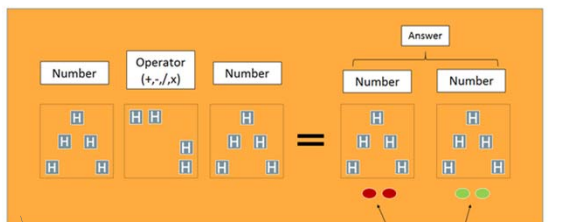
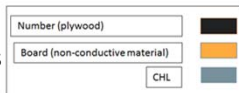


Purpose and Objectives

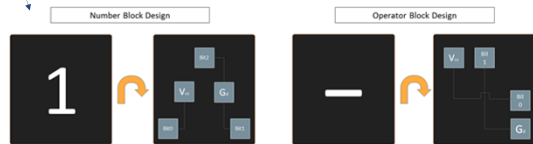
- Characterize and quantify the dynamic conductive hook and loop electrical and mechanical properties of VELCRO® brand fasteners to determine the potential of the material.
- Goal of this project is to utilize conductive hook and loop as a necessary component in a marketable product to be incorporated in the classroom.

Interactive Board Prototype

- Board utilizing CHL as both an electrical connector and a fastener
- Each connection connects to a Raspberry Pi utilizing digital inputs
- Digital inputs converted to decimal to perform operations
- Demonstrates a promising application of CHL for marketable use



Green and Red LEDs for Feedback:
 Correct Answer: Green LEDs lit
 Incorrect Answer: Red LEDs lit
 No Answer: No LEDs lit

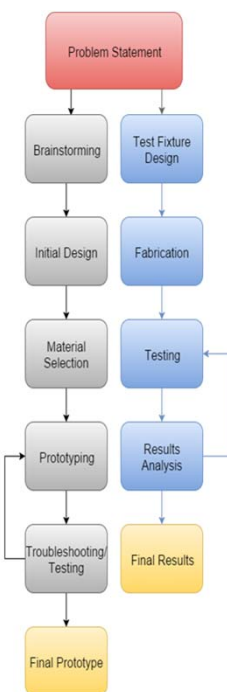


Decimal	Binary
1	001
2	010
3	011
4	100

1 – High Voltage (Vcc)
 0 – Low Voltage (Gd)

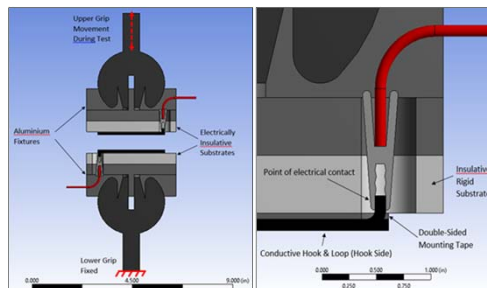
Operator	Bit 1	Bit 0
Addition (+)	1	0
Subtraction (-)	0	1
Multiplication (x)	1	1

Tech Approach

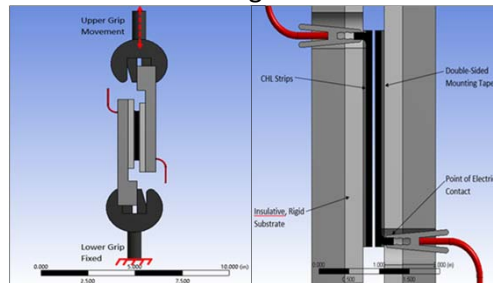


Test Fixtures

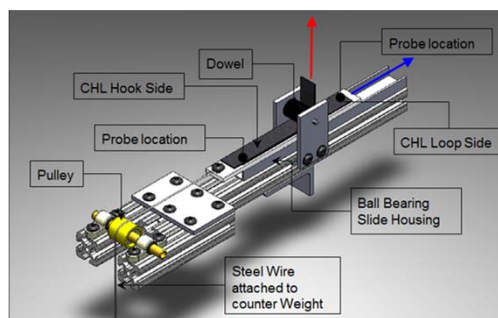
Tension (Normal) Testing Fixture



Shear Testing Fixture



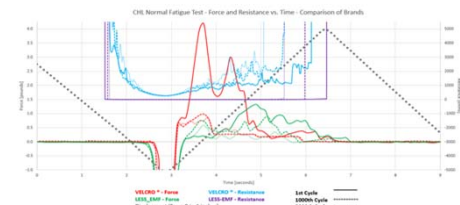
Peel Testing Fixture



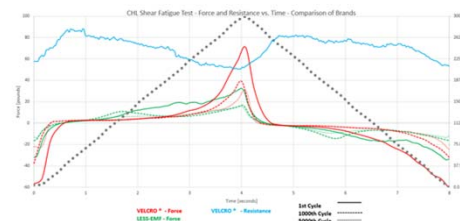
Future Work Suggestions

- Possible Tests: Thermal effects on mechanical testing, higher test count to formulate a standard deviation, maximum allowable current, testing different combinations of hook and loop types, mathematical governance of force and resistance, utilization as a piezoelectrical sensor
- Form a standard of product performance through the utilization of the peel fixture (cycles of usage, durability)

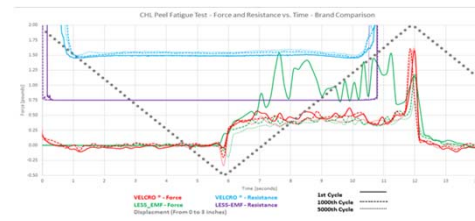
Test Results



- Carbon Loaded Polymer (VELCRO®) CHL higher in resistance, higher in retention force than silver coated nylon (LESS-EMF) CHL
- Resistance minimum doesn't change, but low resistance retention degrades over cycles



- Carbon Loaded Polymer (VELCRO®) has a smoother shear force profile due to higher rigidity in hooks
- Resistance approaches a minimum when the shear force over CHL interface is at a maximum



- Replicates actual user interaction when and usage cycles

- Carbon Loaded Polymer
- (VELCRO®) CHL degrades mechanically much less than silver coated nylon (LESS-EMF) hooks in peel configuration
- Most retention forces stay above 50% of original value after 5000 cycles
- Carbon Loaded Polymer (VELCRO®) cyclical force averages and resistance relationship maps transient mechanical degradation to resistance increase.

