Disease Diagnosis by Listening to Sound Created from Genetic Data

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Introduction
Alzheimer's Disease is the 6th leading cause of death in the U.S. Currently there is no way to diagnose Alzheimer's until after death. Many diagnostic tools use visual methods such as pictures, charts and graphs to help interpret information and make a diagnosis, however we tend to ignore our other capabilities such as hearing. The purpose of this projects was to use sound in analyzing datasets to see if our ears could pick up on differences between data from healthy people compared to those who had Alzheimer's, similar to how we can recognize specific sounds, eg. an oboe in an orchestra or an individual at a large party (the cocktail party effect). The hypothesis was that if we take microRNA expression data from patients with Alzheimer's (AD) and a control group (CG) and convert it into sound, there will be recognizable differences.

Methods
The dataset showed microRNA expression values of 4 control patients and 4 with AD. MicroRNA is significant in protein regulation, so abnormal levels often indicate disease. To hear these differences, I used two approaches. Tuning- Expression data of 5 miRNAs in CG and AD ratioed to mean values of CG, wrote a program to covert these ratios into frequencies, added sine waves of the 5 miRNAs of the AD patient together and compared the interference heard to that of CG. Rhythm- sound based on a 120 bpm pulse and ratioed data converted into taps shifted before or after the beat.

Results
Tones from the tuning method for AD patients had much more interference and sounded very out of tune compared with CG. With the beats produced by the rhythm method, control patients were close to being together on the beat, whereas Alzheimer's beats were not together at all.

Conclusion
Results supported my hypothesis. There are marked differences in the sounds of genetic data from Alzheimer's patients compared to control patients.

Keywords: microRNA, mRNA expression, Alzheimer's Disease, Data Sonification

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Hi I am Lorna Barron, a Senior at Huron High School. I enjoy many things including science, music, sports, and volunteering. I play the trumpet for both Symphony and Jazz band and also have been playing piano for many years. In high school I did several different sports including Crew, Cross Country and Soccer. I also tap dance which is a lot of fun. I especially enjoy volunteering in the community by playing music at churches or assisted living centers and being part of miRcore and the National Honor Society at Huron.

My favorite subject is biology, which is why I joined the miRcore volunteers my sophomore year. It was fantastic to be part of a club with other high school students who were passionate about science. I have really enjoyed meeting new people and working together to help fundraise and raise awareness for diseases within the community.

Being a part of miRcore inspired me to do creative science projects of my own. Pairing my musical background with the new biological concepts taught in miRcore, I tried to see if disease could be diagnosed by creating sounds out of data. It was fascinating to hear just how different the data from Alzheimer's patients sounded from the control group. I found this an extremely interesting and fun project to work on.

Next year I am planning to study Bioengineering at Imperial College London. This choice was strongly influenced by my experience in GIDAS and miRcore. Being a part of these organizations opened my eyes to just how important medical advancements are. By meeting people who were affected by diseases such as Alzheimer's and Autism it made a personalized impact that I had not understood before just by reading about diseases from textbooks. Hopefully by becoming a Bioengineer one day I can help make a difference.