Work Completed and Future Iterations

Early iterations were documented in a file which is included. Tasks I completed over the summer were improvements to wiring design and quality, redesigning the glove, improved FSR adhesion, and an upgraded GUI.

Wiring

- The wiring harness should be improved into a ribbon wire design where all wires leave the arduino and continue to the FSR's
- In the future a PCB may be used to incorporate all resistors needed for each FSR on the fingers and in the palm array
- Another future change could be to completely remove the arduino and to use a micro controller with a PCB to reduce weight and size of device
- The accelerometer should be attached to the wiring harness along the back of the wrist
- Diagrams will be included for wiring design
- All wires should be routed along the back of the hand and fingers while inside the glove to reduce interference with palm and physio therapist
- Wires should be soldered to the solder tabs on the FSR's then coated with plastic dip solution to ensure durability
- Wires were ordered from Cooner Wire, part number: NEF26-10546
- These wires were chosen due to their extreme flexibility and diameter
- The wires are 26 gauge with very thin insulation allowing for minimal interference and discomfort for the user
- The flexibility allows for movement in fingers without restraint
- In the future the wiring can be incorporated into a substrate material containing a printed circuit similar to the design of the TekScan grip force measuring device

Force Sensor Resistors

- The FSRs contain a adhesive backing which should be used when placing them into the pockets
- This design allows the FSRs to stay in place while held firmly by the pocket and not causing the force readings to be compromised
- In the early work completed a product was discovered which had a flexible adhesion which would not cause the back of the FSR to harden and was very thin which ensured the readings would not be altered
- The product is : American Biltrite 9235 adhesive
- In future iterations if a different glove design is created this product may come useful to hold FSR's in place
- FSR's placed on the fingers were changed from previous designs to the FSR 400 Short
- This change was made to ensure that the long tails would not interfere with the user
- Wires are wrapped on the inside of the glove from the FSR solder tabs and routed back to the arduino
- Changes were also made to the FSR's in the palm of the glove
- The palm now contains 3 separate arrays of FSR's each with multiple FSR's which should be used in a future GUI to display a pressure map of that section of the palm
- FSR 400 is used for the FSR's in the arrays
- A diagram displaying the position of theses FSR's will be included
- Plastic Dip is strongly recommended to be applied over solder tabs following soldering to allow for flexibility inside the glove

- A future iteration to the FSR's in the palm arrays is to use and/or make a tactile sensor which can be attached to the glove and used to display a pressure map of the palm
- Currently 13 FSR 400 Short sensors and 25 FSR 400 sensors are available for the current glove design and is included with all other materials and documents
- When work is continued please call Pressure Profile Systems and ask about newly designed force sensors, these may turn out to be useful and may be able to replace the FSR's (were being designed and were not available during my time on the project)

Glove Design
- The glove was completely redesigned
- The final report included displayed large problems with the original glove design
- The new design uses a hybrid material of 30% lycra and 70% cotton this allows for flexibility and very light thin material
- The cotton allows for the material to be cut and shaped into necessary shape without threads hanging out and with flexibility in all directions
- The lycra also forms to the shape and size of the hand allowing for three sizes small, medium, large while still covering every hand shape and size
- The material was bought from Fabricland and after completing 2 prototypes a finalized design was made
- The current design is a full glove covering all fingers and palm with extra material on the side of the fingers allowing for wiring and flexibility
- The glove contains pockets for the FSR's on each finger and also 3 large arrays on the palm
- The pockets and arrays all are on the interior of the glove and the wiring is routed also on the inside of the glove along the back of the hand allowing for a clean flexible non restrictive design
- This design was carefully thought out to ensure that the material between the physio therapists hand and the surface on which they are practising on is minimized and is non restrictive
- Recently Stacy gave a possible future iteration in which a thin layer of silicon is used around the top bend in each finger, used for friction which will stop the cloth with the FSR to stop spinning on the finger
- Another future iteration could be a one size fits all design or a custom glove made for each user
- The physic therapist I spoke to gave me the idea of making a similar design that would add-on to the glove and would wrap around the forearm
- This could be a possible future iteration using tactile sensors and a pressure map

Graphical User Interface
- The original GUI was not included in the old work and so a new one was created using a different software
- The current software used is Qt Creator
- The GUI code was based off a similar tutorial where a user used Qt Creator with an arduino to get temperature readings
- The current code is displaying 2 errors for defined functions once these two errors are resolved the current GUI will display a force reading through a LCD display
- Once the errors are resolved the display section of the code may be copied and pasted multiple times to display the readings from multiple sensors
- This is the basic GUI for the FSR's and can be associated with a diagram displaying the location of the sensor and the current force reading

- A future iteration to the GUI is to incorporate the accelerometer alongside a diagram displaying the movement of the hands angles and direction
- Also a future iteration is to create a pressure map of the arrays across the palm
- Code from the previous GUI may be reused and altered to suit any future iterations
- https://www.youtube.com/watch?v=hLB1FfxSl1A - Where code was originally sourced
- https://www.youtube.com/watch?v=AX-HhBXBzGg - Code altered for sensor readings
- https://github.com/vannevar-morgan/Qt-Temperature-Sensor - Code for sensor readings
- If for testing purposes FSR's want to be tested or used to read FSR values the original arduino code given works but a simplified version is included as Test 1 and Test 2 in the current files

Future Work

- The accelerometer must be incorporated in all three planes allowing for the GUI to know the angle of the hand
- The angle and forces of the hand will be used in physio therapy training
- The wiring harness with a PCB board containing resistors for the FSR's
- Improve the GUI by adding visual diagrams of locations of force sensors on the hand and a pressure map of each array also located on an image of the palm allowing the instructors to have a visual representation of the forces
- In the future the design should have bluetooth capabilities to allow for wireless data transmission
- A bluetooth shield can be used with the arduino to allow for bluetooth capabilities for the future prototypes but in the future a small antenna can also be printed into the substrate material reducing size and weight and allowing for greater flexibility