Enhanced Rehabilitation Glove System for Hand Injury Patients

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Abstract

This wireless system offers patients with hand injuries a path to recovery through guided exercises. A single glove connects them to healthcare professionals who create personalized programs based on their own movements analyzed by machine learning. Patients can choose pre-recorded video exercises or interact live with therapists for maximum flexibility.

Introduction

This project presents an advanced rehabilitation glove system for hand injury and stroke patients. Focusing on accelerated recovery, the system utilizes a glove that mimics healthcare professional movements for targeted exercises. Patients can access these exercises via pre-recorded videos or through live therapist interaction, fostering a personalized rehabilitation experience.

Software Implementation

- **OpenCV** Library
- **MediaPipe** Library
- **serial** Library

OpenCV Library

- **OpenCV** is a powerful **computer vision** library that provides various functionalities for **image and video processing.**

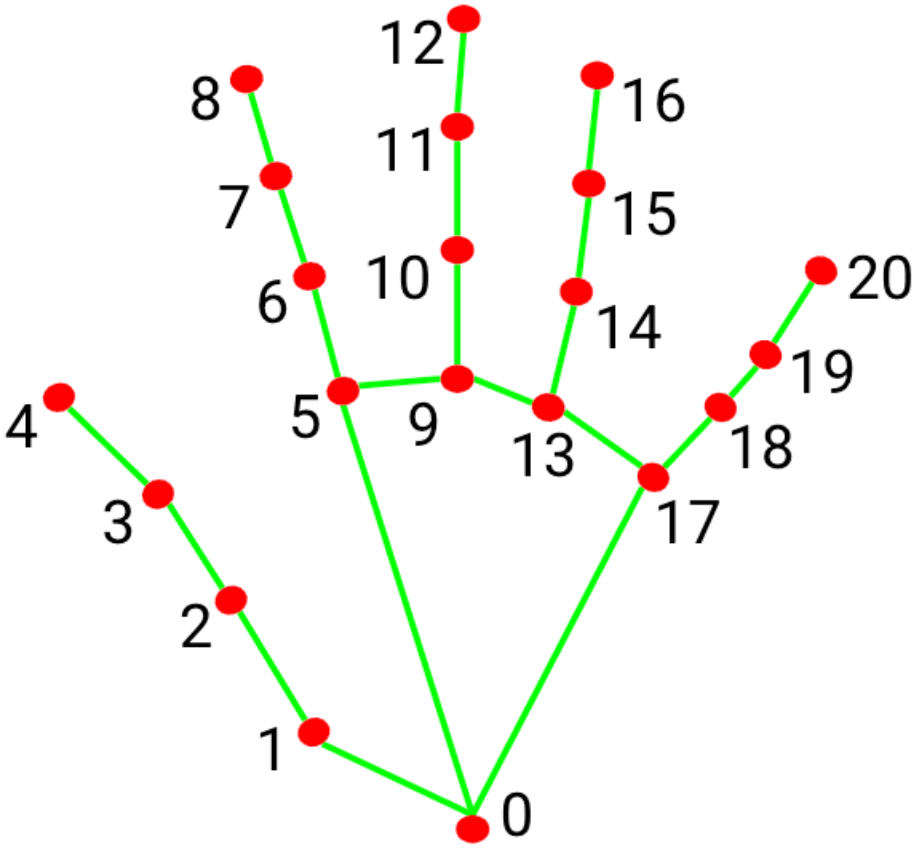
- We can use OpenCV to capture live video streams from **cameras**, **detect hand movements**, **track hand gestures**, and extract relevant features from the video feed.

- With OpenCV, you can implement **algorithms** for **hand detection**, hand tracking, and **gesture recognition**, enabling you to **analyze** and **interpret** the movements of the hand during exercises.

MediaPipe Library

- MediaPipe is a Python library that provides pre-trained models and tools for building machine learning pipelines for various tasks related to **multimedia processing**.
- It **offers ready-to-use solutions** for tasks such as **hand tracking**, **pose estimation**, **object detection**, and **facial recognition**.
- you can use MediaPipe's hand tracking models to detect and **track the movement** of the hand in real-time video streams.
- By integrating MediaPipe into our Python application, we can easily access hand tracking functionalities **without having to develop complex algorithms** from scratch.

Hand Landmarks



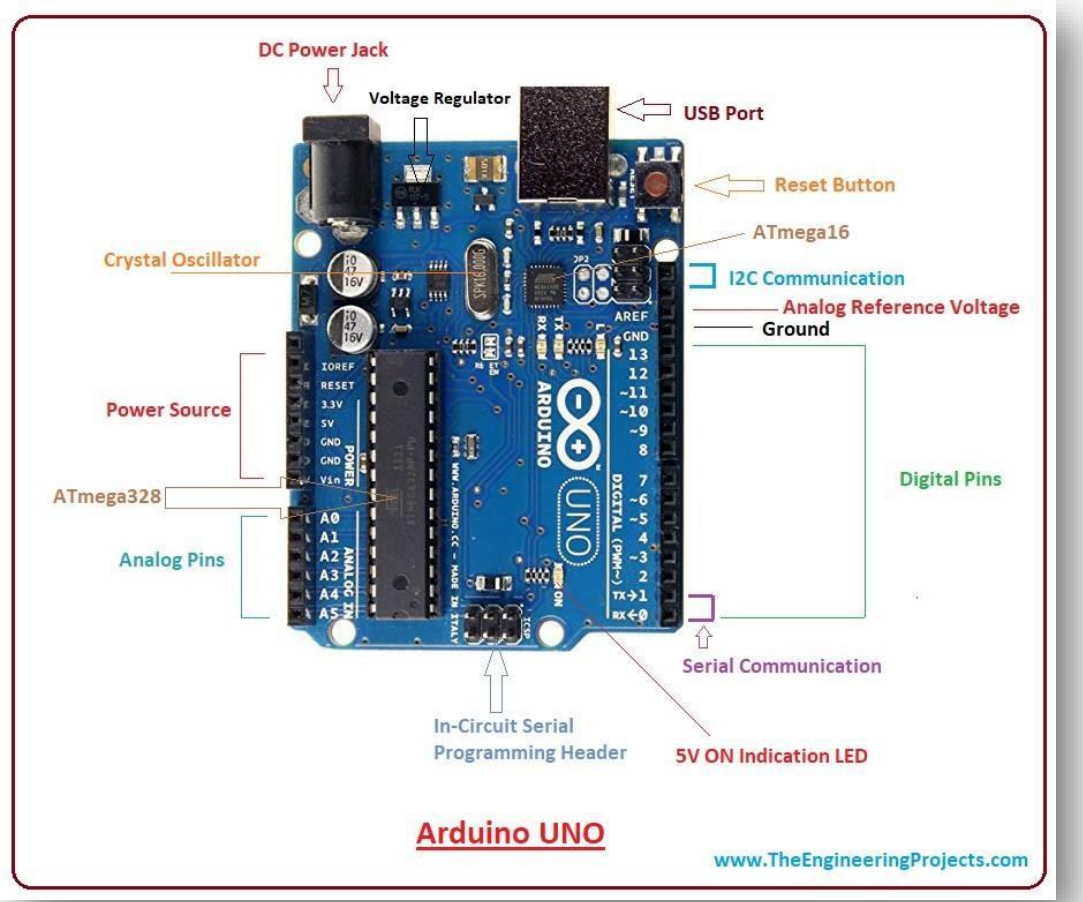
0. WRIST
1. THUMB_CMC
2. THUMB_MCP
3. THUMB_IP
4. THUMB_TIP
5. INDEX_FINGER_MCP
6. INDEX_FINGER_PIP
7. INDEX_FINGER_DIP
8. INDEX_FINGER_TIP
9. MIDDLE_FINGER_MCP
10. MIDDLE_FINGER_PIP
11. MIDDLE_FINGER_DIP
12. MIDDLE_FINGER_TIP
13. RING_FINGER_MCP
14. RING_FINGER_PIP
15. RING_FINGER_DIP
16. RING_FINGER_TIP
17. PINKY_MCP
18. PINKY_PIP
19. PINKY_DIP
20. PINKY_TIP

serial Library

- In Python, the serial library is used to communicate with devices over a serial port. This library allows you to send and receive data through the serial port, which is commonly used for communication with microcontrollers, sensors, and other hardware devices.

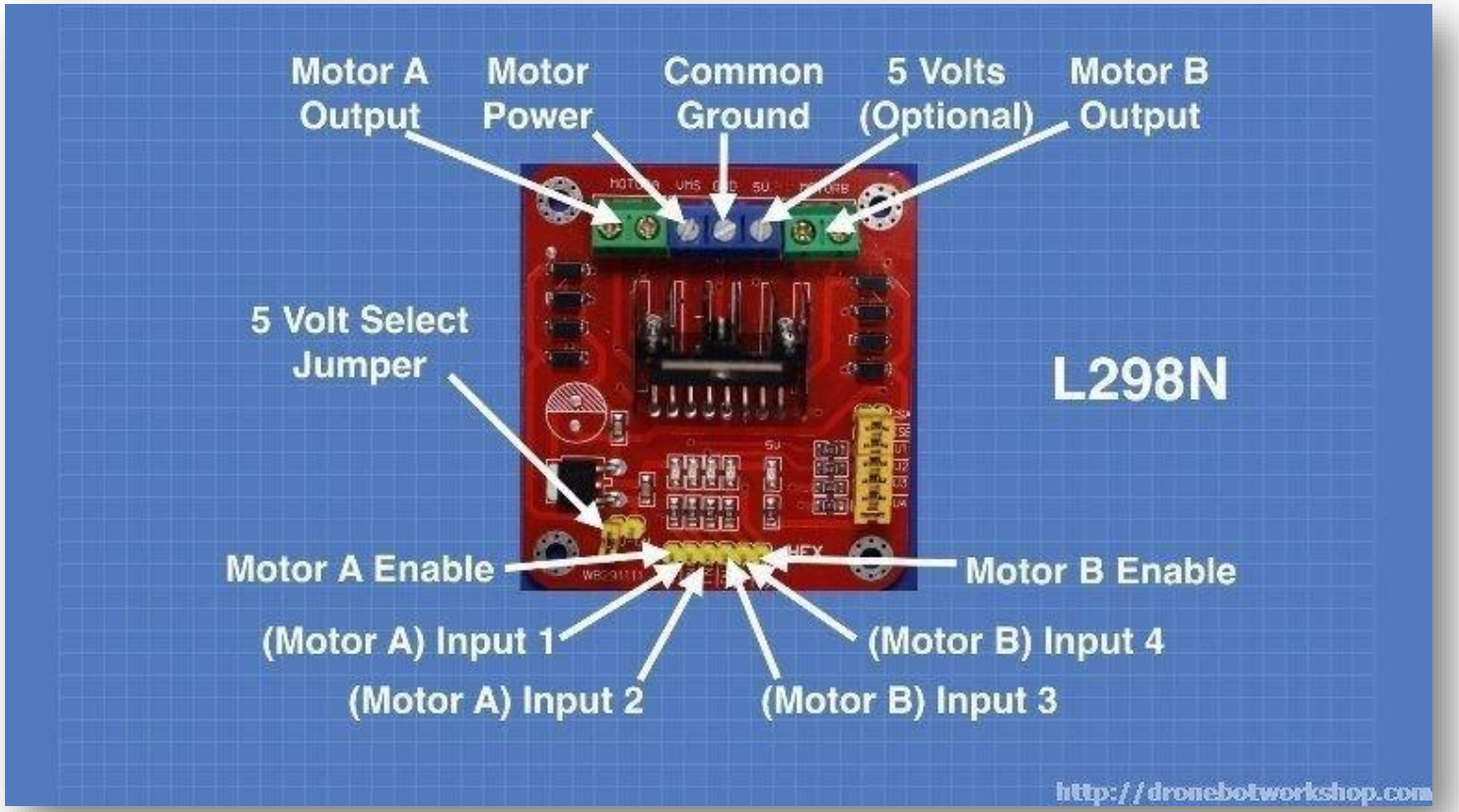
- We import the ***serial*** module.
- Define the serial port and baud rate that the device is using.
- Create a Serial object using ***serial.Serial()***.
- Open the serial port with ***serial.open()***.
- Send data to the device using ***serial.write()***.
- Read data from the device using ***serial.readline()***.
- Close the serial port with ***serial.close()*** when done.

Arduino Uno

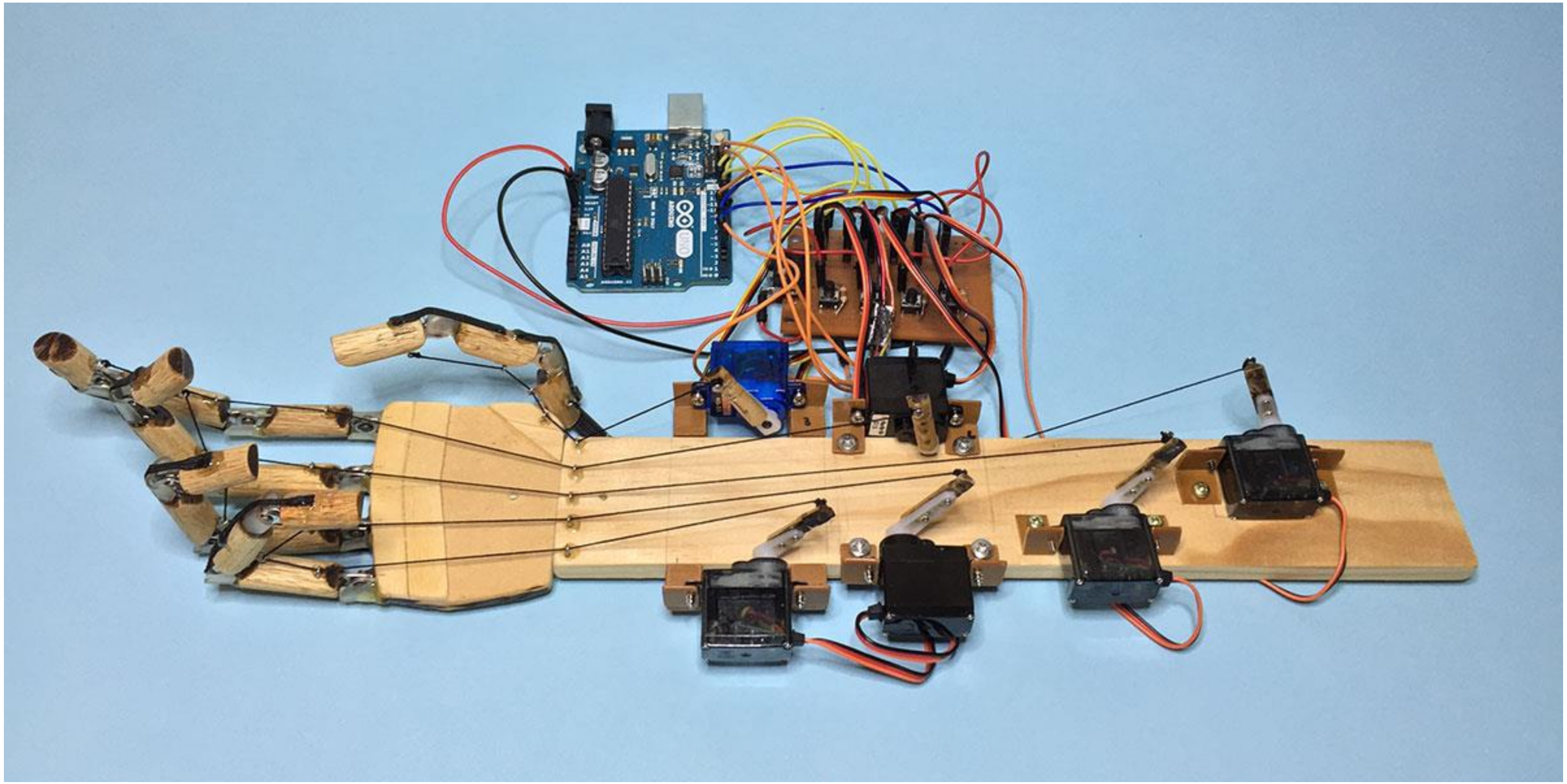


Main processor for transferring and receiving hand movements

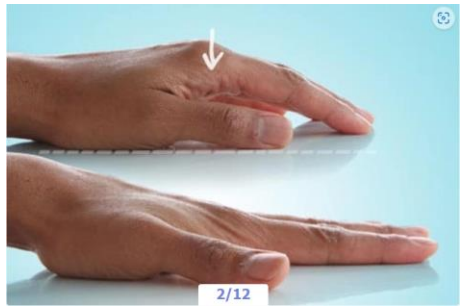
L298n motor driver

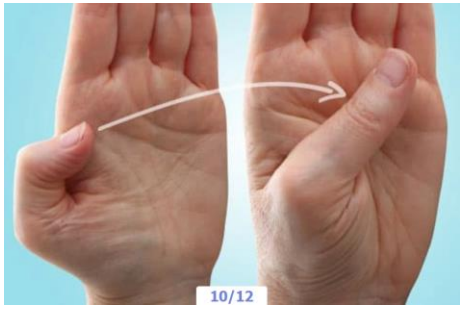


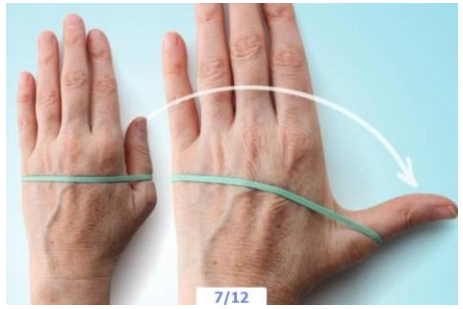
The L298 motor driver for controlling the direction of motor,
we also use voltage regulator for motor power supply with 7.5volt

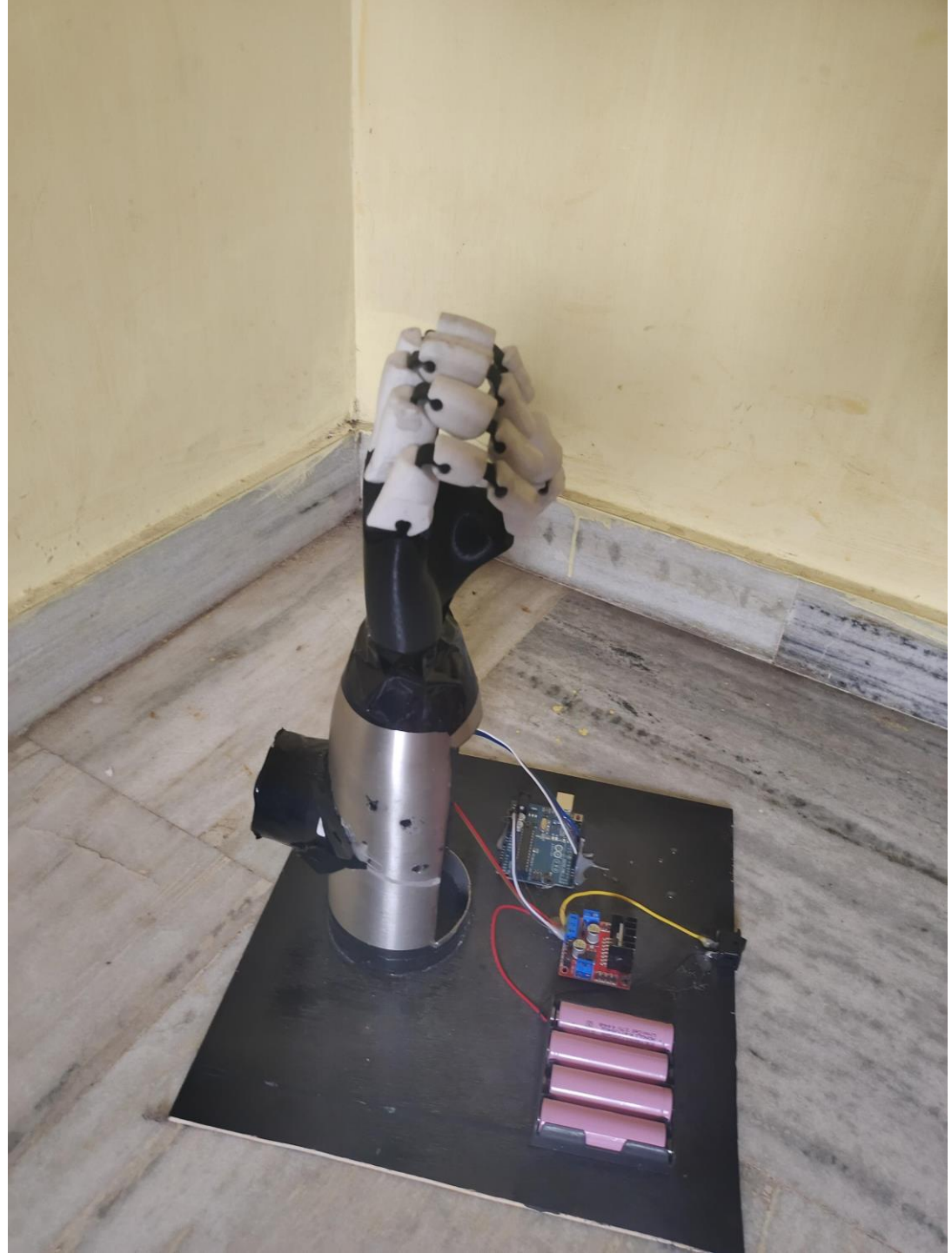


Exercises

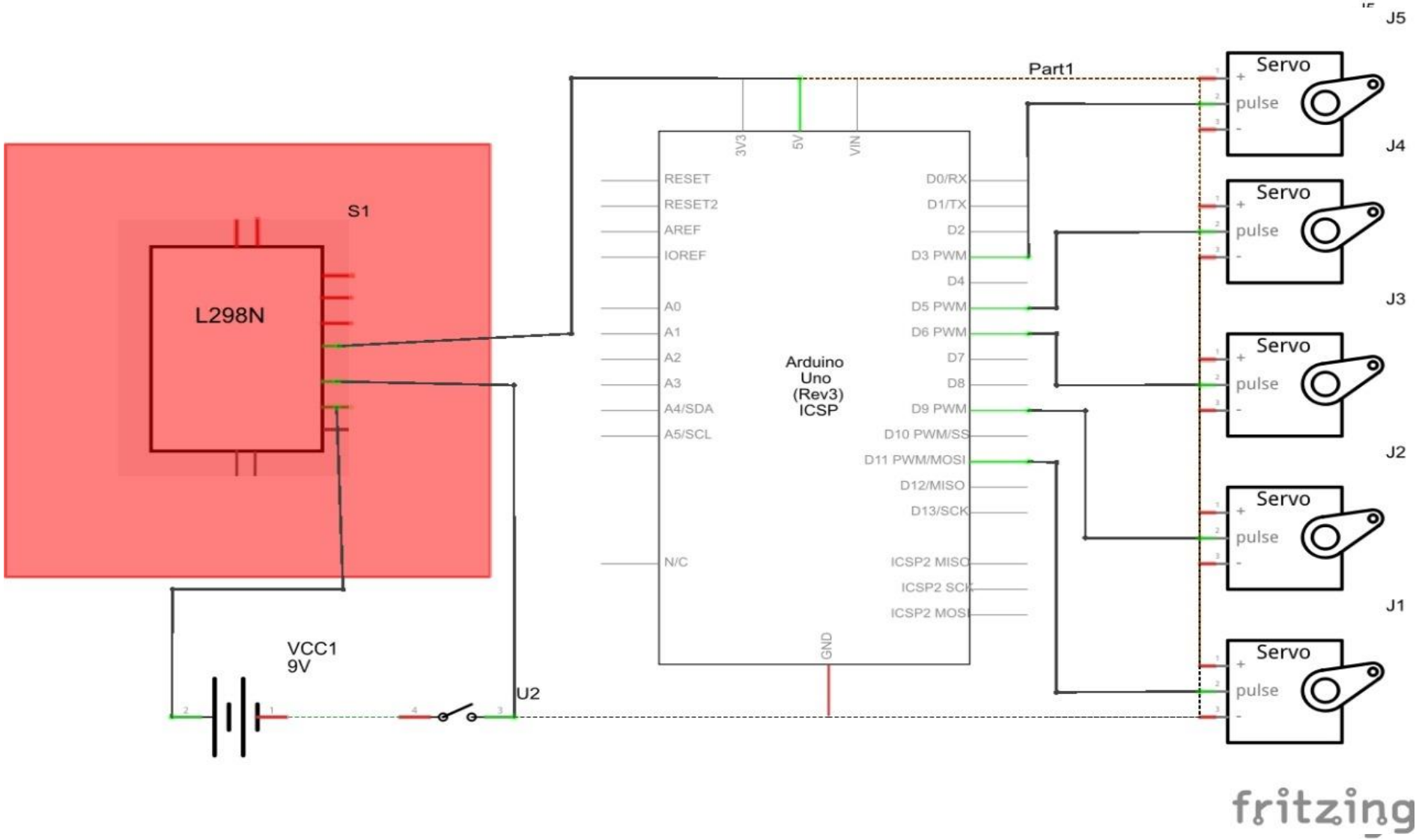








Schematic diagram



Block diagram of ERG

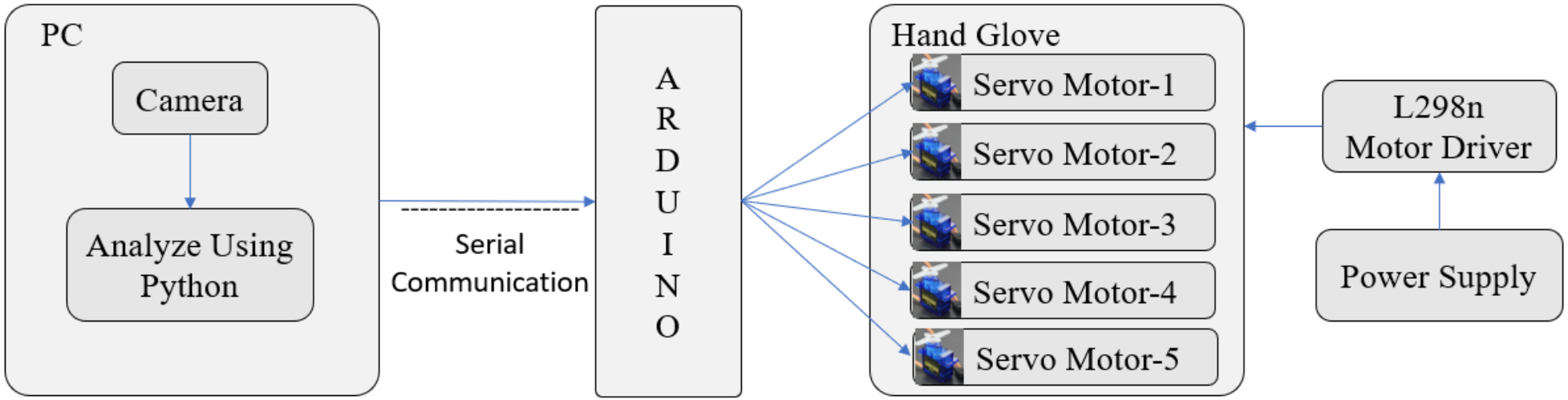


Figure. Block Diagram representation of proposed systems.

Flow Chart

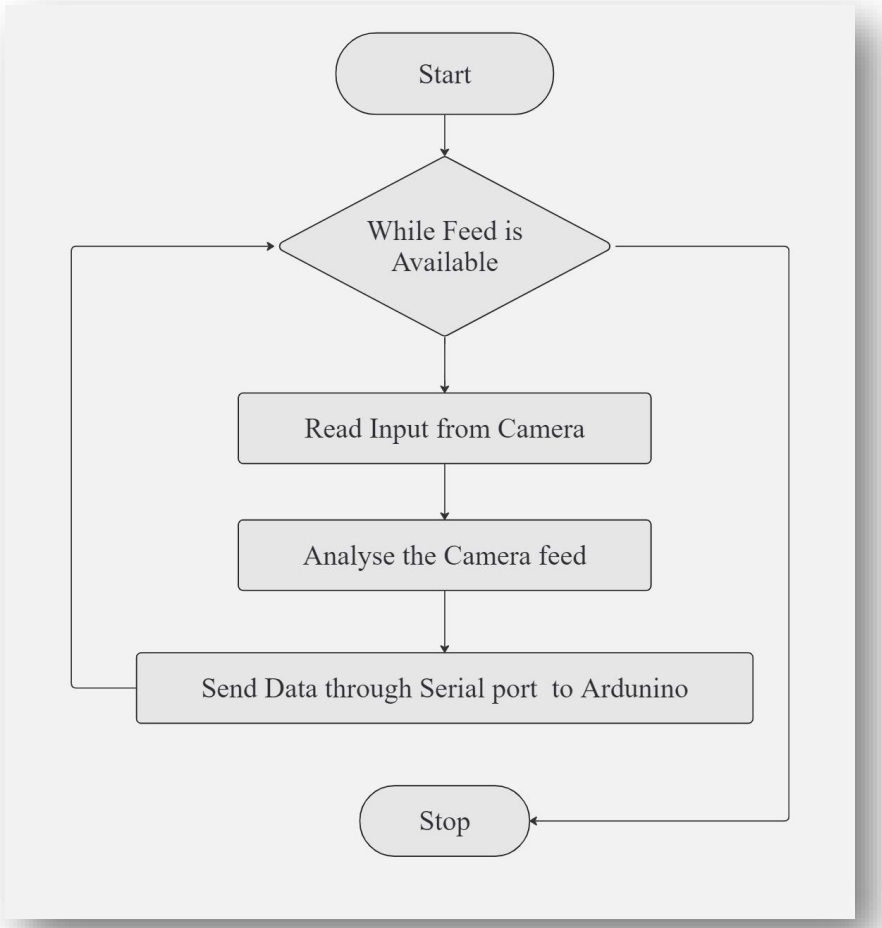


Fig. Flow chart for Operation of HealthCare Professional side setup

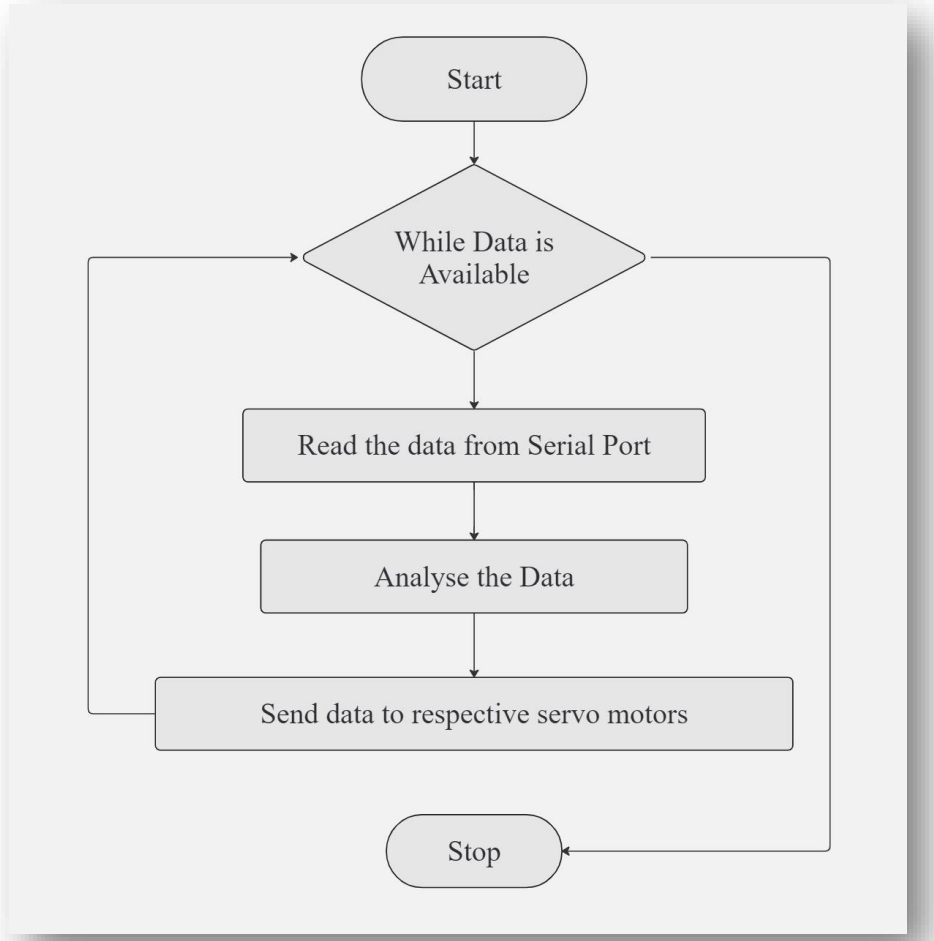


Fig. Flow chart for Operation of Patient side Glove using Arduino Uno

User Interface

Fig. Home page GUI.

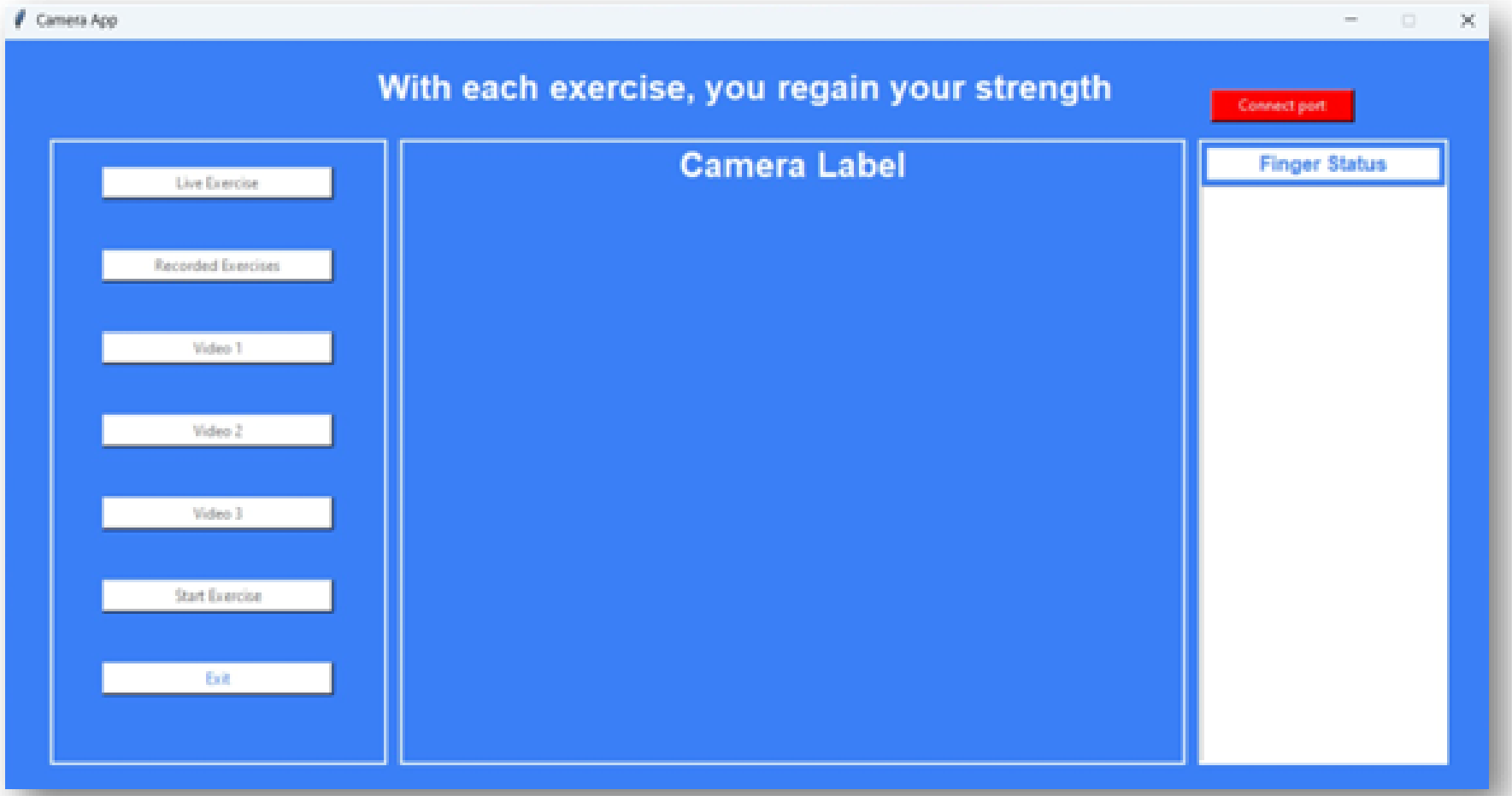


Fig. GUI before connecting port.

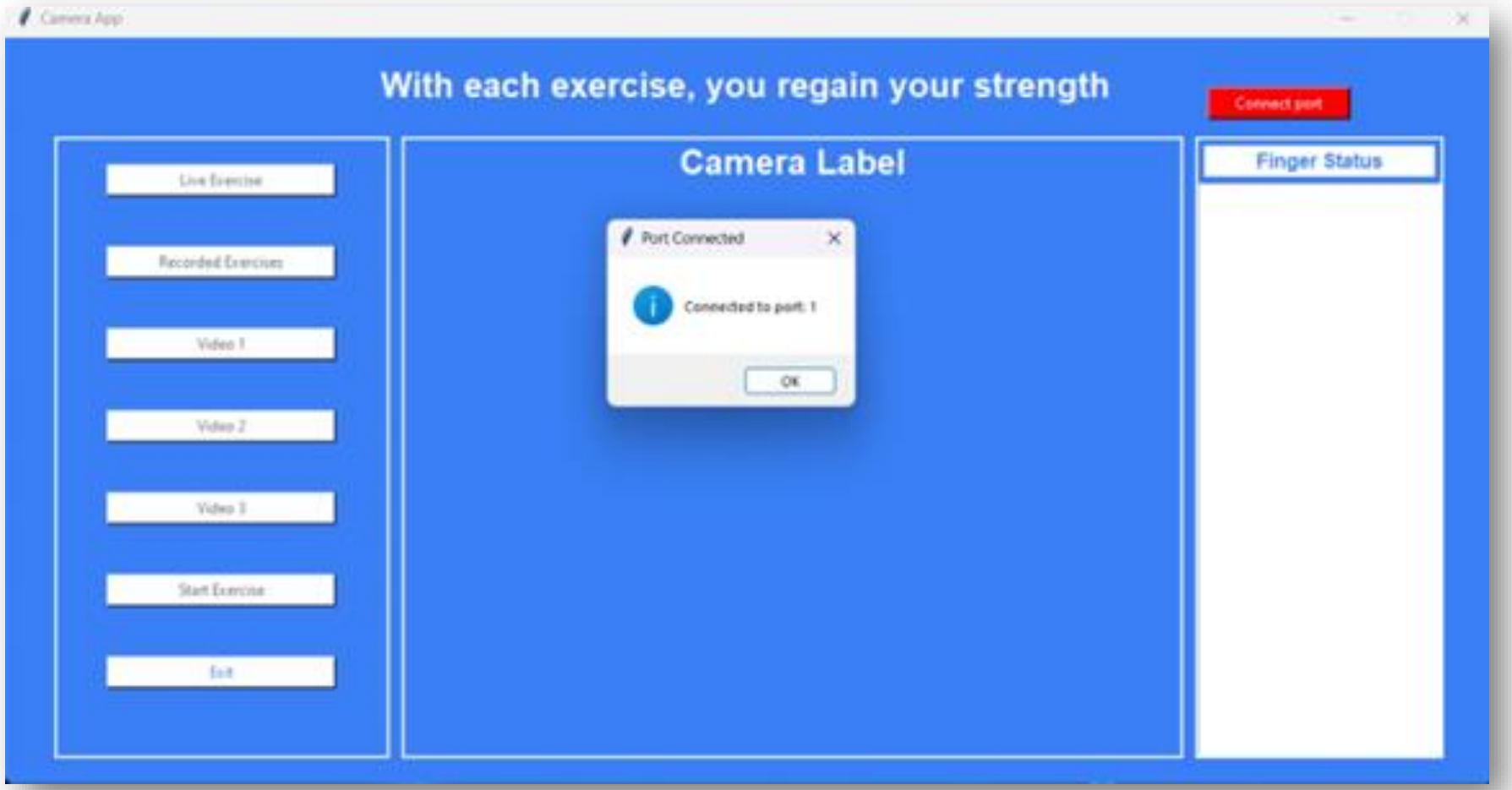


Fig. During port connection.

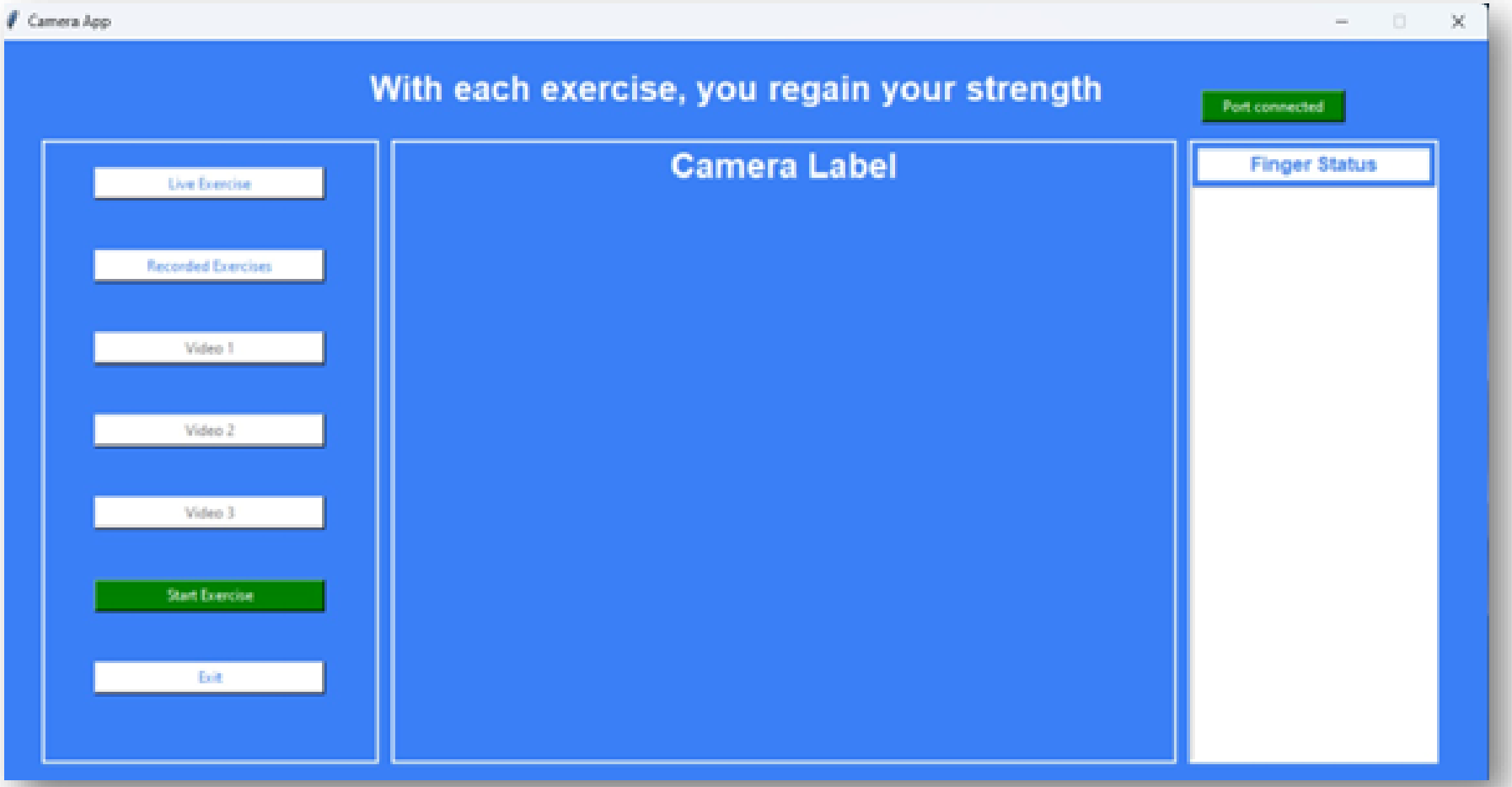


Fig. GUI after port connection.

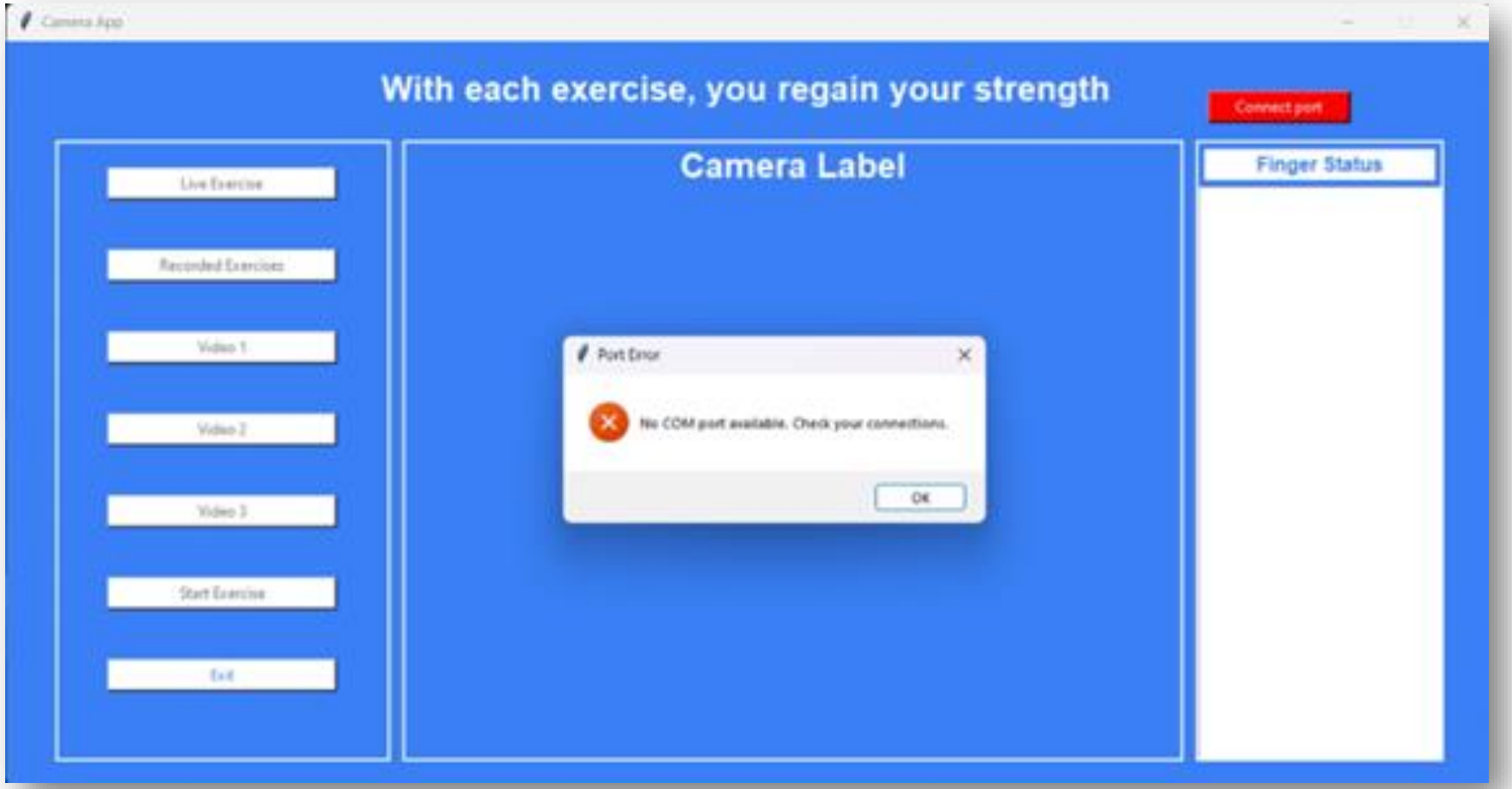


Fig. GUI if port is not connected successfully.

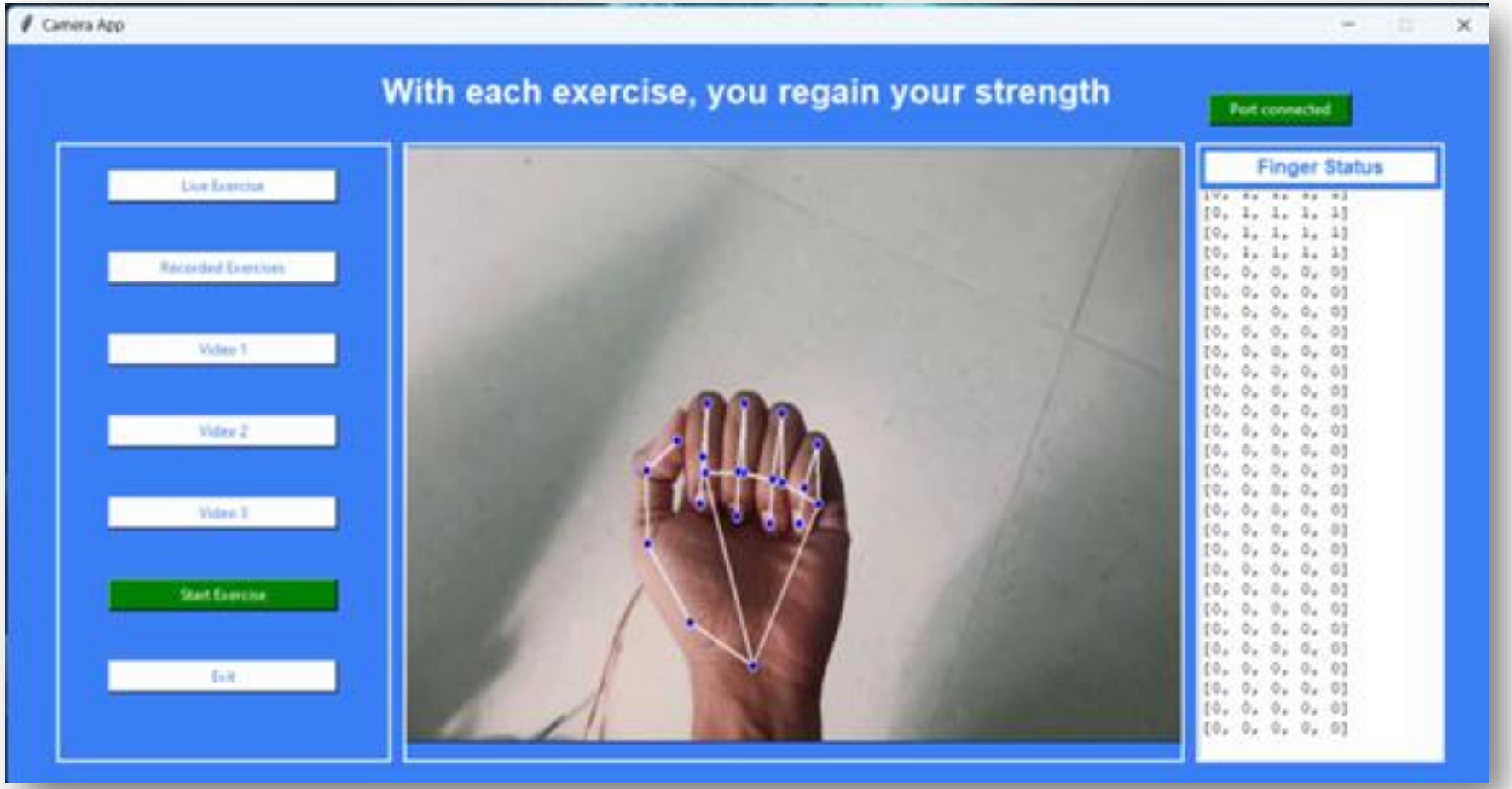


Fig. Pre recorded video GUI.

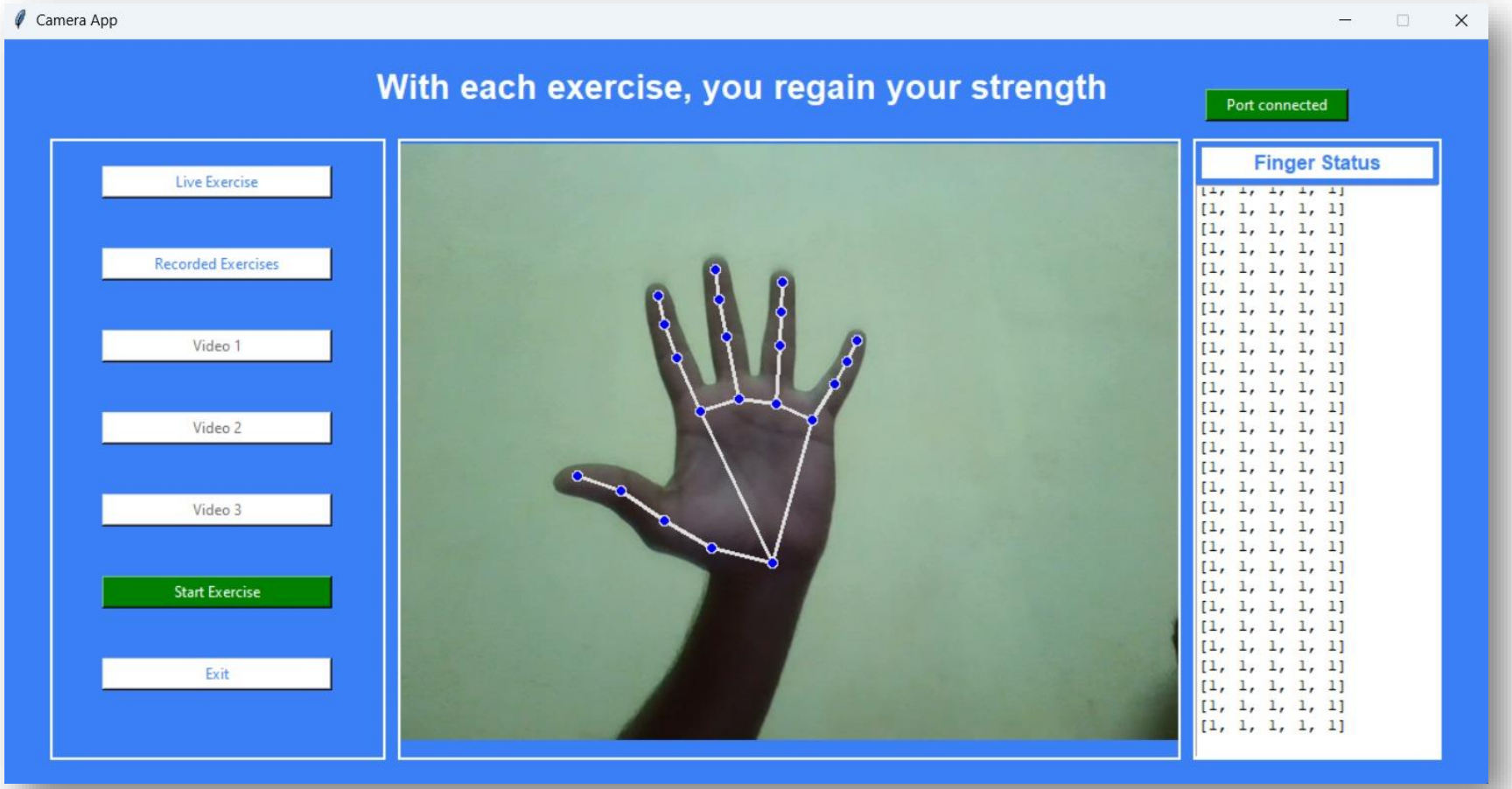


Fig. Live Exercise interface GUI.

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Thank You