G.R.A.S.P

Grip Rectifying Assistive Sensor Pen

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Introduction

Problem Statement: Many people, particularly young children struggle to learn the fine motor skills for proper handwriting posture

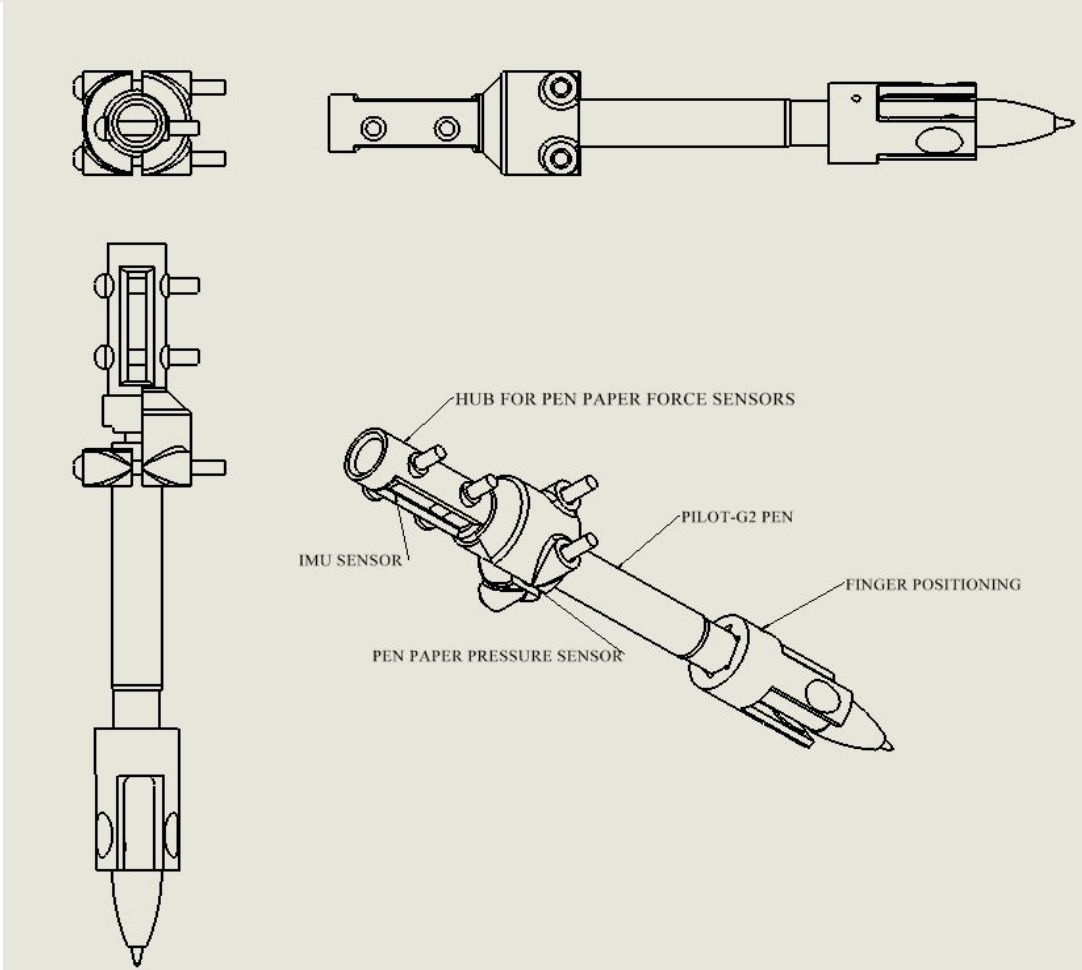
Proposed solution:

- Design an assistive device that is able to measure the three key identified problem areas identified from literature review and occupational therapist for handwriting
    1. Finger Positioning
    2. Finger to Pen Force
    3. Finger to Paper Force
- Based off those measurements, record and report them back to the user in the form of live feedback to assist in their writing

DESIGN

Design goals

- Modular and universal design
- Simple and intuitive design



Design Philosophy

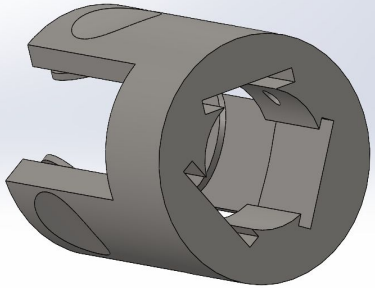
- Compact modular design that can be used with most of the pen
- Better access for the circuits in the pen
- Modular design for effortless swap in components in case of failure/damage
- Modify the pen to house IMU, Pen paper pressure sensor and grip sensors
- Modify the pen to reduce designing an entire pen to save time and cost
- Equally spaced finger grip / Dynamic tripod grip

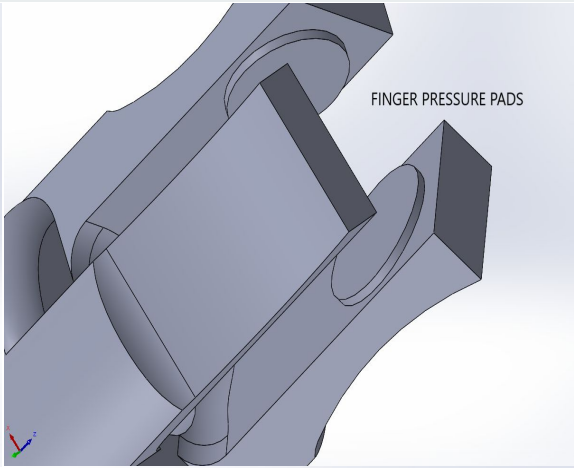
  Since it is the most efficient grip for writing

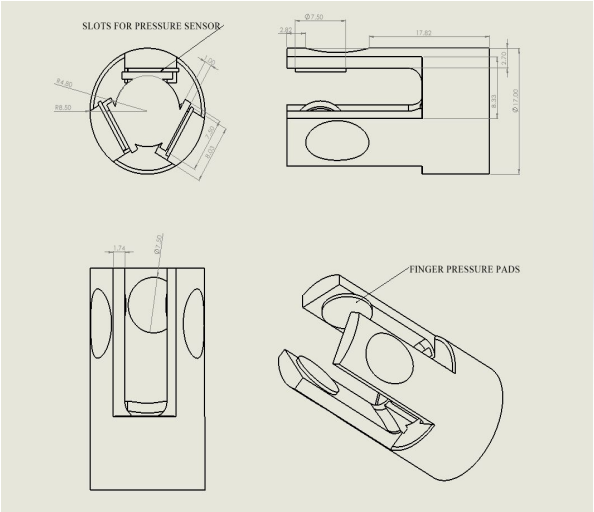
  Helps us achieve finer level of control

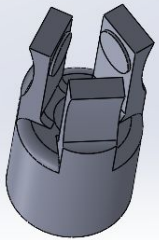
FINGER POSITIONING

- We have used PILOT-G2 as base model for our testing purpose
- Tripod design
- Makes sure the fingers are held at the correct position
- Makes sure required amount of pressure is applied on the pen
- Focus the pressure applied by fingers on the pressure sensor
- House the pressure sensors
- Provide a comfortable grip



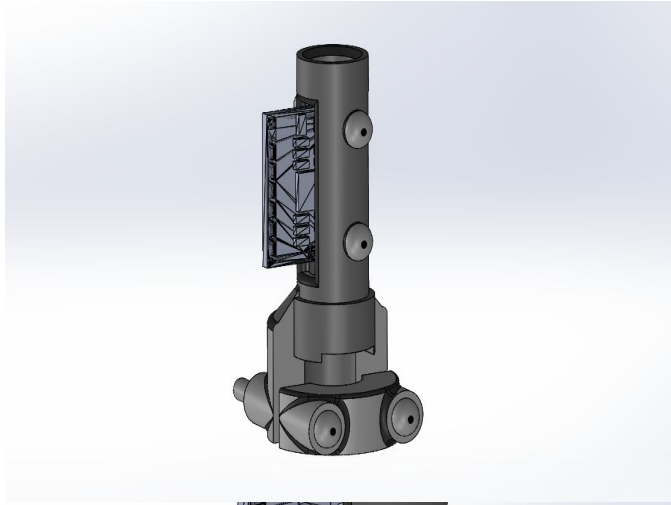


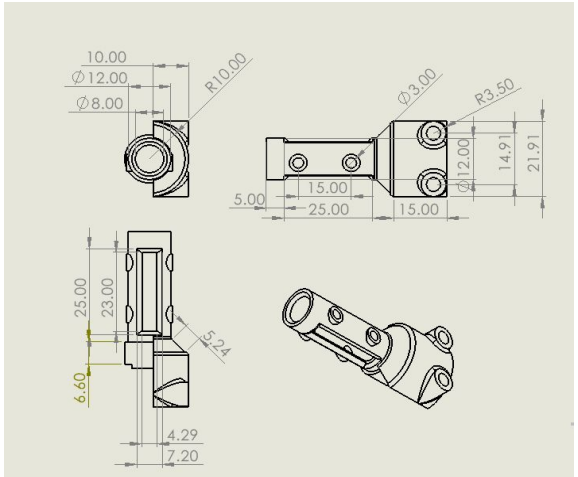


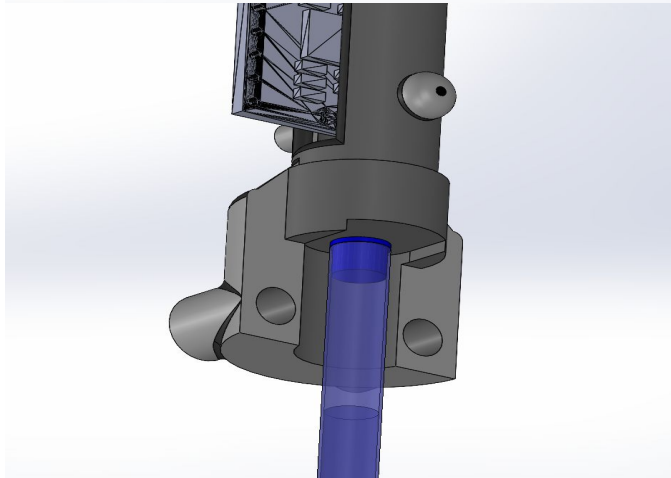


HUB FOR IMU and Pen-tip Pressure

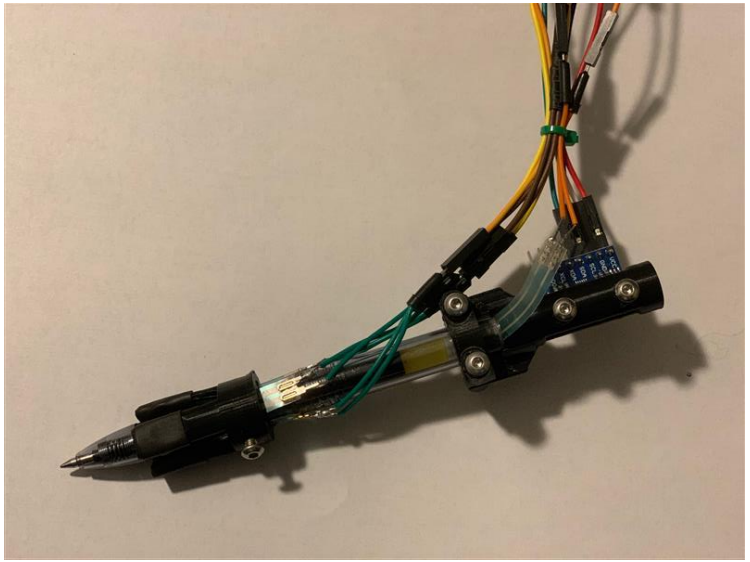
- Hold the IMU and Pen Paper pressure sensor
- Spring that is present at the tip of the pen Pushes the ink cartridge back to apply constant force to the sensor.

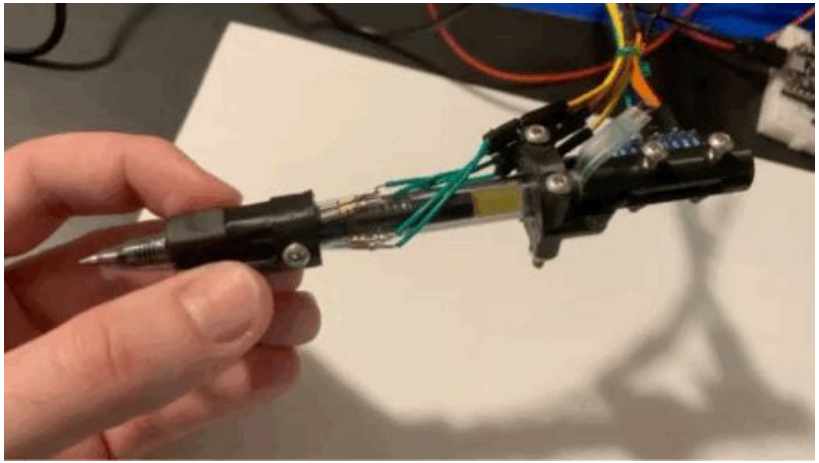


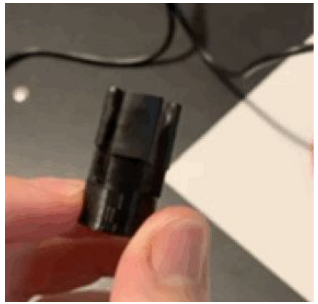




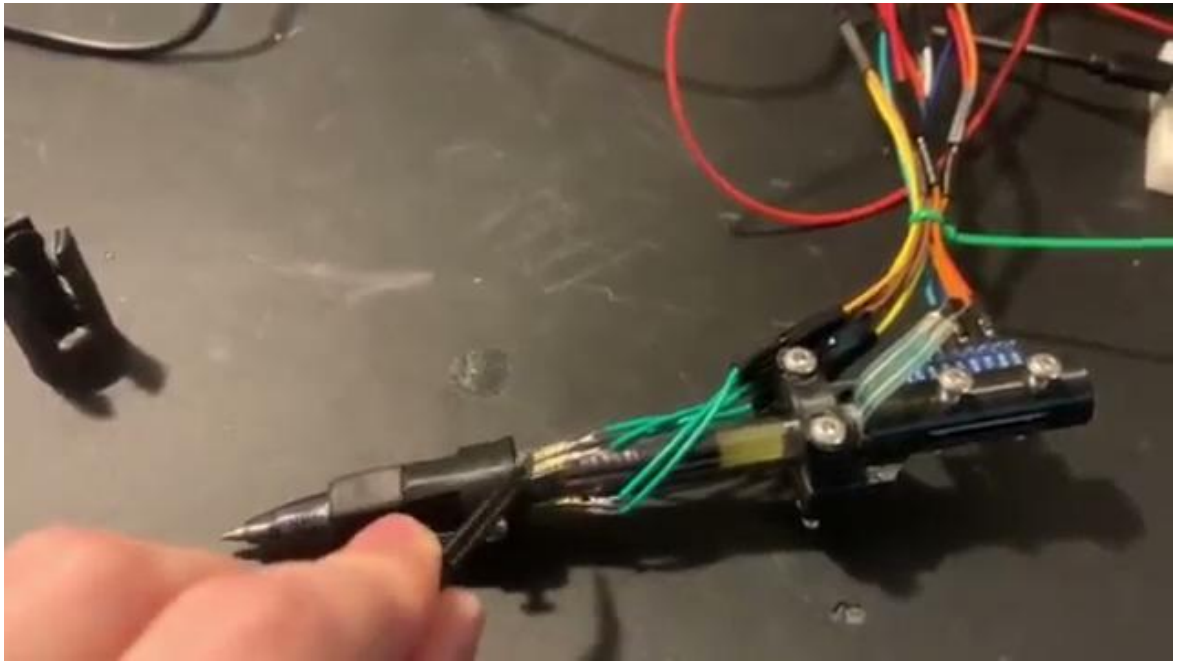
Prototype



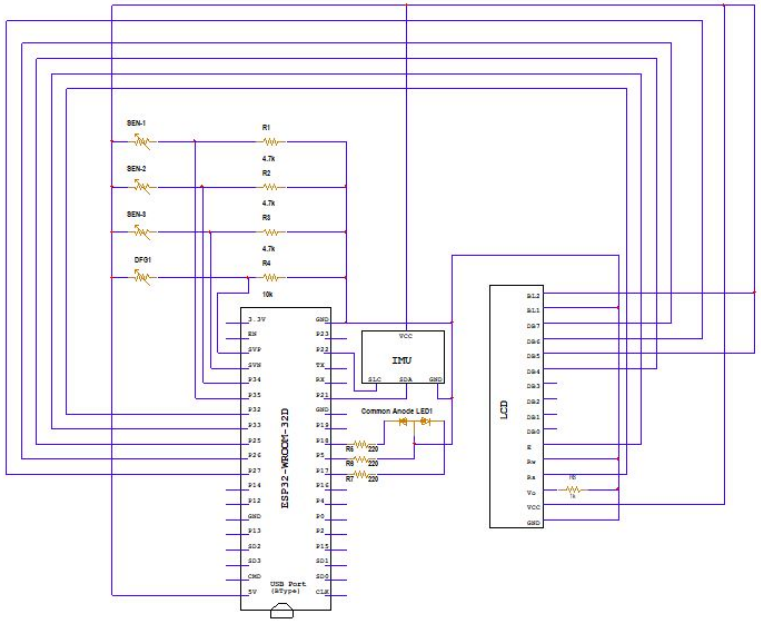




Quick Component Integration Video

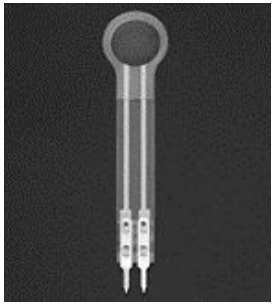


Components & Wiring



Circuit Diagram

ESP32-WROOM-32D



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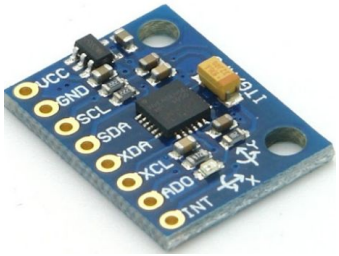

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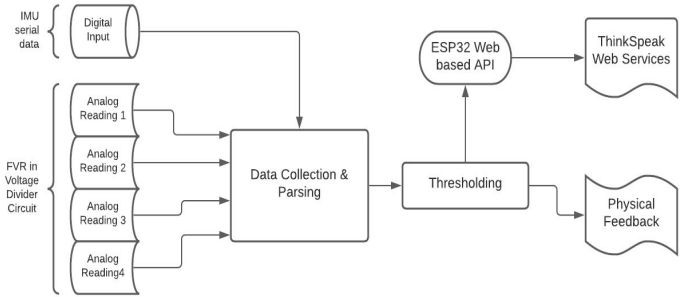
Data Collection via ESP-32

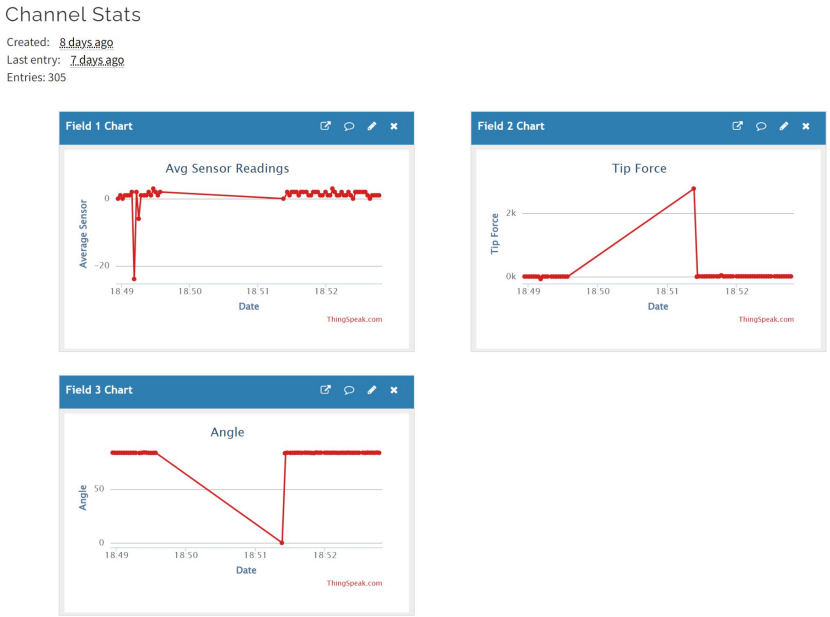
- ESP32 implements **TCP/IP, full 802.1 b,g and n, WLAN MAC protocol**, and Wi-Fi Direct specification. This means ESP32 can speak to most of the WiFi Routers out there when used in station(client) mode. It can also create an Access point with full 802.11 b,g and n.
- ESP32 publishes the sensor values to their respective fields. Each Sensor has a field allotted to it.
- All this data is stored in a unique ThingSpeak channel using Write API keys.



Data Analysis via ThingSpeak

- ThingSpeak is an IoT analytics platform service that allows you to aggregate, visualize, and analyze live data streams in the cloud. You can send data to ThingSpeak from your devices, create instant visualization of live data, and send alerts.

- Sensor data is stored in “Private Channels”. The stored data can be analyzed and visualized using MATLAB and various other softwares. The same data can also be shared with others by making the channels “Public”.



Testing

- Writing samples of 6 people were taken into consideration.
- Each person wrote with both their left and right hand. This was done to compare “Good” handwriting to a relatively “Bad” handwriting.
- Every person wrote the same piece of information to maintain consistency.
- As people wrote, the data was read by the ESP32 and simultaneously published to ThingSpeak.
- Sensor values were plotted in form a 2-D plot (Sensor Reading Vs Time).

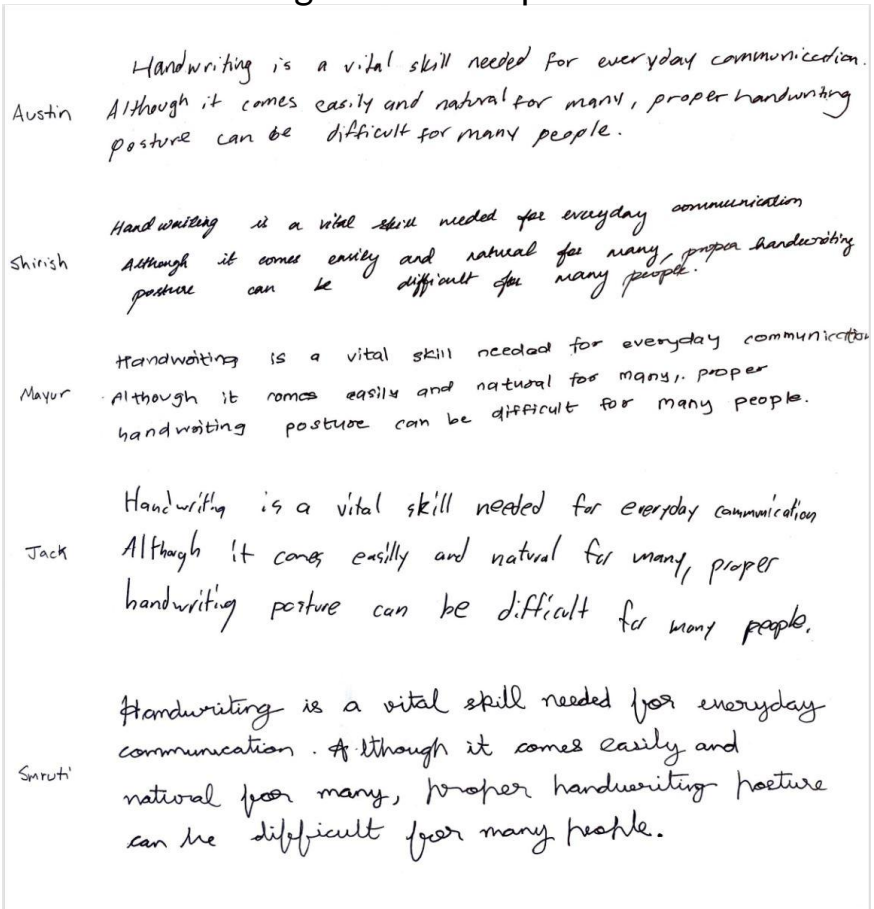
SAMPLE TO WRITE FOR RIGHT-HAND:-

Handwriting is a vital skill needed for everyday communication. Although it comes easily and natural for many, proper handwriting posture can be difficult for many people.

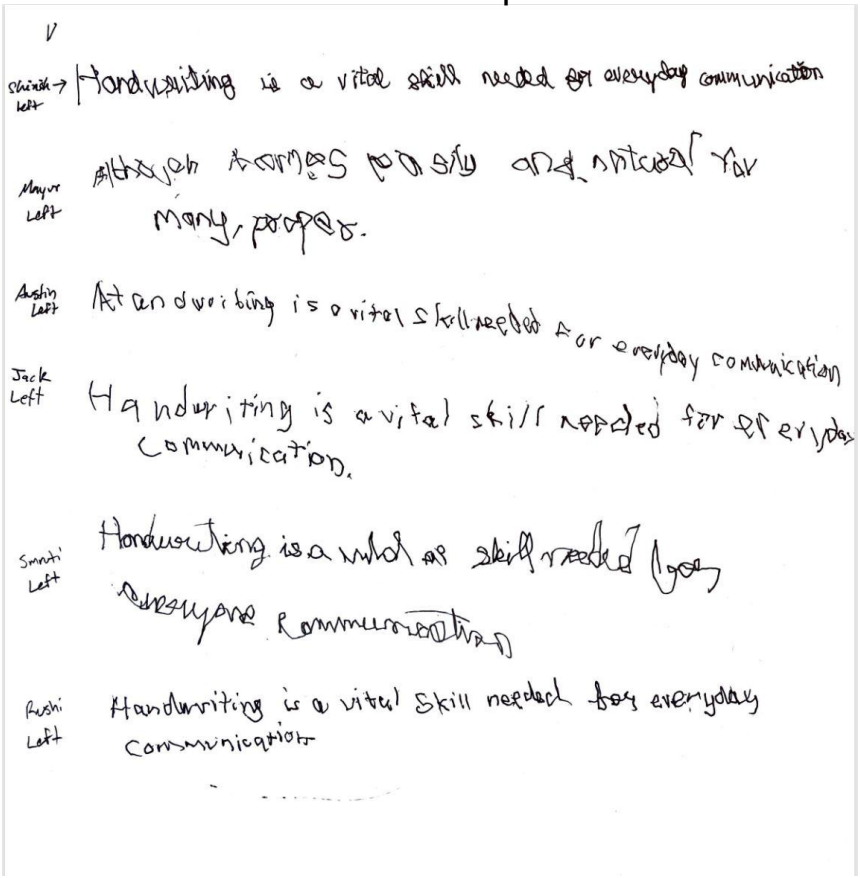
SAMPLE TO WRITE FOR LEFT-HAND:-

Handwriting is a vital skill needed for everyday communication.

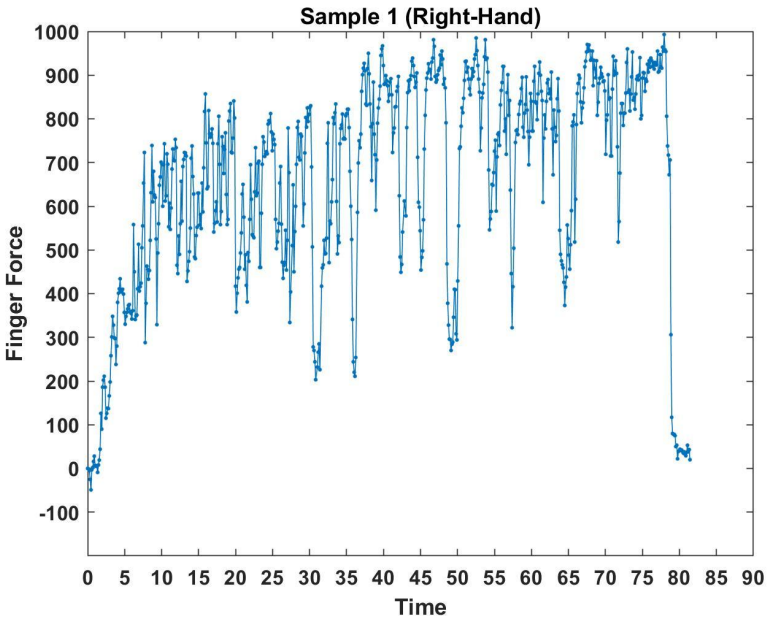
Right Hand Samples

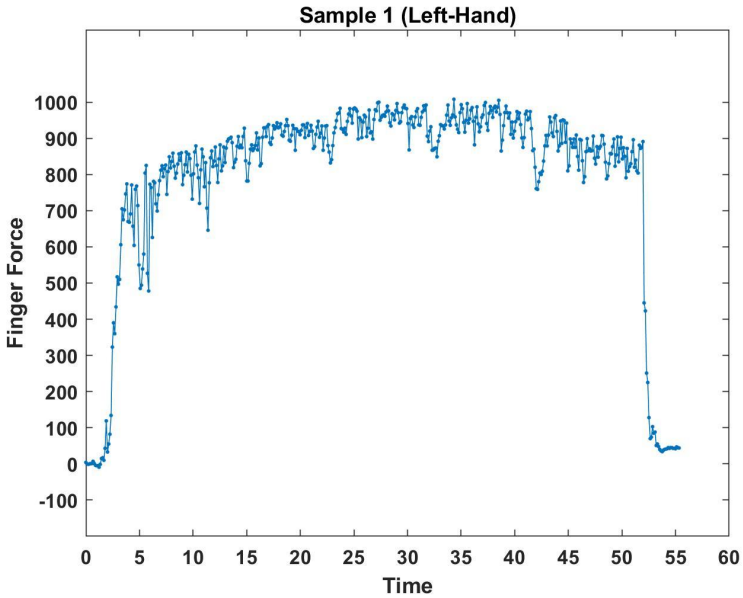


Left Hand Samples



Graph of Mean Grip Force vs Time





Austin Handwriting is a vital skill needed for everyday communicedion. Although it comes easily and natural for many, proper handwriting posture can be difficult for many people.

Austin Left Handwriting is a vital skill needed for everyday communication

Jack Left

IMU

Pen tip

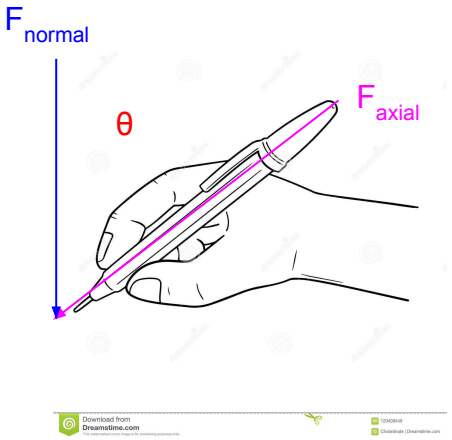
sensor

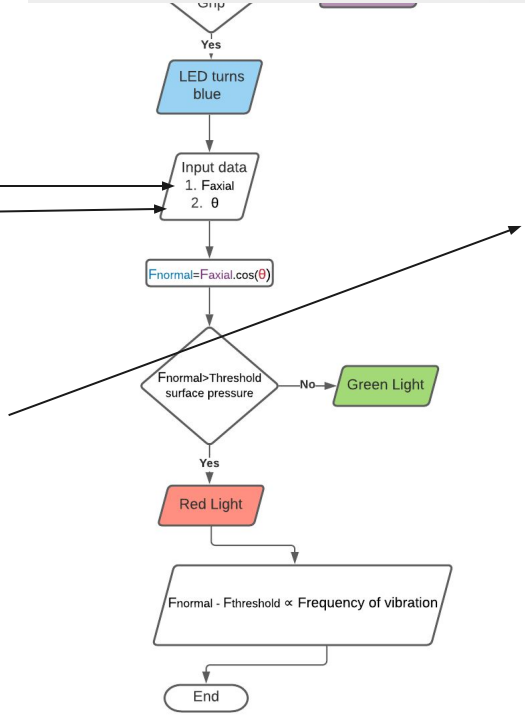
Grip sensors

Grip

Pen tip

Inclination of pen



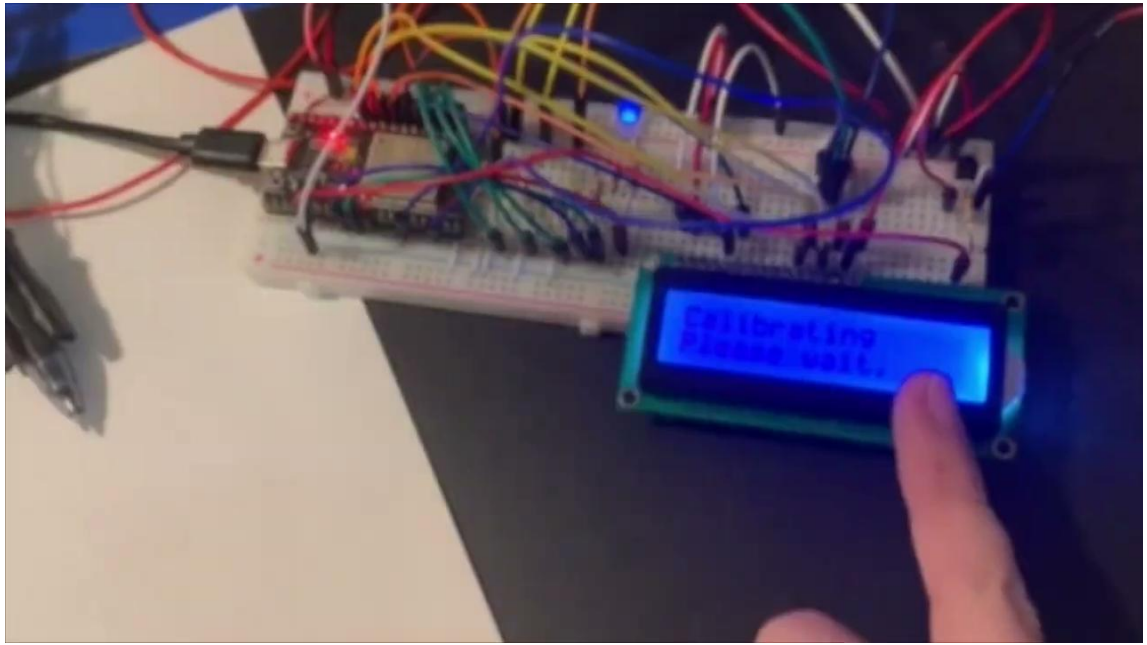


Initialization

Force Normalization

Feedback in form Light and vibration

Demo of Pen in action



Conclusion

- Successfully measured parameters and their relation with the handwriting quality. ✓
- Provide feedback to user ✓
- Data for Occupational Therapist/Teacher/Mentor/Parent ✓
- Simple and Intuitive ✓

Future Scope

- Ergonomic design
- Share the data with an occupational therapist.
- Test it with kids, collect more data.
- Handwriting Recognition with live feedback.

THANK YOU

Questions?