NFPA Fluid Power VEHICLE Challenge

NFPA Education and Technology Foundation

FINAL PRESENTATION
FLUID POWER CLUB
AT SOUTH DAKOTA STATE
DOUG PRAIRIE
4/21/22

Team Introductions: ABE

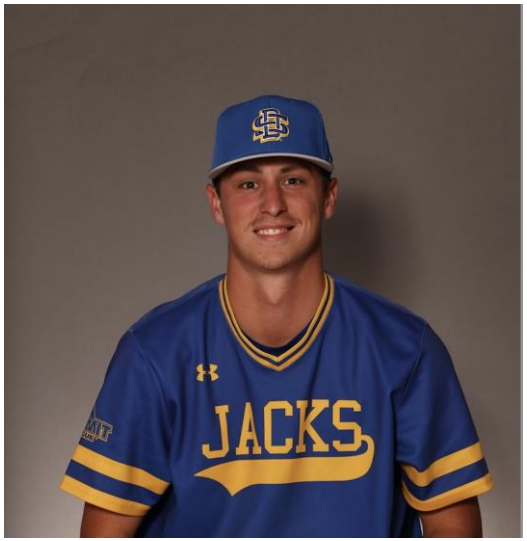
Ethan Geraets

Dylan Hanisch

Dalton VanderWal

Team Introduction: OM

Bret Barnett



Patrick Lovrien

Cole Shannon

Design Objectives

- Utilize last year's bike
- Focus on hydraulics
- Maximize efficiency
- Improve user experience

Summary of Midway

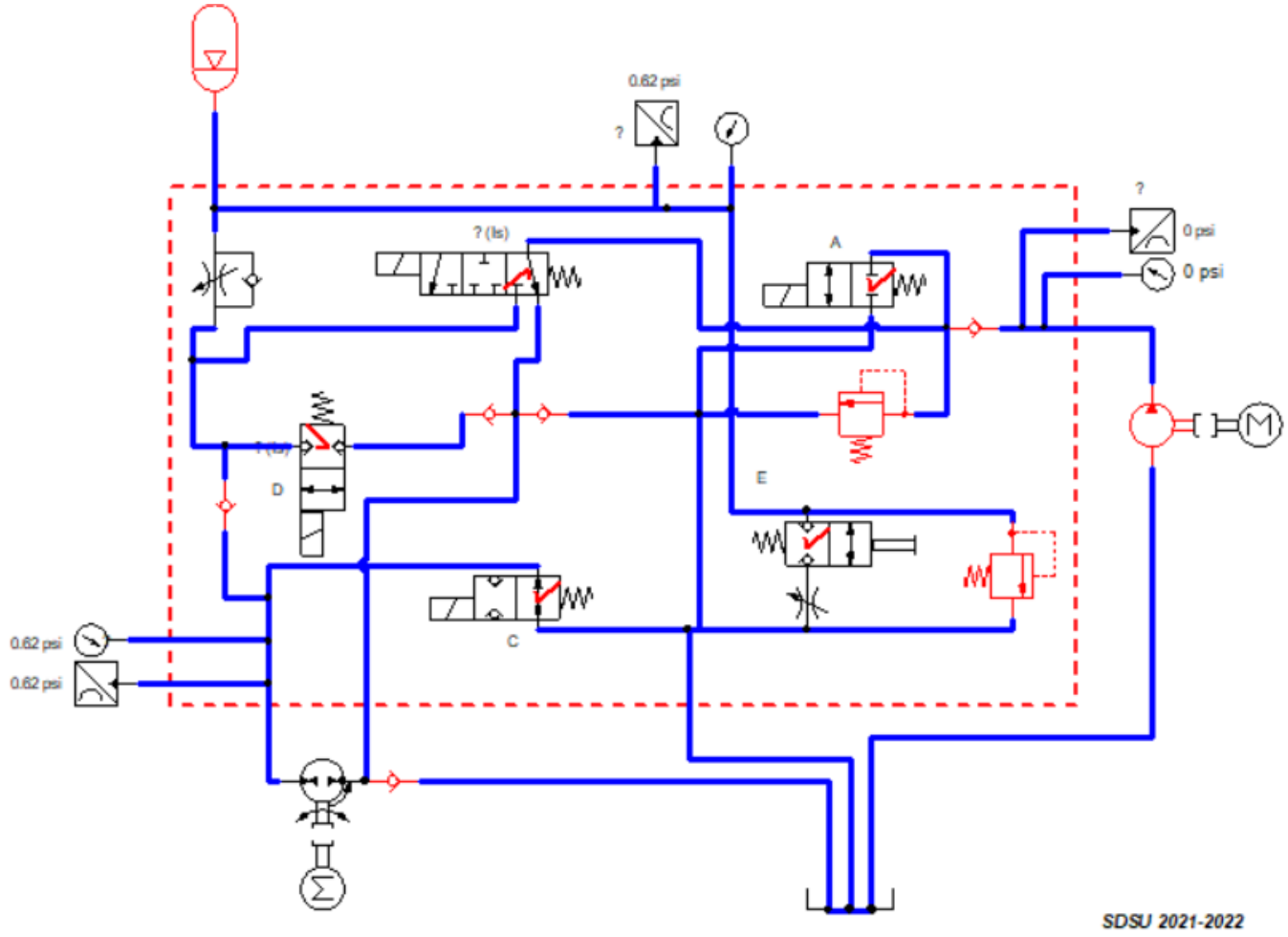
- Analyzed last years' bike for problems
- Tested with altercations and validated
- Set baseline to improve

Hydraulic Calculations								
Given			***Calculated***			***Measured***		
Motor Displacement:	5.34	cc/rev	**Pump Flow Rate:**	1.47	L/min	**Pump Flow Rate:**	1.46	L/min
Pump Displacement:	3.40	cc/rev	**Motor Shaft Speed:**	264.33	RPM	**Motor Shaft Speed:**	254.80	RPM
Pump Speed:	465.00	RPM	**Wheel Speed:**	101.66	RPM	**Wheel Speed:**	98.00	RPM
Pressure:	1500.00	PSI	**Shaft Power:**	337.91	Watts	**Shaft Power:**	336.24	Watts

Summary of Midway

- Use same frame but condense component locations
- Improve hydraulic circuit based on issues noticed from testing
- Increased pump size
- Utilize controller kit for electronics and programming

Hydraulic Circuit



Changes:

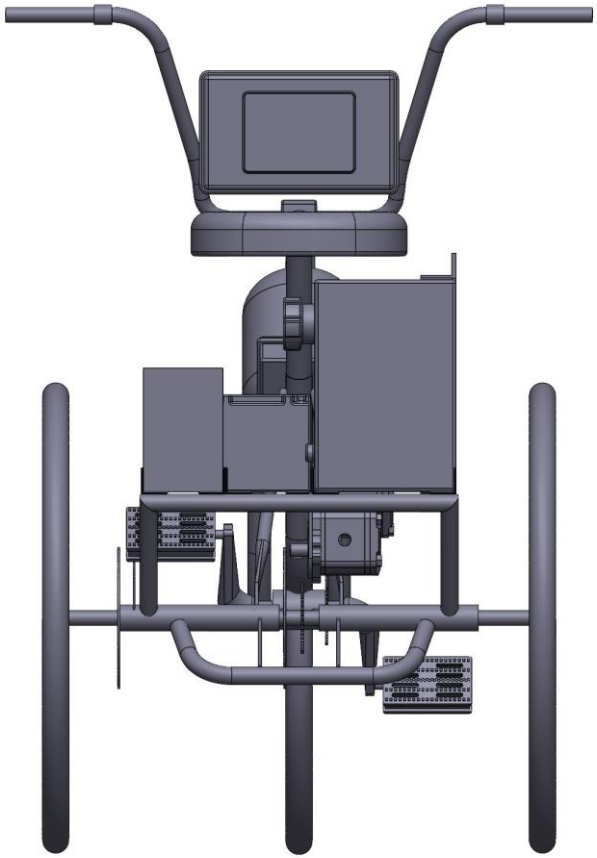
- Removed filter from suction line.
- Added relief valve in parallel with valve E.
- Tied in relief valves to tank
- Added testing and pressure transducer points.
- Added one more pressure transducer.
- Added external low-crack check valve after motor-out side.

Mode Valve Breakdown

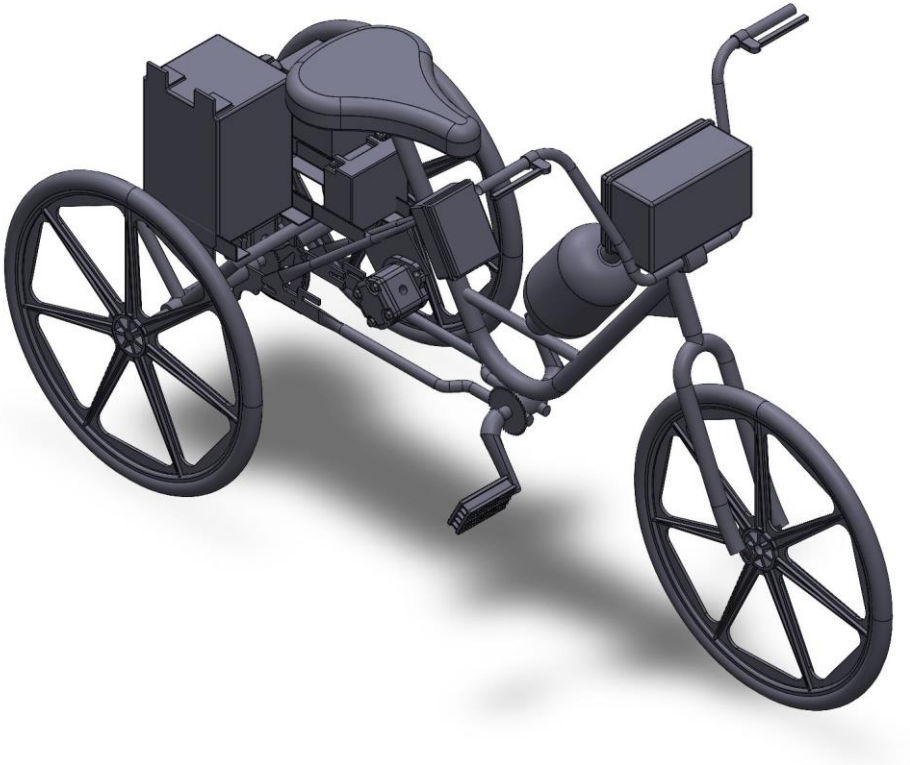
		Valve			
		A	**B**	**C**	**D**
Mode	**Pedal to Power**	0	0	0	1
	Accumulator Charge	0	1	0	0
	Accumulator Discharge	0	1	0	1
	Regenerative Braking	0	0	1	0
	Pressure Dump	1	1	0	0

*There is a valve E used for manually dumping the pressure.

Vehicle Construction

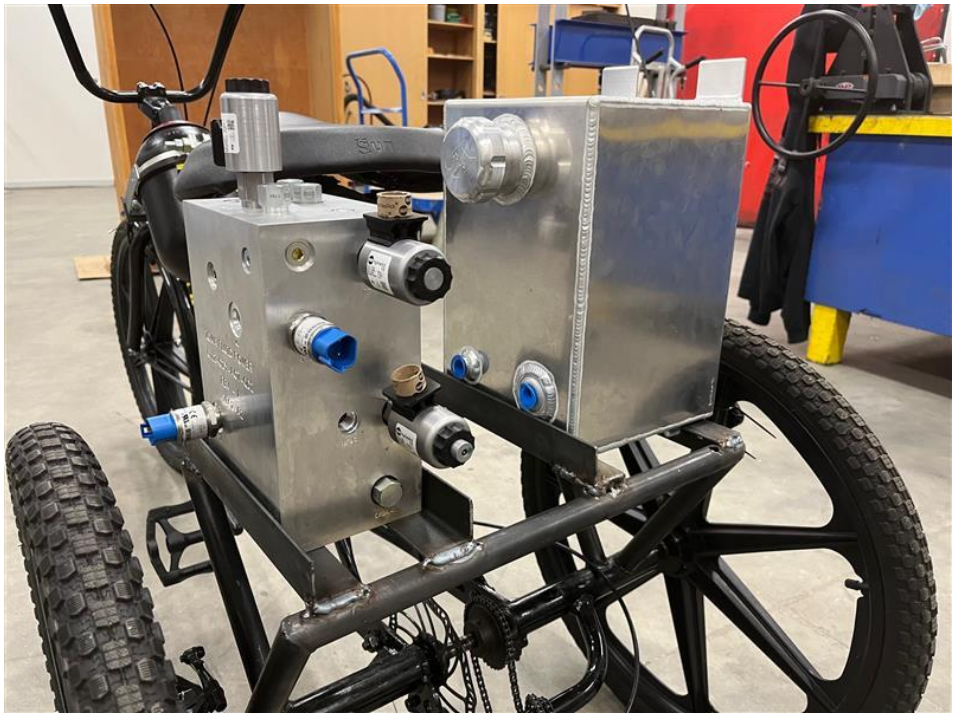


Vehicle Construction



Vehicle Construction

Vehicle Construction



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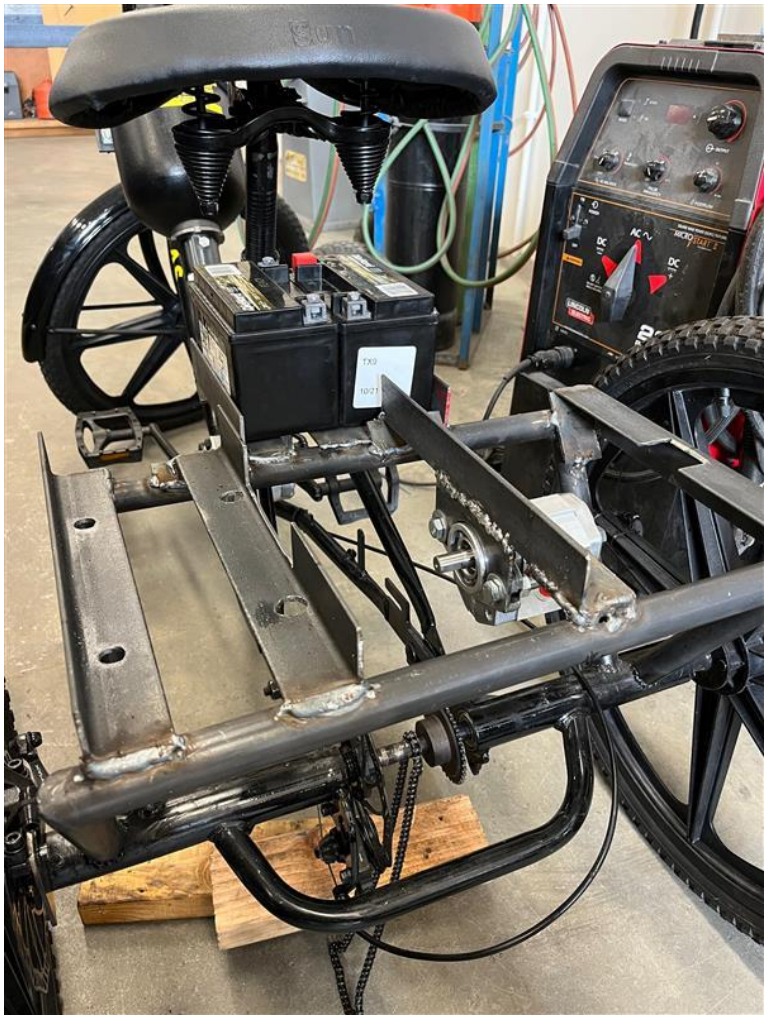

Vehicle Construction

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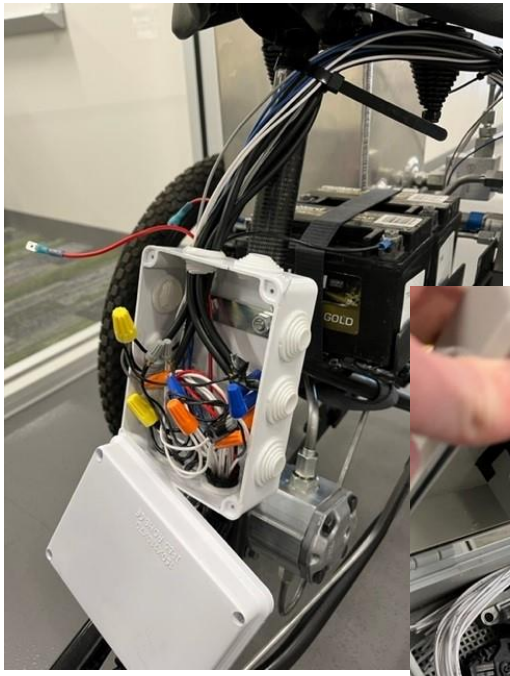

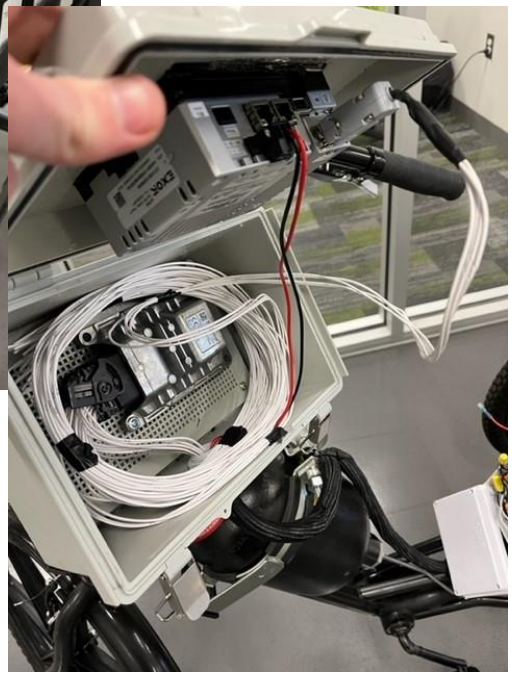

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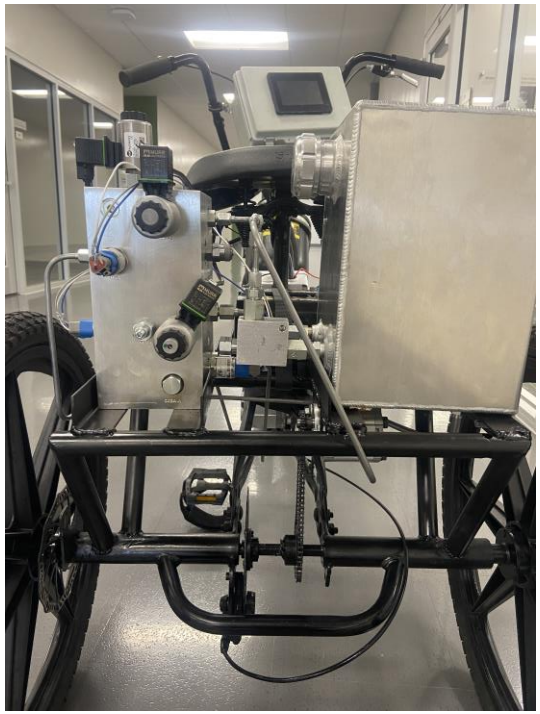
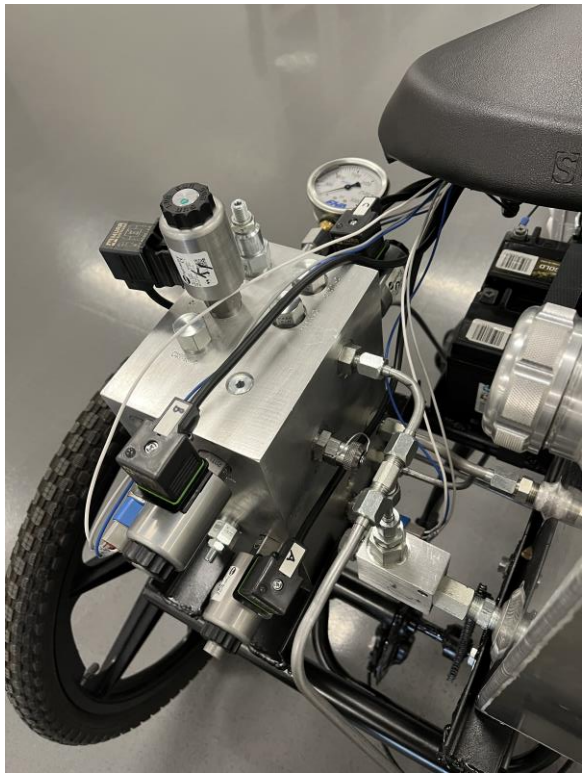
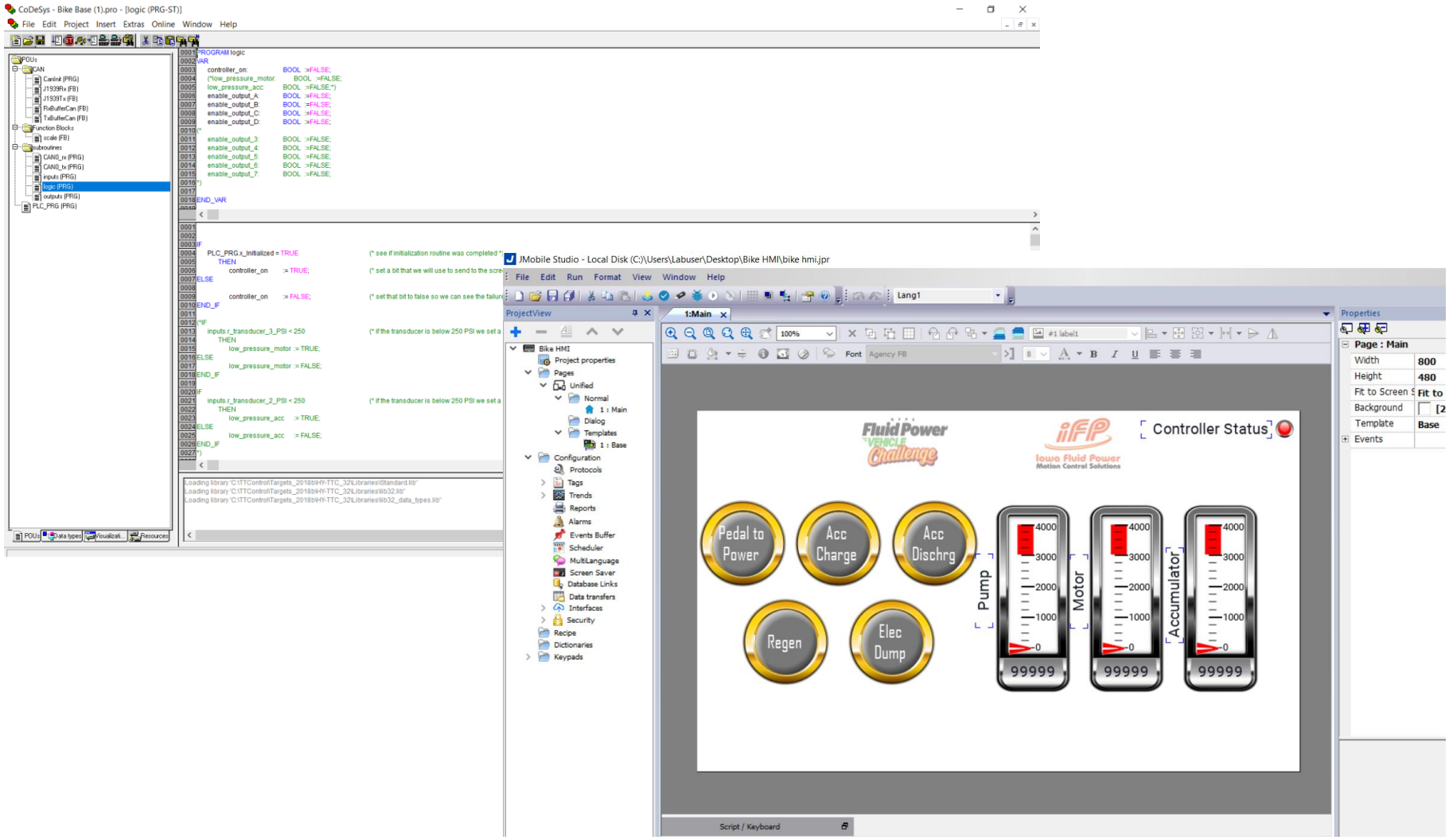




Vehicle Construction



Testing

- Technical issues off the start
- Tested two motor sizes
- Validated every mode

Hydraulic Calculations V2								
Given			***Calculated***			***Measured***		
Motor Displacement:	5.34	cc/rev	**Pump Flow Rate:**	1.77	L/min	**Pump Flow Rate:**	1.72	L/min
Pump Displacement:	4.10	cc/rev	**Motor Shaft Speed:**	318.75	RPM	**Motor Shaft Speed:**	308.40	RPM
Pump Speed:	465.00	RPM	**Wheel Speed:**	124.03	RPM	**Wheel Speed:**	120.00	RPM
Pressure:	1800.00	PSI	**Shaft Power:**	407.48	Watts	**Shaft Power:**	394.25	Watts

Final Vehicle

Lessons Learned

- Don’t overcomplicate tasks
- Time management
- Start small for troubleshooting
- Don’t be afraid to ask for help
- Circuit follow through
- Gear ratios and free wheel
- Be flexible

Questions?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