**Biomedical Engineering Stroke Rehab Research**

**Stroke and its Effects**

A stroke is a disease that attacks the brain. Specifically, it is a disease that affects the arteries of the brain. In fact, it is so common that it is the 5th leading cause of death in the United States. Stroke is a disease where a blood vessel in the brain is cut off or completely interrupted due to a clog caused by fatty deposits. Because of the clog, the blood vessel may even burst or rupture. As it is commonly known, blood that flows through the body consists of red blood cells. These cells function as the transporters of oxygen through the human body. As a result of stroke, the brain being deprived of oxygen which, in turn, kills off the brain cells. This severe neurological disorder has devastating effects on the functionality of the human body. A stroke can affect each person in unique ways and to various extents. This is because a stroke can occur in any location of the brain with some killing more brain cells than others. For instance, one who is a patient of stroke may struggle with speaking, have problems with their vision, experience paralysis, endure muscle weakness, and face loss of dexterity in the joints.

**Possible Solutions**

Neuroplasticity is a method of recovering from stroke. It is the brains ability to develop new neurological connections or strengthen existing ones through the brain’s adaptation of new experiences or environments. The solution that I am proposing is a solution to strengthen the remaining connections that after the stroke has occurred. This solution will be able to recover patients who have minimal control in the hand as a result of partial paralysis. It will be able to treat those who have not experienced a total loss of function in the hand. The ultimate goal is to restore the functionality of the neural pathways through neuroplasticity exercises. The repetition of using the muscles of the hand will make the connection between the muscle and the brain more efficient. Because these exercises require extensive training and frequent visits to the physical therapist, this process of rehabilitation may take longer and require more effort than it actually should. This solution will be a motivating, interactive, and independent treatment at a low cost.

Flex Sensors allow us to directly track the position of the finger

sEMG will allow us to theoretically predict that the mobility in the finger will correspond to the signal.

**Virtual Reality Game Development**

“ "Many patients will accept video games more readily than other medical interventions," adds psychiatrist Jürgen Gallinat, co-author of the study. Further studies to investigate the effects of video gaming in patients with mental health issues are planned. A study on the effects of video gaming in the treatment of post-[traumatic](https://www.psychologytoday.com/basics/trauma) [stress](https://www.psychologytoday.com/basics/stress) disorder is currently in progress.”

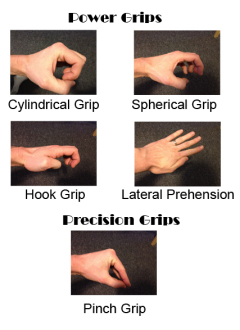
Source: <https://www.psychologytoday.com/blog/the-athletes-way/201310/video-gaming-can-increase-brain-size-and-connectivity>

**Patient Hand Position Exercises**

There are many different positions that the hand can be to productively function. Here are the most common hand positions that a stroke patient typically practices while undergoing physical therapy.

Power Grip – All fingers are clamped around an object such as a ball.

Pinch Grip – This grip is a gentle grip that



**Exercises**

**Different games – different hand positions**

**I have to figure out how to get the hand positions**

**Daily Tasks that Involve the Hand and Arm**

* Brushing Your Teeth
* Combing Hair
* Eating with Utensils (Ex. Spoon or Fork)
* Cutting with a Knife
* Typing on a Keyboard
* Using the mouse on a Computer
* Picking up Delicate Objects with Precision
* Turning a Door Knob

**Technologies Used:**

* **Computer Vision**
* **Flex Sensor**
* **Arduino Microcontroller**
* **Processing**
* **VR (If I can get it to work)`**

**https://explorable.com/writing-an-abstract**

The game that the patient will play will allow the patient to repetitively attempt to move the impaired part of the body to eventually gain the mobility that the patient previously possessed. This type of training is known as neuroplastic rehabilitation.

The arm movement will be detected through computer vision. The camera will recognize the specific color of the LEDs and track the movement of that color. This group of LEDs will be placed on the back of the hand. The computer vision technology will be utilized to detect mobility in the entire arm. Movements in the fingers will be detected through the flex sensors that are attatched to each of the fingers.