CALIFORNIA STATE SCIENCE FAIR
2015 PROJECT SUMMARY

Name(s)

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Project Number

S0922

Project Title

Compass Belt: Utilizing Neuroplasticity and Digital Signal Processing to Improve Self-Navigation

Abstract

Objectives/Goals

When people lose their ability to competently navigate their environments, quality of life can quickly erode. In severe cases, such as Alzheimer#s disease or blindness, loss of independence or institutionalization can ensue. This project#s aim is to create a non-intrusive device for under 100 dollars that is durable and easy to use. Through neuroplasticity, the device would enable the user to gain a better sense of direction, eventually interpreting the subtle vibrational stimuli autonomically.

Methods/Materials

I designed a prototype belt that gives users a sense of spatial orientation: a #compass belt,# consisting of eight motors spaced evenly around the user#s waist, indicating north through selective vibrations. After considering other options, such as a hat, I decided on a belt as it is more practical, easily concealed, and remains level. Throughout the design process, I worked to balance size, cost, durability, and functionality.

Results

A 3-axis compass, gyroscope, and accelerometer are used to collect data from the environment. This data is interpreted and manipulated by the Arduino Pro Micro. In turn, the Arduino#s I/O pins turn on and off the eight transistors, thus allowing for the north-most vibrational motor to be powered. A pouch on the back left of the belt houses the electronics that selectively control the eight motors, indicating to the user which direction is north. The cost of the components came to 94 dollars. The next step is user trials.

Conclusions/Discussion

This non-intrusive technology has great potential to improve the lives of individuals who struggle with navigation. As the brain adapts to the new form of neurological stimuli from the compass belt, the user will learn to intuitively and autonomically interpret the data from the belt, and thus gain a natural sense of direction and orientation in space. In conclusion, I have successfully constructed the compass belt prototype under budget, with all design criteria met.

Summary Statement

Bridging the fields of neuroplasticity and digital signal processing, this project aids people with orientation difficulties; by learning to interpret vibrational stimuli from a compass belt, users can gain an autonomic spatial awareness.

Help Received

Erik Meike (classmate), provided help with code and circuit design; Meera Santhanam (classmate), collaborated during initial design stages; Andrew M. Saxe (mentor, PhD candidate Stanford), provided guidance in my exploration of neuroscience and neuroplasticity.