

# HR 2 BREAKDOWN

**TEAM: HPVCP**

Due Date:

Friday, November 5, 2021, at 11:59 pm

Provide several pics of the current state of your completed system thus far here:

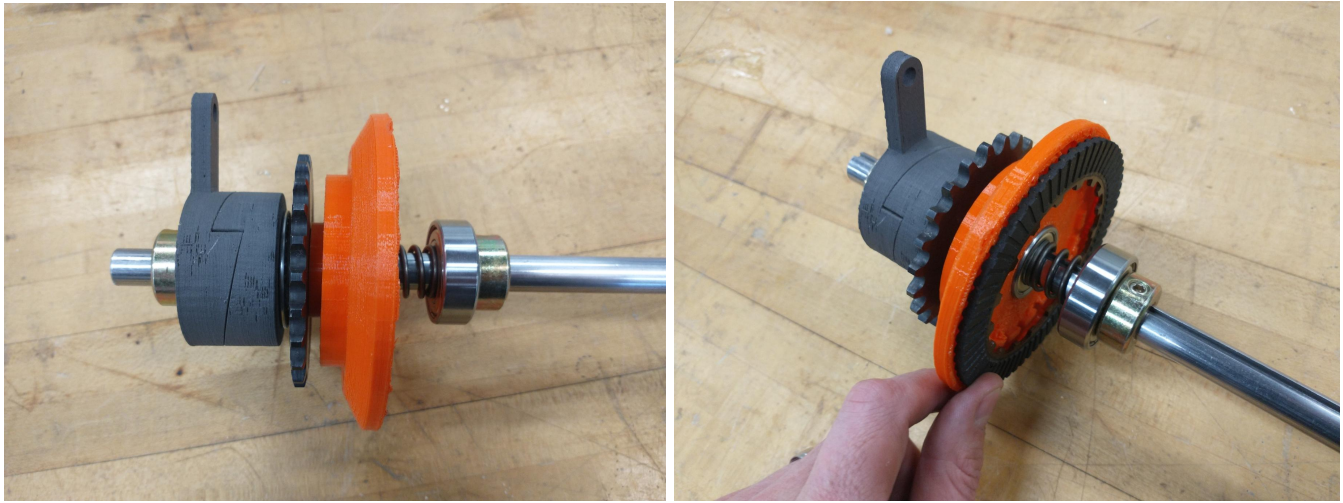


Figure 1: Clutch Assembly

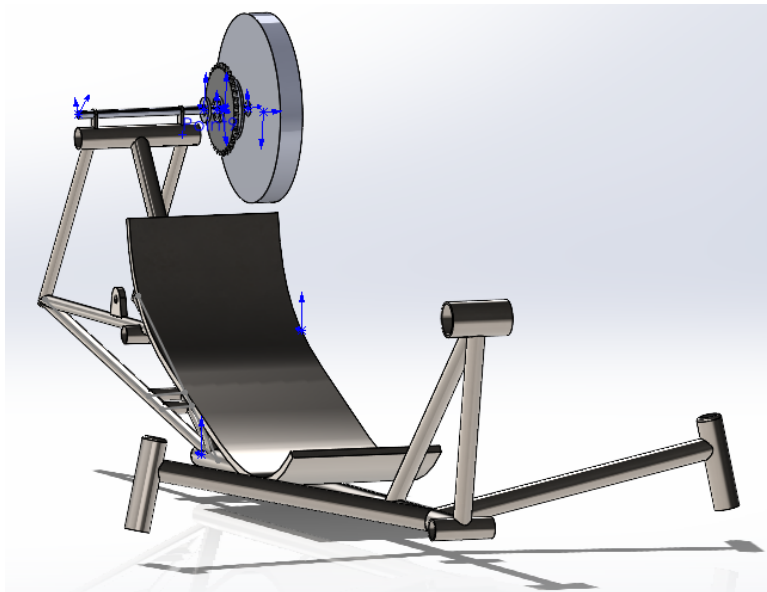


Figure 2: Full CAD Model

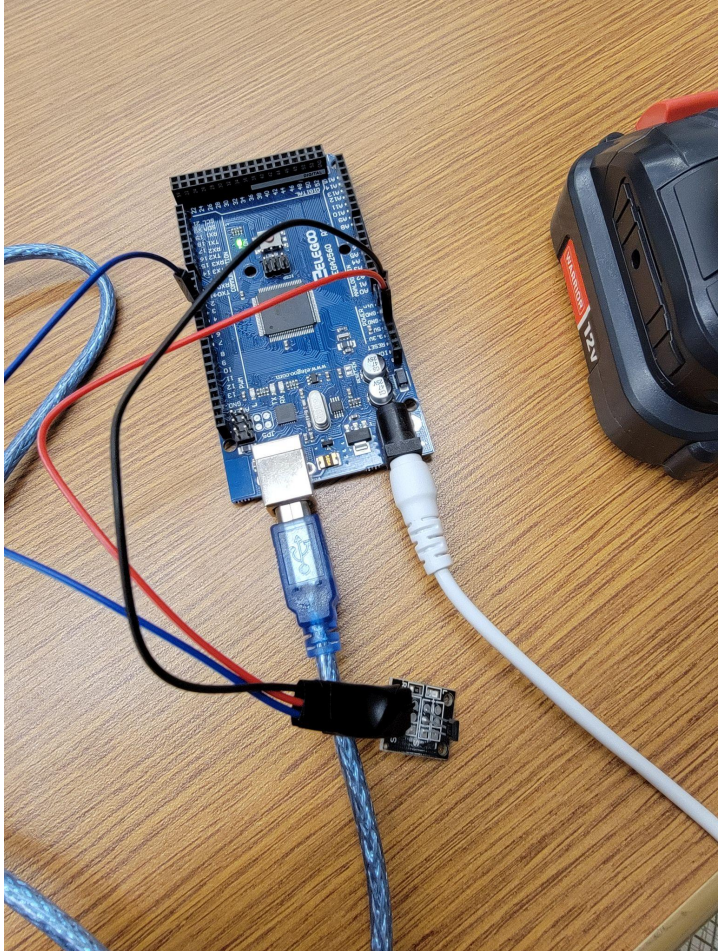
The following are the Action Items each person completed between Hardware Review 1 and Hardware Review 2:

### Team Member: Abdulh Alsabaie

Action Item	Date Completed	Result/Proof of Completion
Chain and sprocket calculation	10/27/2021	for the chain length = $2*40+(20+70/2)+(70-20/2\pi)^2*(1/40)$ so it will be 127 inches and that is length of the chain for our HPV
Engineering requirement	10/30/2021	Doing research in the ER and making sure we have met all the engineering requirement for our project

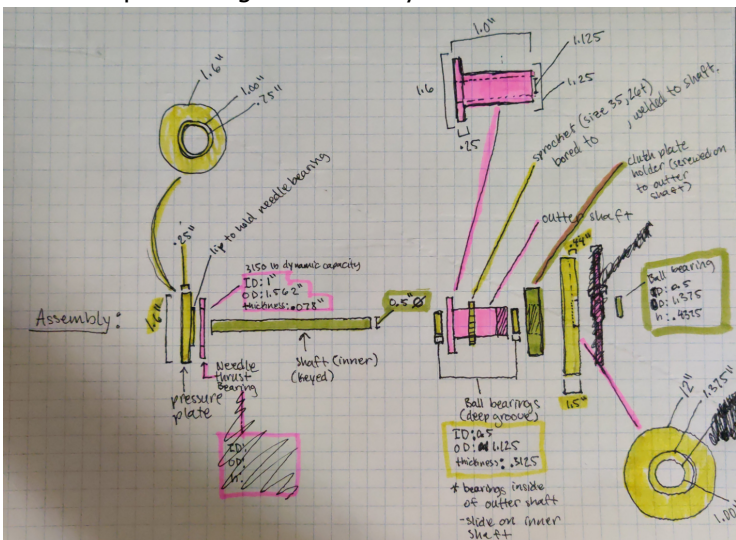
### Team Member: Yen Clutter


Action Item	Date Completed	Result/Proof of Completion
Updated Website for check #1	10/01/2021	<a href="https://ceias.nau.edu/capstone/projects/ME/2021/21Su02_HPVC/">https://ceias.nau.edu/capstone/projects/ME/2021/21Su02_HPVC/</a>  Updated team photos, CAD and progress images, added linked in profiles
Composed code for arduino	10/22/2021	Completed initializations, calculations for rpm and mph, and display to pc screen. Here are some code snippets.  <pre>//while the sensor hasn't timed out loop through while (currentTime &lt;= sampleTime) {   //check if sensor has been triggered   if (digitalRead(sensor) == HIGH)   {     count_flag = HIGH;   }    //if so update the count and flag   if (digitalRead(sensor) == LOW &amp;&amp; count_flag == HIGH)   {     count++;     count_flag=LOW;   }   currentTime = millis() - startTime; }  //calculates rpm float current_rpm = int(60000/float(sampleTime))*count;</pre>

		<pre>//convert rpm to mph float rpmToMph(int rpm) {   float inches_per_min = WHEEL_CIRCUMFERENCE * rpm;   float inches_per_hour = inches_per_min * 60;   float mph = inches_per_hour/63360;   return mph; }</pre>
Re-configured arduino with new hall-effect sensor	11/01/2021	Added new hall-effect sensor, added code for led indicator 

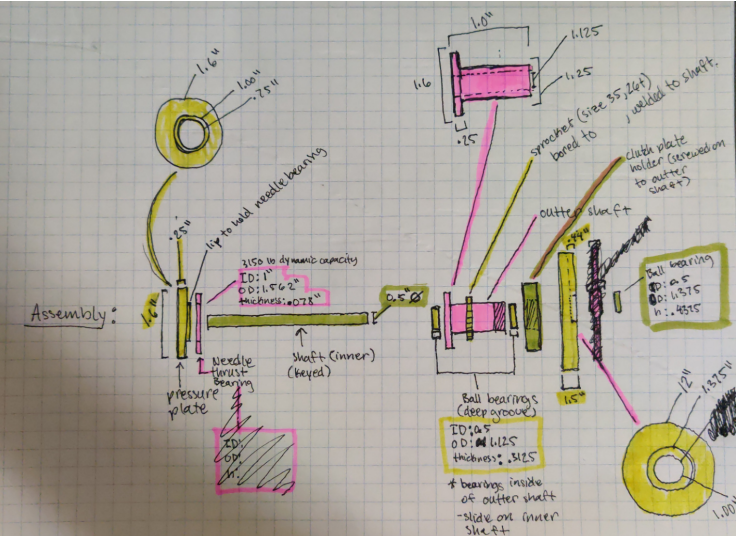
Tested Arduino and Code	11/04/2021	RPM = 120 MPH = 9.28 RPM = 240 MPH = 18.56 Slow Down RPM = 360 MPH = 27.85 Slow Down RPM = 240 MPH = 18.56 Slow Down RPM = 180 MPH = 13.92 RPM = 300 MPH = 23.20
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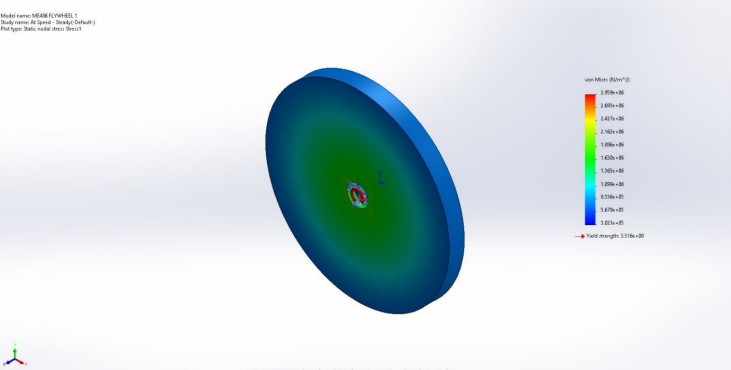
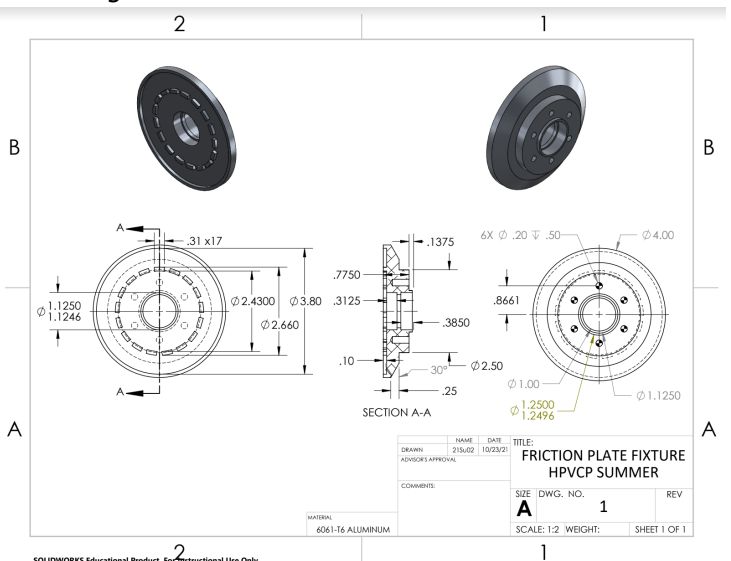
## Team Member: Daniel Quezada

Action Item	Date Completed	Result/Proof of Completion
clutch redesign with Connor	9/24/21-9/27/21	<p>new conceptual design of clutch layout</p> 
redo force application, make an accompanying design tool	10/25/21	<p>recalculate forces applied to system as a whole, using the new design and of the system. made a design tool in excel to be able to adjust factors as needed and be able to do fea on any iteration of the design.</p>

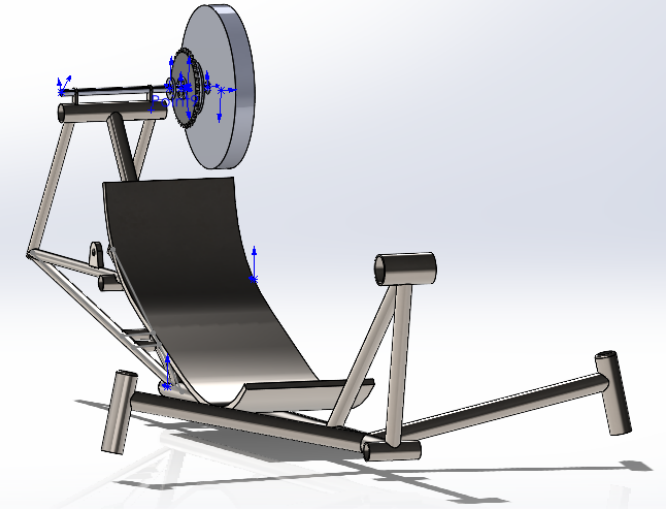
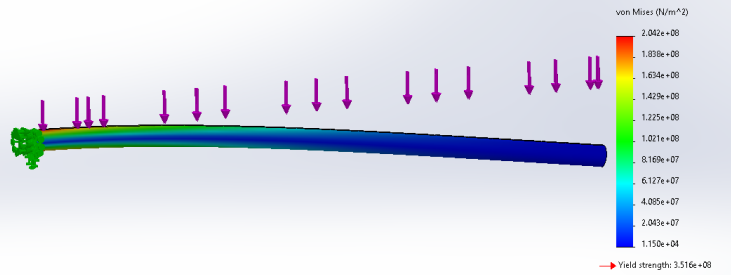
friction plate fixture final design	11/3	working with connor, we were able to redesign the outer shaft to incorporate the clutch plate fixture, and the sprocket mount into one condensed part that is lighter and more machinable, as well as being more modular if gear ratios need to change.
first assembly of subsystem components	11/4	 <p data-bbox="703 835 1380 903">final fitment of jaws, polishing of mating surfaces, dimpling shaft for semi-permanent fixture</p>

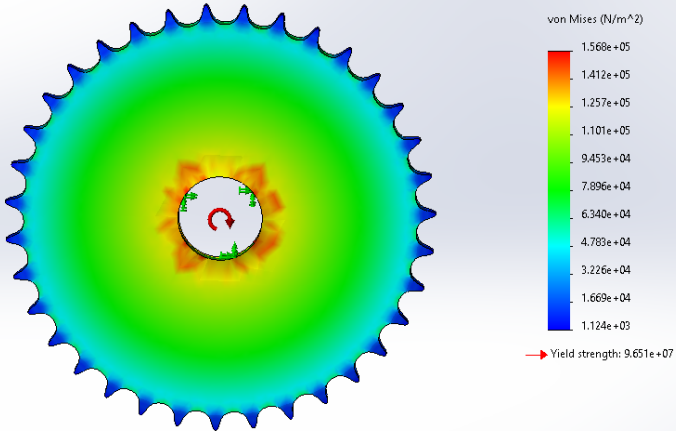

**Team Member: Connor Tolman**

Action Item	Date Completed	Result/Proof of Completion
Clutch Redesign	9/24/21	Worked with Daniel to redesign the clutch system 

<p>Energy Efficiency Test Design (Midpoint Presentation)</p>	<p>10/14/21</p>	<div data-bbox="711 113 1084 262"> <h3>Testing - Clutch Efficiency/Energy Storage [ER 1,2]</h3> </div> <table border="1" data-bbox="711 283 1031 430"> <thead> <tr> <th>No.</th> <th>Engineer Req.</th> <th>Value</th> </tr> </thead> <tbody> <tr> <td>1</td> <td>Energy Stored</td> <td>600 J</td> </tr> <tr> <td>2</td> <td>Regen. Braking Efficiency</td> <td>0.15</td> </tr> <tr> <td>3</td> <td>Max. Speed</td> <td>20 mph</td> </tr> <tr> <td>4</td> <td>Display Metrics</td> <td>Yes/No</td> </tr> <tr> <td>5</td> <td>Usable Energy Threshold</td> <td>200 J</td> </tr> </tbody> </table> <div data-bbox="1120 142 1437 283"> <p><b>Procedures</b></p> <ol style="list-style-type: none"> <li>1. Measure vehicle speed</li> <li>2. Engage clutch to power flywheel</li> <li>3. Measure flywheel angular velocity</li> <li>4. Measure vehicle speed</li> <li>5. Engage clutch to remove power from flywheel</li> <li>6. Measure vehicle speed</li> <li>7. Repeat steps at different speeds</li> </ol> </div> <div data-bbox="1120 336 1421 420"> <p><b>Tools Used</b></p> <ul style="list-style-type: none"> <li>• Sensors/Display</li> <li>• Tachometer/Odometer if necessary</li> </ul> </div>	No.	Engineer Req.	Value	1	Energy Stored	600 J	2	Regen. Braking Efficiency	0.15	3	Max. Speed	20 mph	4	Display Metrics	Yes/No	5	Usable Energy Threshold	200 J
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<p>Flywheel FEA Analysis</p>	<p>10/26/21</p>	 <p>SOLIDWORKS Educational Product. For Instructional Use Only.</p>																		
<p>Friction Plate Fixture CAD Redesign</p>	<p>11/3/21</p>	<p>Worked with Daniel, Yujie and Dr. Willy to finalize friction plate design.</p>  <p>SOLIDWORKS Educational Product. For Instructional Use Only.</p>																		

## Team Member: Yujie Zhang

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CAD Drawing	10/8/2021	Draw CAD images of shafts, connecting parts and frames 																																																				
Chain and sprockets calculation	10/27/2021	<table border="1" data-bbox="711 1066 1437 1234"> <tr> <td>ANSI#</td> <td>35</td> <td>Number of teeth</td> <td>24</td> <td>Material</td> <td>Carbon Steel</td> </tr> <tr> <td>Pitch, in</td> <td>0.375</td> <td>Bore Pitch, in</td> <td>0.5</td> <td></td> <td></td> </tr> <tr> <td>Width, in</td> <td>0.188</td> <td>Angular Velocity, rev/min</td> <td>974.028</td> <td></td> <td></td> </tr> <tr> <td>Min Tensile Strength, lbf</td> <td>1760</td> <td></td> <td></td> <td></td> <td></td> </tr> <tr> <td>Average Weight, lbf/in</td> <td>0.21</td> <td></td> <td></td> <td></td> <td></td> </tr> <tr> <td>Diameter of pitch circle, in</td> <td>0.35174999</td> <td></td> <td></td> <td></td> <td></td> </tr> <tr> <td>Velocity of chain, rev/min</td> <td>730.521</td> <td></td> <td></td> <td></td> <td></td> </tr> </table> <table border="1" data-bbox="711 1247 1360 1480"> <tr> <td>Length between sprockets, in</td> <td>12.3548359</td> </tr> <tr> <td>Number of sprocket1</td> <td>24</td> </tr> <tr> <td>Number of sprocket1</td> <td>11</td> </tr> <tr> <td>Pitch, in</td> <td>0.375</td> </tr> <tr> <td>X0</td> <td>83.5223919</td> </tr> </table>	ANSI#	35	Number of teeth	24	Material	Carbon Steel	Pitch, in	0.375	Bore Pitch, in	0.5			Width, in	0.188	Angular Velocity, rev/min	974.028			Min Tensile Strength, lbf	1760					Average Weight, lbf/in	0.21					Diameter of pitch circle, in	0.35174999					Velocity of chain, rev/min	730.521					Length between sprockets, in	12.3548359	Number of sprocket1	24	Number of sprocket1	11	Pitch, in	0.375	X0	83.5223919
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		 <p>von Mises (N/m<sup>2</sup>)</p> <ul style="list-style-type: none"><li>1.568e+05</li><li>1.412e+05</li><li>1.257e+05</li><li>1.101e+05</li><li>9.453e+04</li><li>7.896e+04</li><li>6.340e+04</li><li>4.783e+04</li><li>3.226e+04</li><li>1.669e+04</li><li>1.124e+03</li></ul> <p>→ Yield strength: 9.651e+07</p>
Purchase Order 3D Print submit	11/1/2021	



The following are the Action Items for each team member between HR 2 and the Final Product presentation:

<b>Team Member</b>	<b>Action Items</b>	<b>Date Due</b>
Abdulh Alsabaie	<ol style="list-style-type: none"> <li>1. Calculation on the friction plate fixture</li> <li>2. Working on the final delivery on our CAD</li> </ol>	<ol style="list-style-type: none"> <li>1. 11/8/21</li> <li>2. 11/20/21</li> </ol>
Yen Clutter	<ol style="list-style-type: none"> <li>1. Complete code calculations for flywheel storage</li> <li>2. Complete code calculations for flywheel efficiency</li> <li>3. Set arduino up with 5v battery supply</li> <li>4. Make housing</li> <li>5. Test Final Code</li> <li>6. Refactor if needed</li> </ol>	<ol style="list-style-type: none"> <li>1. 11/10/2021</li> <li>2. 11/14/2021</li> <li>3. 11/14/2021</li> <li>4. 11/19/2021</li> <li>5. 11/22/2021</li> <li>6. 11/26/2021</li> </ol>
Daniel Quezada	<ol style="list-style-type: none"> <li>1. find out if Perry will recognize my old machine shop qualifications from last year</li> <li>2. finalize redesign of clutch plate fixture for production</li> <li>3. finalize modular flywheel plate fixture for production</li> <li>4. do final assembly of subsystem on shaft, and mount shaft</li> <li>5. connect all components to make the system homogenous (using the chains, cables, etc...)</li> </ol>	<ol style="list-style-type: none"> <li>1. whenever perry can</li> <li>2. 11/5</li> <li>3. 11/5</li> <li>4. 11/12-11/29</li> <li>5. 11/12-11/29</li> </ol>
Connor Tolman	<ol style="list-style-type: none"> <li>1. Submit Drawings to Machine Shop</li> <li>2. Design CAD for fixing the Steering System</li> <li>3. Acquire/Deliver Stock Material for Parts</li> <li>4. Assemble Steering System</li> <li>5. Test Flywheel Efficiency/Clutch Wear</li> </ol>	<ol style="list-style-type: none"> <li>1. No Later than 11/9/21</li> <li>2. 11/12/21</li> <li>3. 11/16/21</li> <li>4. No Later than 11/22/21</li> <li>5. No Later than 12/1/21</li> </ol>
Yujie Zhang	<ol style="list-style-type: none"> <li>1. Run Cables &amp; Chains/Mount Derailers</li> <li>2. Assemble/Mount Sprockets and Shafts</li> <li>3. Welding begin</li> <li>4. final CAD</li> </ol>	<ol style="list-style-type: none"> <li>1. 11/9/2021</li> <li>2. 11/12/2021</li> <li>3. 11/19/2021</li> <li>4. 11/26/2021</li> </ol>