Smart rehabilitation device using EMG sensor

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Problem

According to Centers for Disease controls and preventions, every year more than 795,000 in the United States have a stroke, and about 610,000 of these are first or new strokes. 87% percent of all strokes are ischemic strokes, in which blood flow to the brain is blocked. Recovery can take weeks or even years. Some patients have a rough time recovering from them and the majority are old in age and have a hard time moving so they are not able to visit busy hospitals frequently. After a stroke a patient can expect paralysis in some parts of the body like the arm or even in half or the whole body. Stroke-related costs in the United States came to nearly $56.5 billion between 2018 and 2019. This total includes the cost of health care services,

Objectives

This project aims to create a smart rehabilitation device that can be utilized at home and without the need to leave your house.

If the doctor following the patient's condition needs to follow up on the patient ai a whole report will be sent to the doctor directly.

To reduce the time it takes it takes to recover from approximately 1 year to 8 months.

Restoring Range of Motion: One of the primary objectives of hand rehabilitation is to restore the normal range of motion in the hand, wrist, and fingers.

Background

Smart rehabilitation device using EMG sensor is a project to solve the problem of ischemic stroke victims in which they have paralysis in some parts of the body because a stroke affects the cerebellum and the primary motor cortex of the brain which control the movement of the body. I want to create a smart hand rehabilitation robot that gives exercises to the hand and sends statistics and information and graphs of the improvement and performance of the muscle using EMG sensor so that the doctor can give advice, commands and types to the patient .

, Electromyograph sensor provides a non-invasive window into the nervous system that can be used to monitor muscle activity monitoring with EMG sensor may help doctors quantify muscle activity , track recovery, and inform rehabilitation.

We can also use EMG sensors to enable biofeedback and provide metrics necessary for supporting and justifying care .So based on this if we incorporate the EMG sensor into the Transcutaneous electrical nerve stimulation device it will expedite the procedure of recovery and make the communication between doctor and patient faster and more efficient by sending the improvement of muscles strength and statistics to the doctor with a report using AI .

Hypothesis

Null hypothesis: There is no difference in efficiency between wired and wireless EMG sensors.

Alternative hypothesis: Wired EMG sensors are more efficient than wireless EMG sensors.

Null hypothesis: Not using an EMG sensor does not affect the outcome or results.

Alternative hypothesis: Not using an EMG sensor will lead to incomplete or inaccurate assessment and analysis of muscle activity.

Null hypothesis: There are no significant barriers preventing patients from going to hospitals to review their medical case.

Alternative hypothesis: There are barriers or factors that prevent patients from going to hospitals to review their medical case, such as geographical distance, lack of accessibility, or personal circumstances

Variables

The same device will be used for every patient.
The devices are the Electromyograph sensor and the Transcutaneous electrical nerve stimulation device
The nerve stimulation device will be used to give exercises to the muscle and the EMG sensor will give the feedback to the doctor based on the improvement of the muscle strength.

Dependent variables :
Different hospitals and doctors for each patient .
Each patient will go to different hospitals, and they will have different doctors.
Different healing time .
Each patient will have a different healing time based on their age and the severity of the stroke .

Procedures

Components :

Esp8266

Electromyograph sensor

Pocket tense 7000

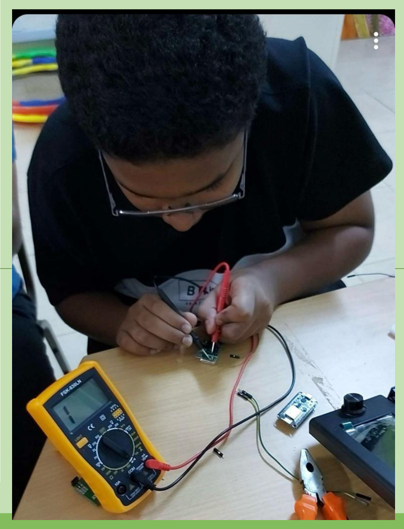
Battery 9v

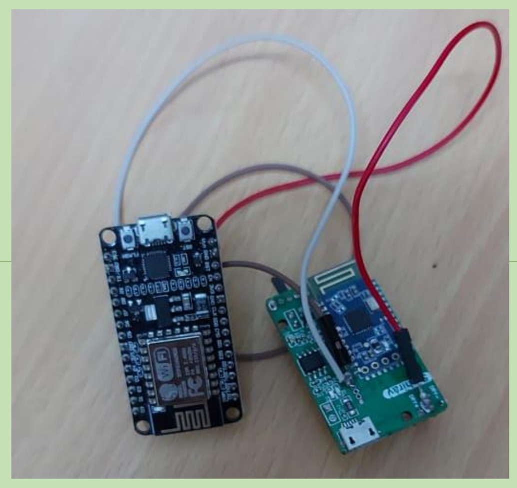
the first thing we did was connect the esp8266 to the emg sensor by connecting TX with RX and RX with TX which are communication pins that are found in the esp8266 and EMG sensor

next, we started experimenting the code for the EMG sensor and trying it out , seeing if its working

After we made sure that it is working, we combined the EMG sensor to the pocket tense 7000

After that we made the code for the report that will be sent to the doctor



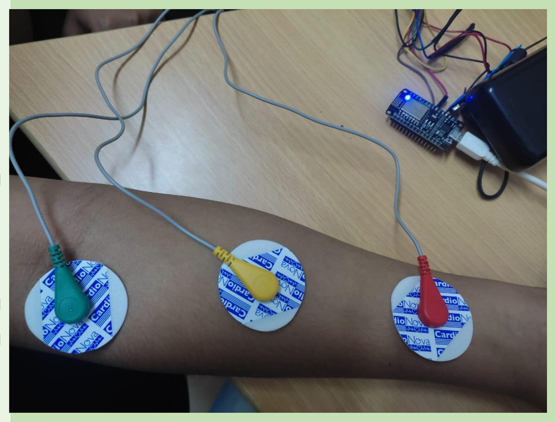


Experiment

Is the wired EMG sensor more efficient than the wireless sensor?

In this experiment, we try to find best efficient of sensor and how we can get signals from the sensor Then we will try to make a training model using Ai

First, we need to analyze the Result from EMG sensor and make a Comparison between wired and wireless, we will take this result and send for the doctor to can take a decision about the patient and Follow up on the progress from our activity log



Prototype

Soft robotic hands are proposed for stroke rehabilitation in terms of their high compliance and low inherent stiffness. We investigated the clinical efficiency of a soft robotic hand that could actively flex and extend the fingers in chronic stroke subjects with different levels of spasticity.

We are working now to measure signals from the EMG sensor and communicate with Doctors in King Fahd Hospital to test our prototype on patient devices can send a Report to the doctor using email

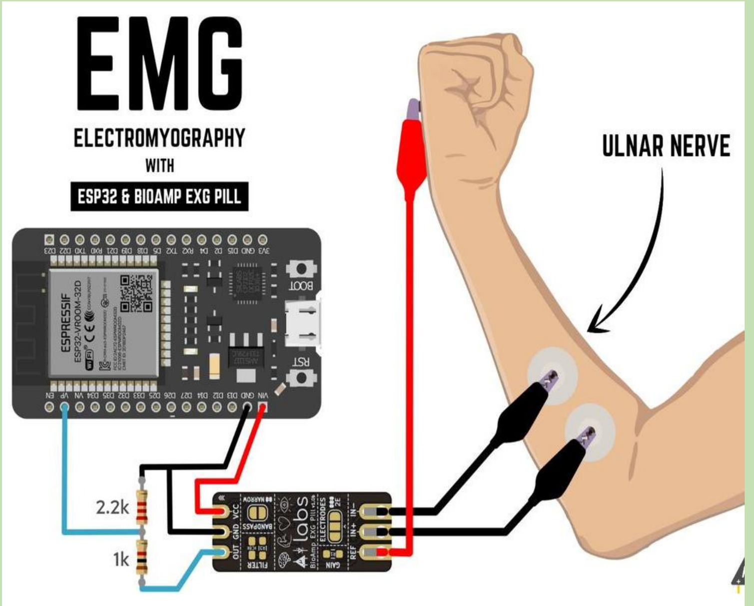
Smart rehabilitation device that can be utilized at home and without the need to leave your house.

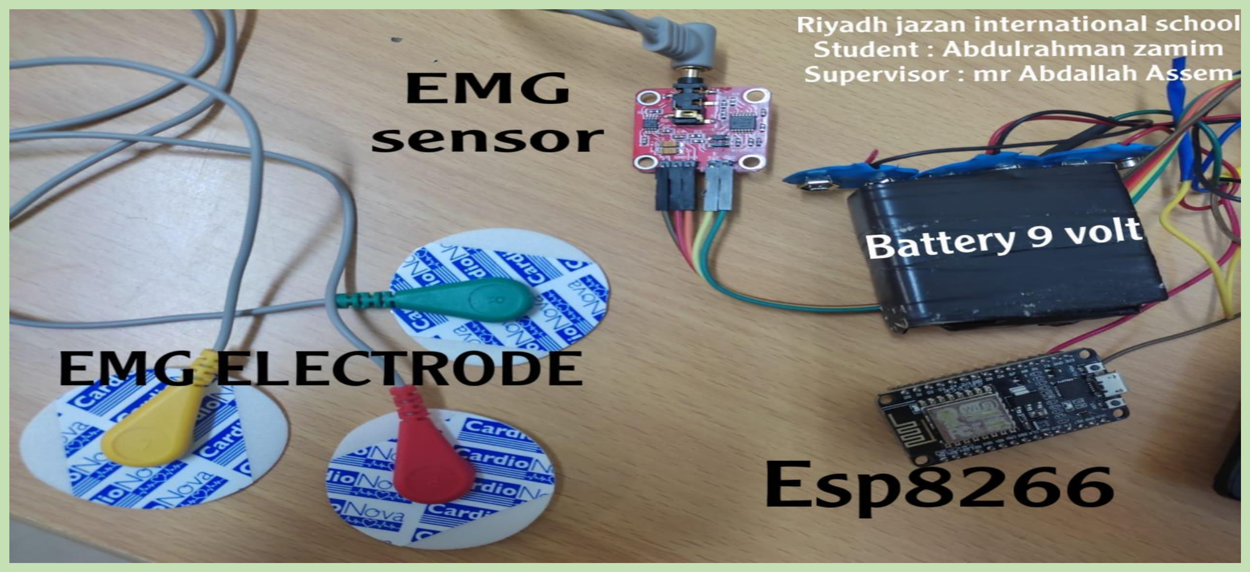
If the doctor following the patient's condition needs to follow up on the patient, it will happen using Artificial intelligence with the use of statistics, and AI a whole report will be sent to the doctor directly.

To reduce the time it takes it takes to recover from approximately 1 year to 8 months.

Restoring Range of Motion: One of the primary objectives of hand rehabilitation is to restore the normal range of motion in the hand, wrist, and fingers.

strengthening Muscles: Hand rehabilitation also focuses on strengthening the muscles in the hand and forearm. Muscle weakness can occur due to disuse, nerve damage, or certain medical conditions.

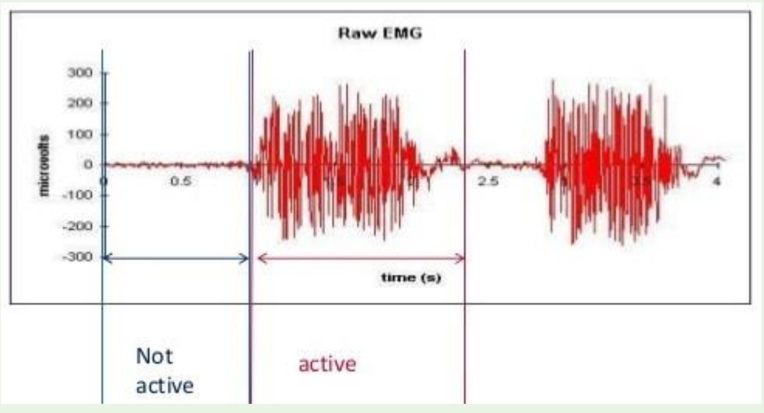




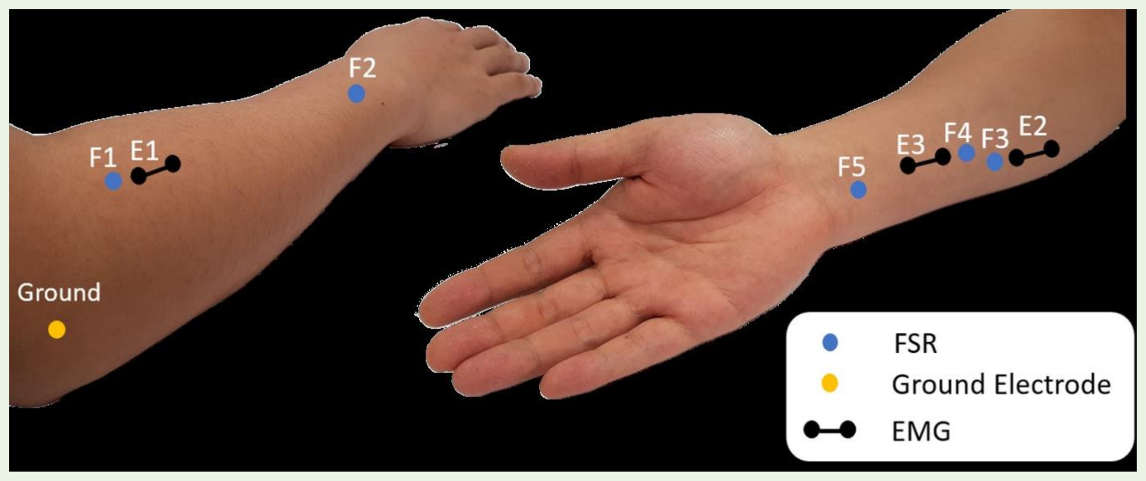

```
void setup()
{
  Serial.begin(9600);
  display.begin(SSD1306_SWITCHCAPVCC, 0x3C); //initialize with the I2C addr 0x3C
  delay(500);
  display.clearDisplay();
  display.setCursor(30, 15);
  display.setTextSize(1);
  display.setTextColor(WHITE);
  display.println("Sensor");
  display.setCursor(25, 35);
  display.setTextSize(1);
  display.print("Initializing");
  display.display();
  delay(3000);
}

void loop()
{
  float sensorValue = analogRead(A1);
  float millivolt = (sensorValue/1023)*5;

  Serial.print("Sensor Value: ");
  Serial.println(sensorValue);

  Serial.print("Voltage: ");
```

Data analysis

EMG Sensor Rustle Graph



Best Points to measure EMG signals



Results

In conclusion, smart rehabilitation devices using an Electromyograph sensor and Transcutaneous electrical nerve stimulation device (pocket tense 7000) . The job of pocket tense 7000 is to give exercises to the hand. The doctor will give information to the device like every 30 minutes give a certain exercise and the EMG sensor will give certain feedback and a report to the doctor every week to follow up on the patient's medical case.We expect to reduce the time it takes to recover from approximately 1 year to 8 months.

Final Product

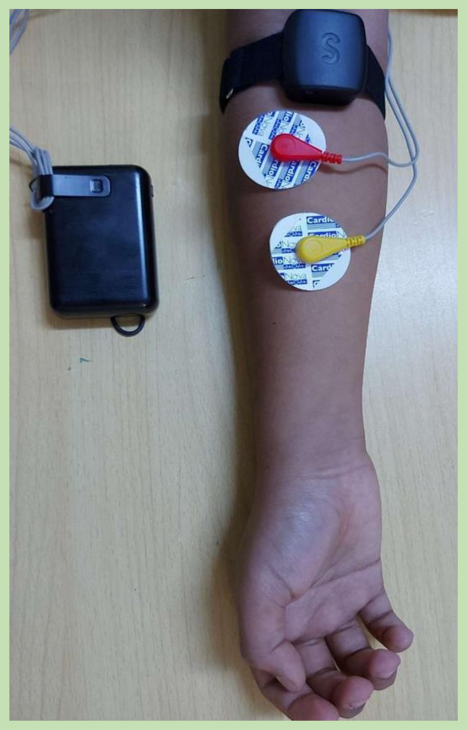
Smart rehabilitation devices using EMG sensors are proposed for stroke rehabilitation in terms of their high compliance and low inherent stiffness. We investigated the clinical efficacy of a soft robotic hand that could actively flex and extend the fingers in chronic stroke subjects with different levels of spasticity.

The doctor following the patient's condition needs to follow up on the patient and send a report using iot doctor directly.

Applications :

The first thing is a patient can buy this product directly from a local Pharmacy and doesn't need to go to the hospital to get a prescription from his doctor

The second thing is that we can utilize it into the rehabilitation clinic so that doctors can use it with their patients



Feasibility Study

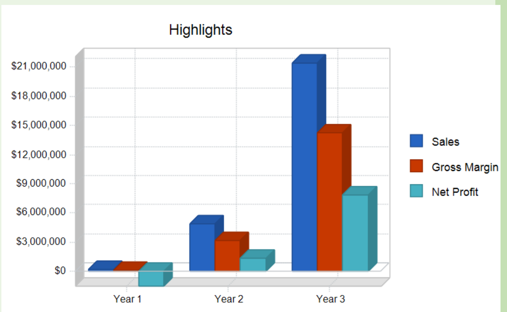
Technical parts

- TENS 7000 Device
- EMG Armband
- Controller unit

From Studying The market we expected our device cost from 1500 to 2500 SRA Depending of future of Customers

Financial Plan

my Project requirements for Fund: Prototyping, Testing, MVP, manufacturing, Business Development, Marketing, Sales Customer services and training expenses and assets will see us through the first year, as we hire sales representatives to secure increasing market share. Even with our conservative estimates, based on market research and the industry knowledge of the founders, we will far surpass the break-even point from the second quarter of sales.



Market size

References

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1. Steele, K. M., Papazian, C., & Feldner, H. A. (2020). Muscle activity after stroke: perspectives on deploying surface electromyography in acute care. Frontiers in Neurology, 11, 576757.

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