DEPARTMENT OF MECHANICAL ENGINEERING

TEAM NUMBER 19

Team Reflex

Josh DeGuzman, Gabriel Elgharbawi, Brenden Gray, Maansi Gupta, Chase Ritter, Parker Ritter

A. JAMES CLARK SCHOOL OF ENGINEERING

Problem Definition

The traditional reflex hammer is outdated in today's clinical settings.

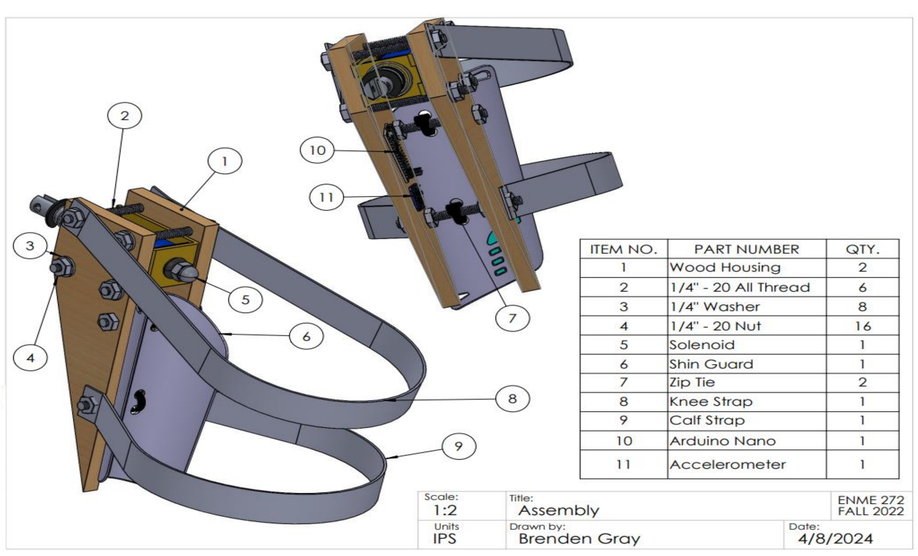
COVID-19 has shifted medical procedures to be more practiced in stay-at-home environments. Veterans who already may have back damage want a device to test the patellar tendon reflex. The customer wants a device that avoids the trip to the VA.

A device that can be safely put on, mechanically actuated, secured to the leg as a wearable device, and data capture a reflex vs non-reflex would adhere to modern medical standards

Final Design

The final design is a wearable leg brace with housing for system components. The system includes a solenoid, an accelerometer, and an Arduino Uno. An accelerometer validates the reflex in the leg's projection in reflex vs. self-motion based on the plane of motion and a doctor's validation. User-controlled, it is wired in series with its 24V 3A power supply and a switch. When the button is pressed, current flows through the windings of the solenoid and by Ampere's law, generates a magnetic field which generates the force to strike the patellar tendon.

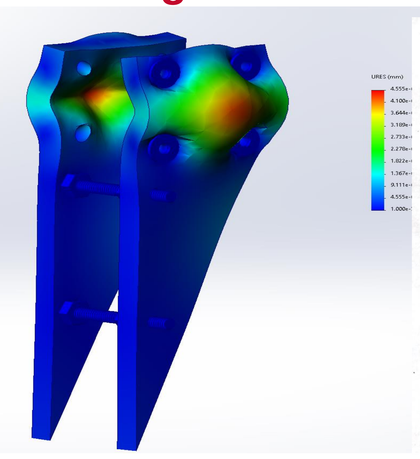
The wearable leg brace also includes padding with a strap-able shin guard that secures the leg for safety and functionality. The central housing is made of two pieces of wood connected with cross-member bolts that secure components.

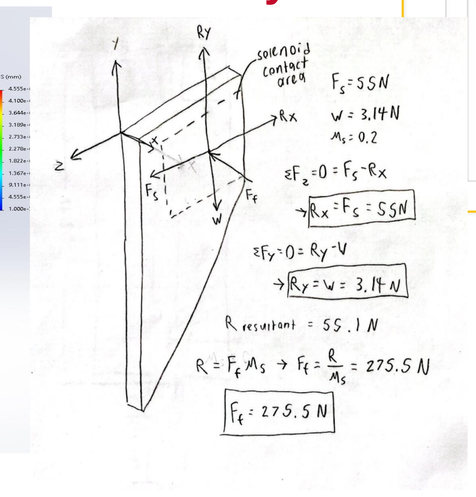


ITEM NO.	PART NUMBER	QTY.
1	Wood Housing	2
2	1/4" - 20 All Thread	6
3	1/4" Washer	8
4	1/4" - 20 Nut	16
5	Solenoid	1
6	Shin Guard	1
7	Zip Tie	2
8	Knee Strap	1
9	Calf Strap	1
10	Arduino Nano	1
11	Accelerometer	1

Scale: 1:2	Title: Assembly	ENME 272 FALL 2022
Units IPS	Drawn by: Brenden Gray	Date: 4/8/2024

Design Calculations & Analysis





Above a force concentration analysis can be seen of the device. The solenoid creates a variety of forces that over time contribute to fatigue and failure of the solenoid housing. The team continued to innovate until the final design mitigated fatigue failure.

The central housing has a strap that controls the recoil and keeps the solenoid within striking distance of the tendon while also being a wood core and 3D printed outside. The solenoid has a rubberized tip to increase the striking area and safety which regulates the +20N force.

Prototype & Test Results

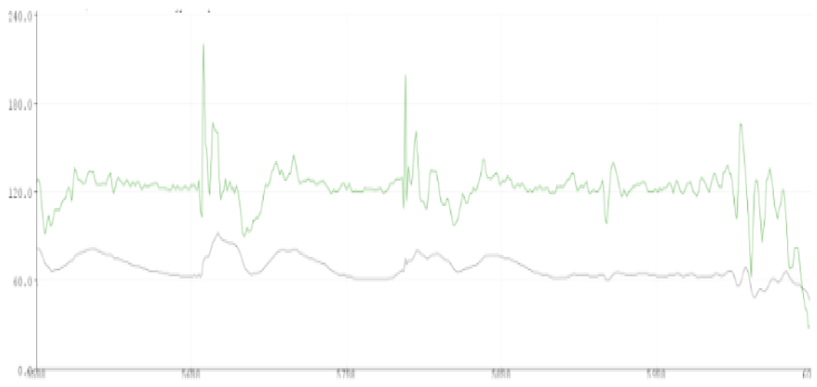


Figure 2: Acceleration data fitted with a low pass filter. Green, original signal. Black, Filtered signal