize the need to consider all types of solutions, not just advanced novel technologies. The sociotechnical research paper argues that this can be done through walkable urban design and when people are given the opportunity to live in walkable urban

environments, public health also tends to improve. Sociotechnical solutions are not perfect either, new walkable urban neighborhoods skyrocket housing prices, which displaces low-income communities. The capstone technical paper argues that a wearable device can be used to improve sleep and memory through acoustic stimulation, but factors such as costs should be considered. Will low-income individuals be able to afford a novel technology like this one? These are just some initial questions that this simultaneous work tries to answer, but further research must be done to understand this issue in depth.