BME 484 Biomedical Engineering Capstone Design
Project Proposal

Project Title: MagnetPeutics: Wearable Transcranial Magnetic Stimulation for Self-Rehabilitating Stroke Patients

Team: Juan Malvar, Software Engineer
Austin Ramos, Hardware Engineer
Zach Brown, Project Manager

Abstract:
TMS (Transcranial Magnetic Stimulation) is a non-invasive procedure that uses magnetic fields to stimulate nerve cells in the brain. This procedure can help treat symptoms of depression and may even help rehabilitate stroke patients. This procedure requires patients to be sitting for long periods of time with the magnetic apparatus remotely placed on their head. Patients are required to sit for long periods of time and are even prescribed with multiple TMS procedures which can cost $250-$300 daily. The goal of this project is to design a prototype of a wearable device that may have an adequate amount of magnetic fields that can reach the brain cells. The new design will be a different iteration of the design from last year where the motor units will be replaced with polarity changing electromagnets. This may help reduce the noise and vibration produced by a traditional DC motor. If this new design does not work out, a brushless motor may be a good alternative to a DC motor.

Innovation: The motor units from the old design will be replaced with a motorless unit, powered by weaker electromagnets that may achieve a rotational speed of 1-3 Hz.

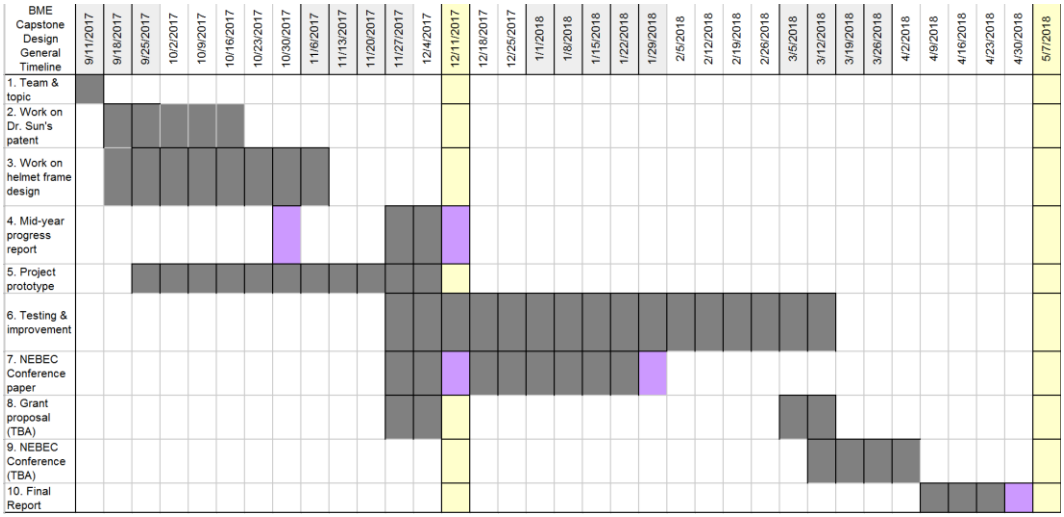
Materials:

- Neodymium N52 magnets
- PVC
- Breadboard
- PIC and other various electronics materials
- ABS plastic (optional for 3D printing)
- PCB (optional)
- Velcro
- Old bicycle helmet frame

Subtasks:

1. Find optimal design for rotating magnetic units
2. Design circuitry for electromagnetic current control system
3. PIC microprocessor coding to control electromagnet currents.
4. PCB design of control system (optional).
5. Design a stable structure to mount the electromagnetic units on the helmet.
6. Design ergonomics (optional) and methods to readjust locations of rotating magnetic units.

Timeline:



References:

Webster, B., Celnik, P. and Cohen, L. “Noninvasive Brain Stimulation in Stroke Rehabilitation.” *NeuroRx: The Journal of the American Society for Experimental NeuroTherapeutics*, vol. 3(4), pp.474-481, (2006).

Hallet, M, A. Pascual-Leone, S. Rossi, and P. M. Rossini. “Safety, ethical considerations, and application guidelines for the use of transcranial magnetic stimulation in clinical practice and research.” *Clinical Neurophysiology*, vol. 120(12), pp. 2008-2039, 2009.

Paillère-Martinot et al. “Active and placebo transcranial magnetic stimulation effects on external and internal auditory hallucinations of schizophrenia.” *Acta. Psychiatr. Scand*., vol. 135(3), pp. 228-238, 2017.

Chervyakov, A.V., A.Y. Chernyavsky, D. O. Sinitsyn, and M. A. Piradov. “Possible mechanisms underlying the therapeutic effects of transcranial magnetic stimulation.” *Frontiers in Human Neuroscience*, vol. 9, pp. 1-14, 2015.

Alzowelei, M., M. Congdon, J. Havas, T. Wang, Y. Sun, and B. Silver. “A lightweight helmet with rotating permanent magnets for brain injury rehabilitation.” 42nd Northeast Bioengineering Conference, Binghamton University, Vestal, NY, April 5-7, 2016.