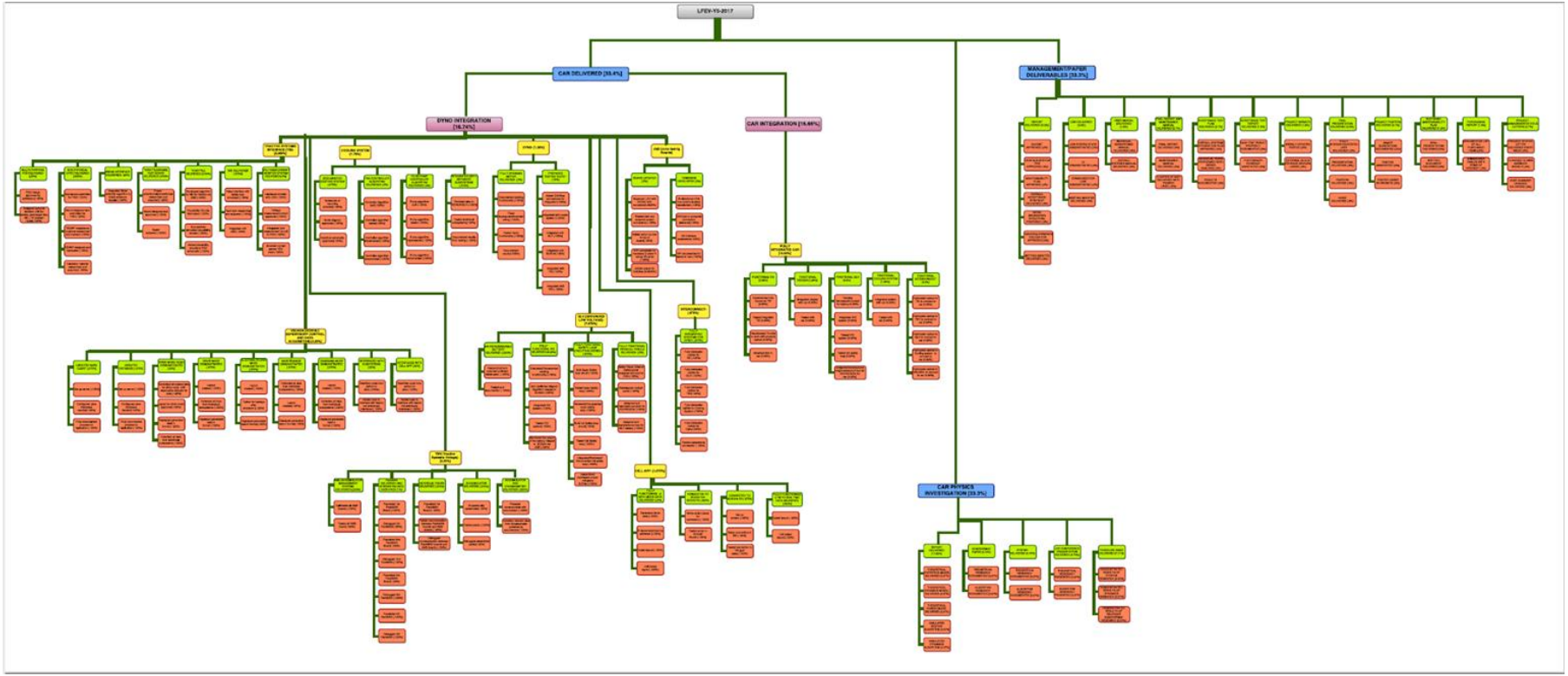
LFEV - Y5 - 2017

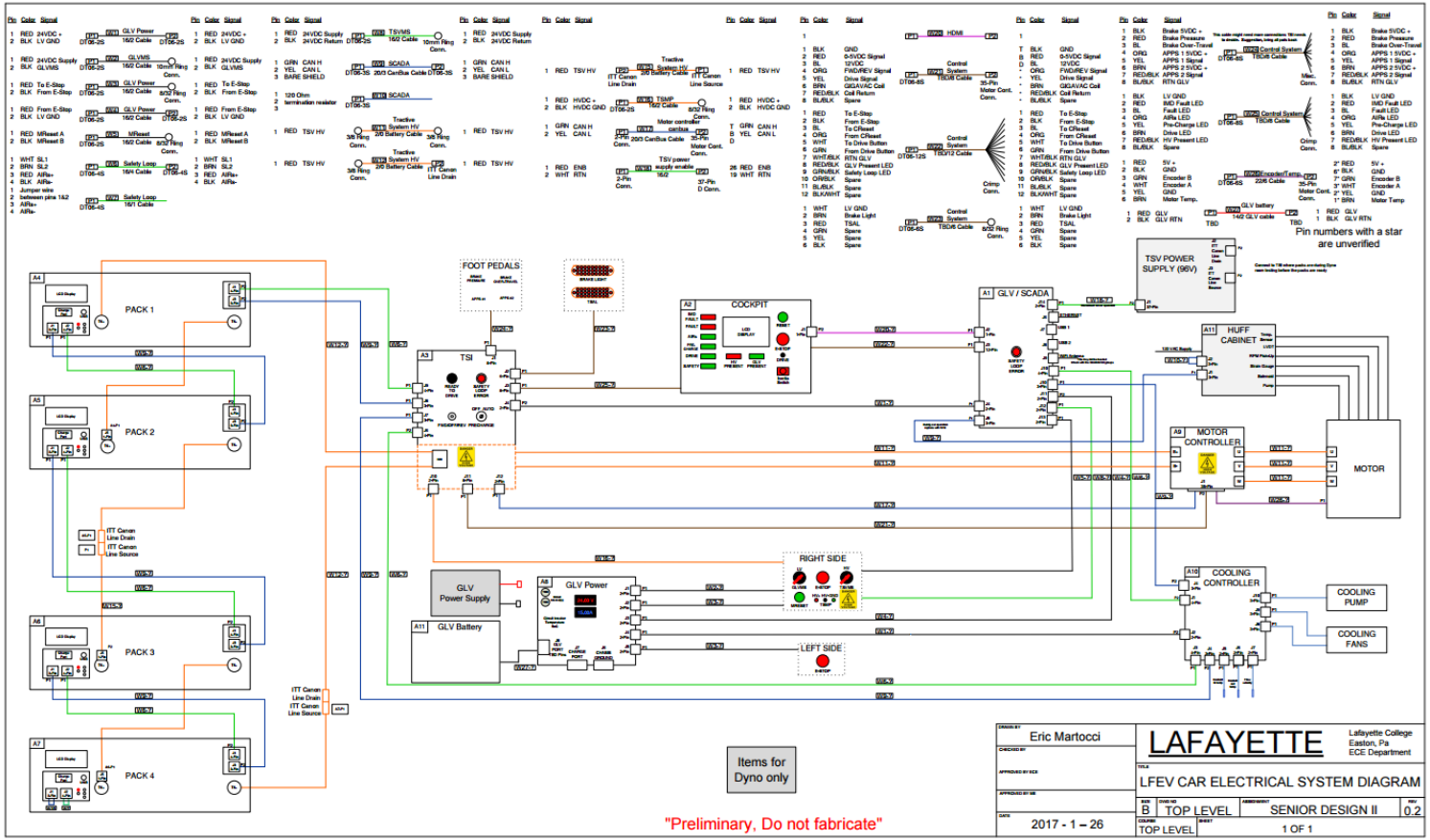
Lafayette Formula Electric Vehicle
Year 5
ECE 492 - Spring 2017

LAFAYETTE
ELECTRICAL & COMPUTER
ENGINEERING

Overall WBS


LFEV-YS-2017
CAR DELIVERED [33.4%]
DYNO INTEGRATION [16.74%]
CAR INTEGRATION [16.66%]
MANAGEMENT/PAPER DELIVERABLES [16.3%]
CAR PHYSICS INVESTIGATION [33.3%]

Overall System Diagram



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GLV - Current State of Affairs/ Goals

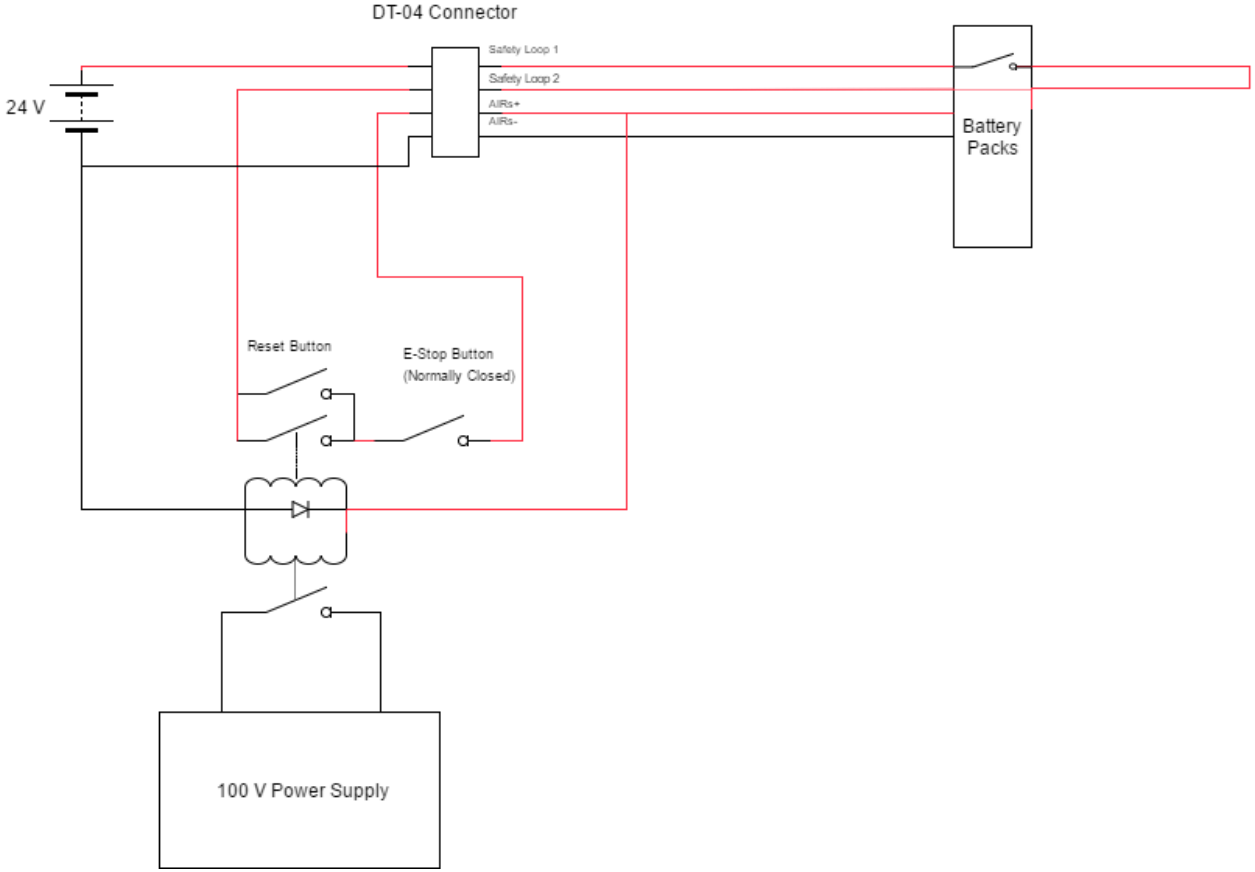
Current State:

- GLV Power Source: non-existent
- Safety loop: system mostly designed, hardware implementation incomplete
- VCI: JGB boards are available. CAN bus exists, but functionality is unknown
- VUI: 2 panels manufactured (cockpit panel, safety panel) with bad light bulbs

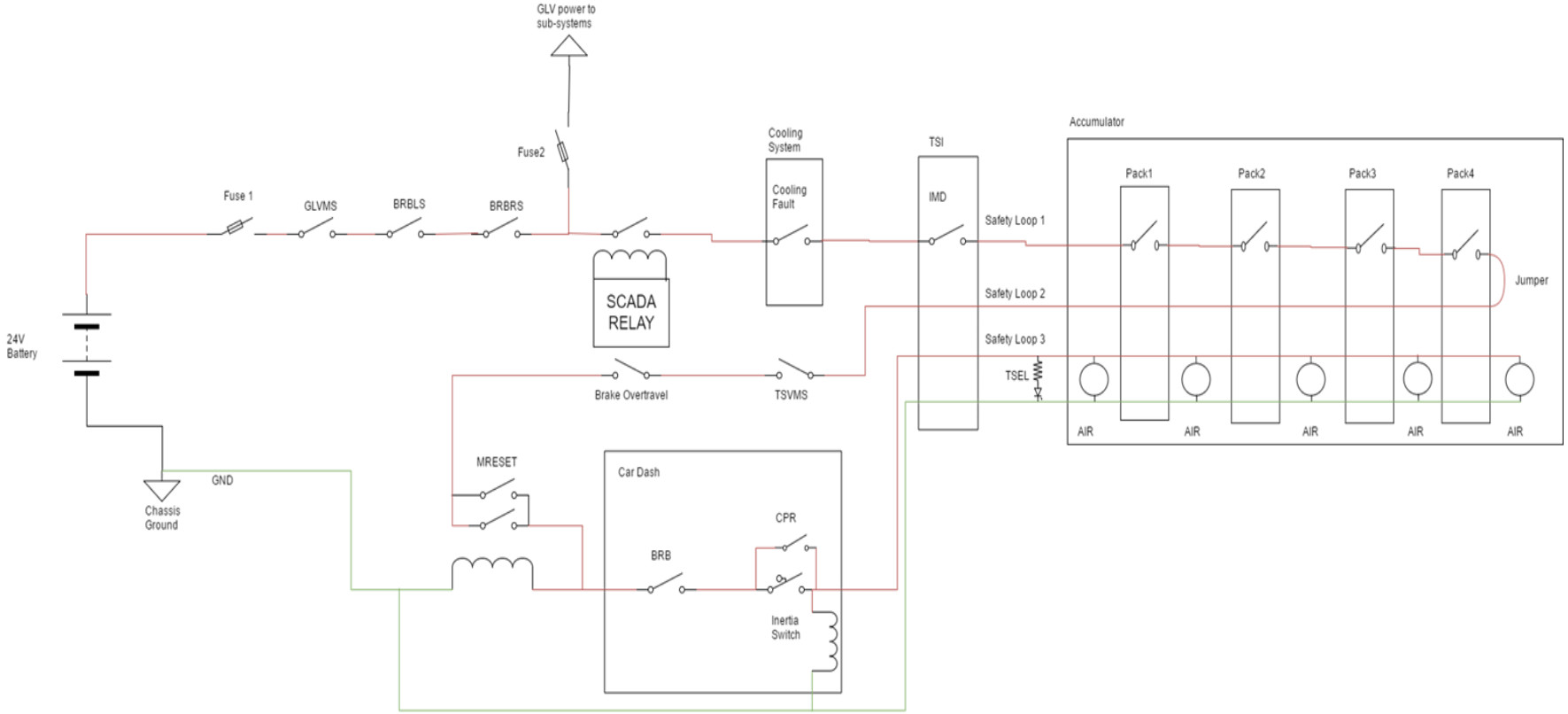
Goals:

- GLV Power: spec and buy proper battery, develop SOC monitoring system
- Safety loop: integrate in dyno room, refine and complete safety loop design.
- VCI: provide hardware to interact with VSCADA
- VUI: remanufacture cockpit and exterior panel, manufacture housing for systems

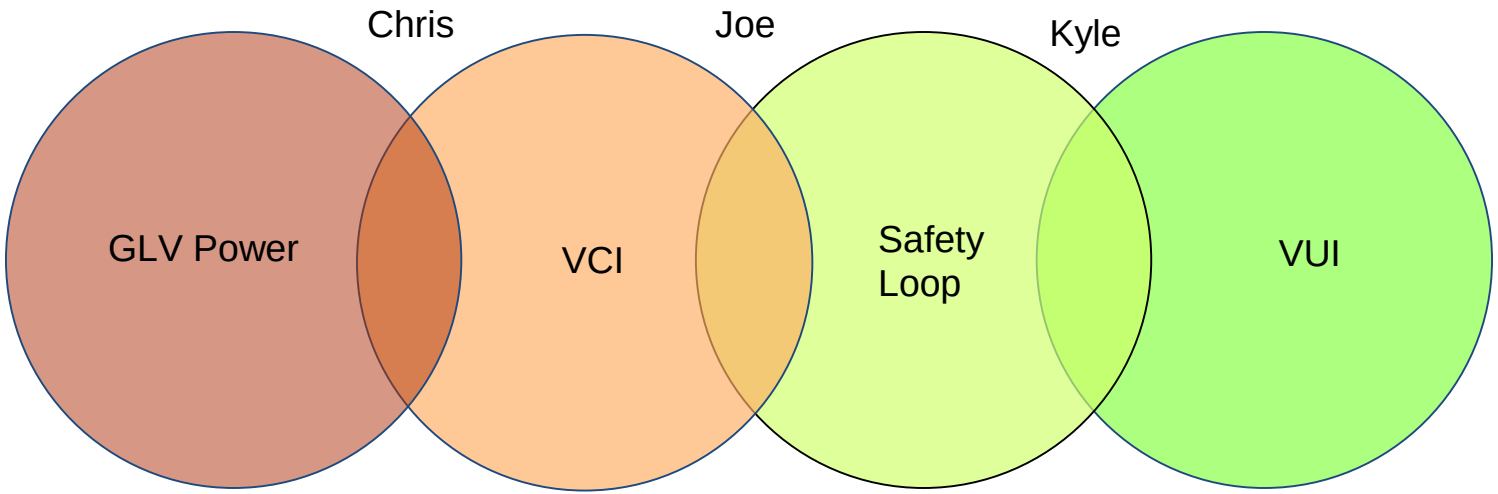
GLV - Basic Safety Loop



GLV - Full Safety Loop



GLV - Team Breakdown



IC - Current State of Affairs/Goals

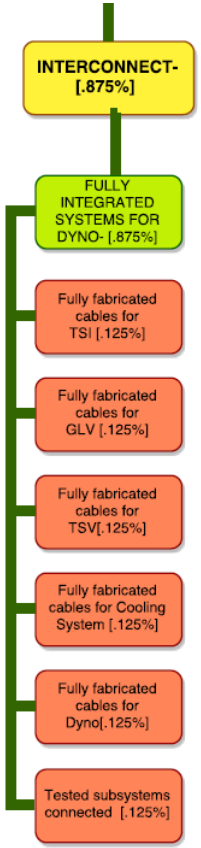
Current State:

- Have most known and labeled cables
- A few wires connecting packs assembled
- Inventory taken

Goals:

- Assemble cables
- Test cables

IC - Work Breakdown Structure



VSCADA - Current State of Affairs/Goals

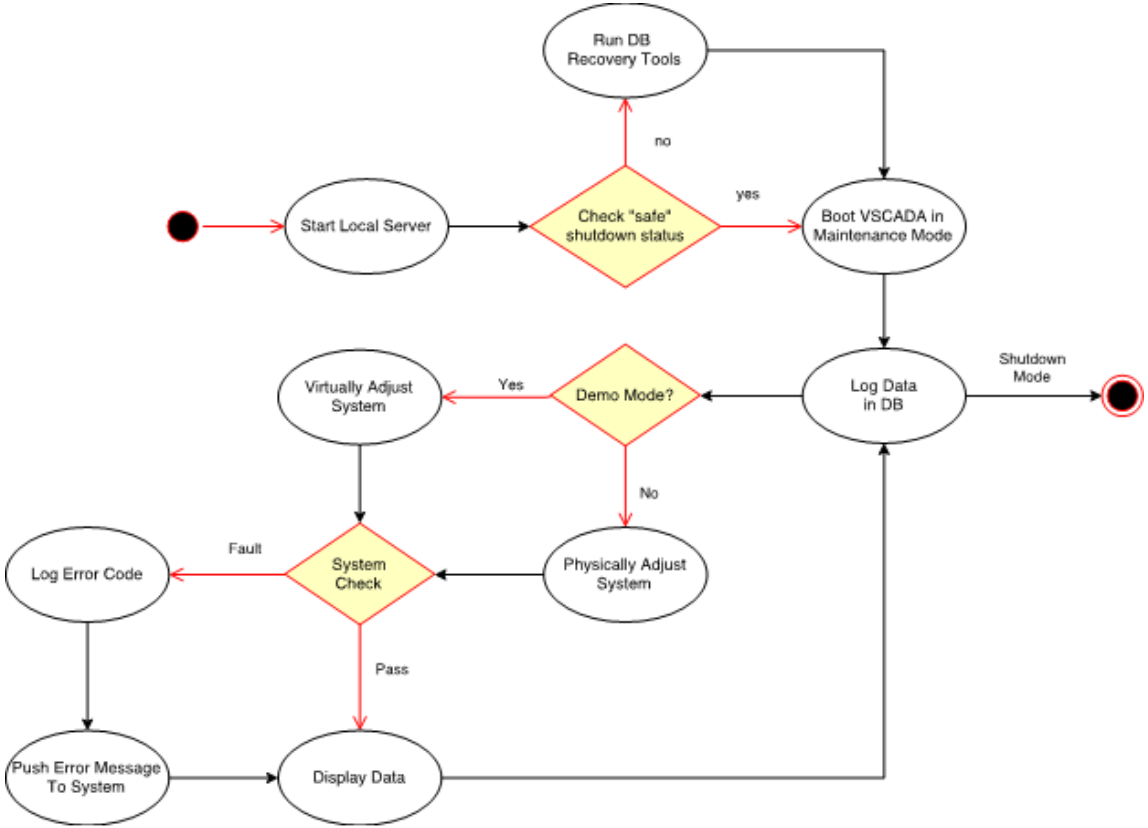
Current State:

- Operational data acquisition tool for the dyno room (Brendon Carroll)
- Web server for communicating with cell app and external computers
- SQLite database handler

Goals:

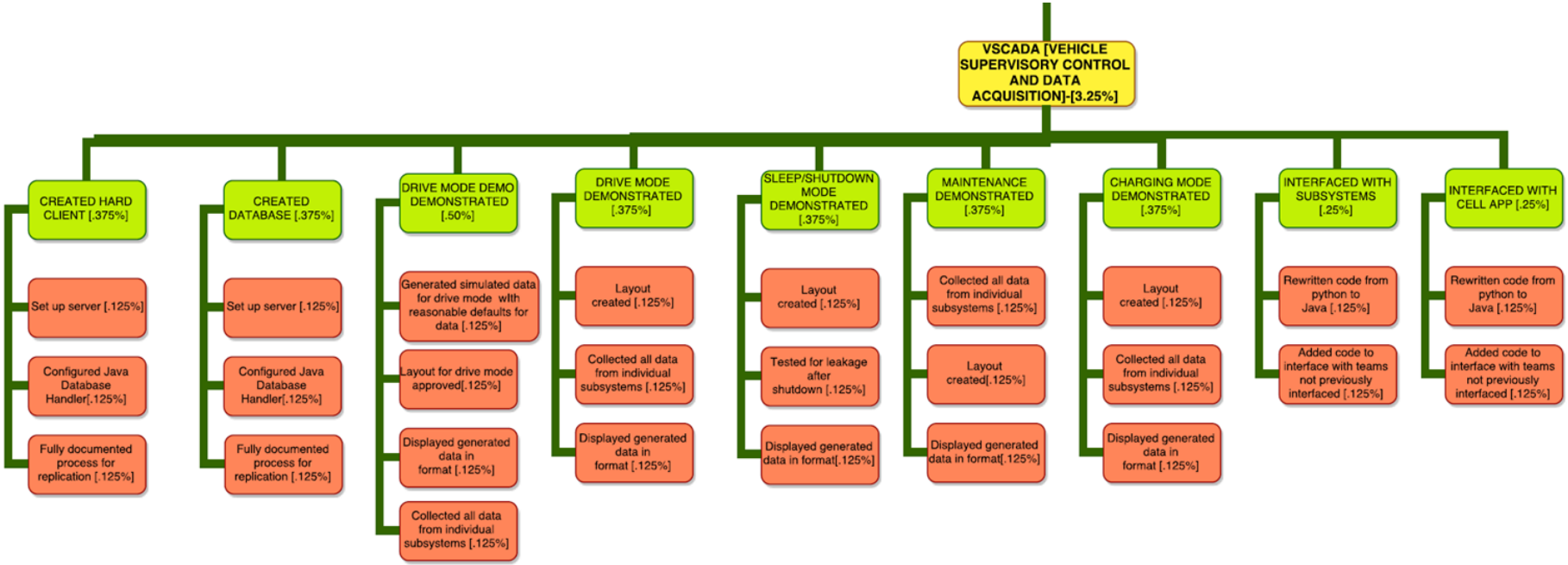
- Rewrite code to be maintainable and scalable (Python -> Java)
- Operational and reconfigurable drive modes
- Data acquisition using the SQLite database
- Simulation software to test various components of the overall system
- Ready to run code that launches on startup, no compilation needed

VSCADA - Proposed Program Control Flow



VSCADA - Proposed Drive Mode Display

VSCADA - Work Breakdown Structure



Cell App - Current State of Affairs/Goals

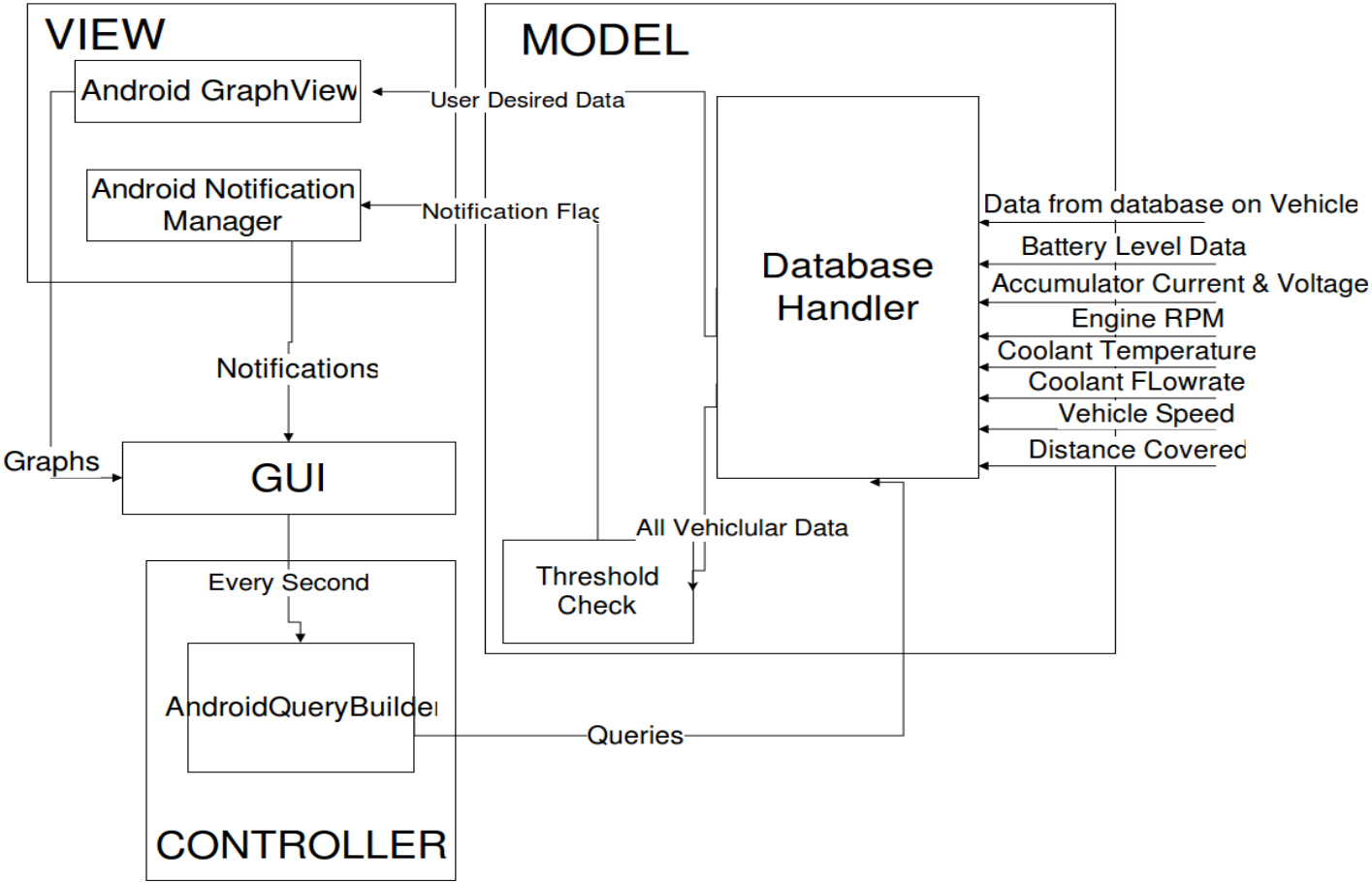
Current State:

- No current work exists.

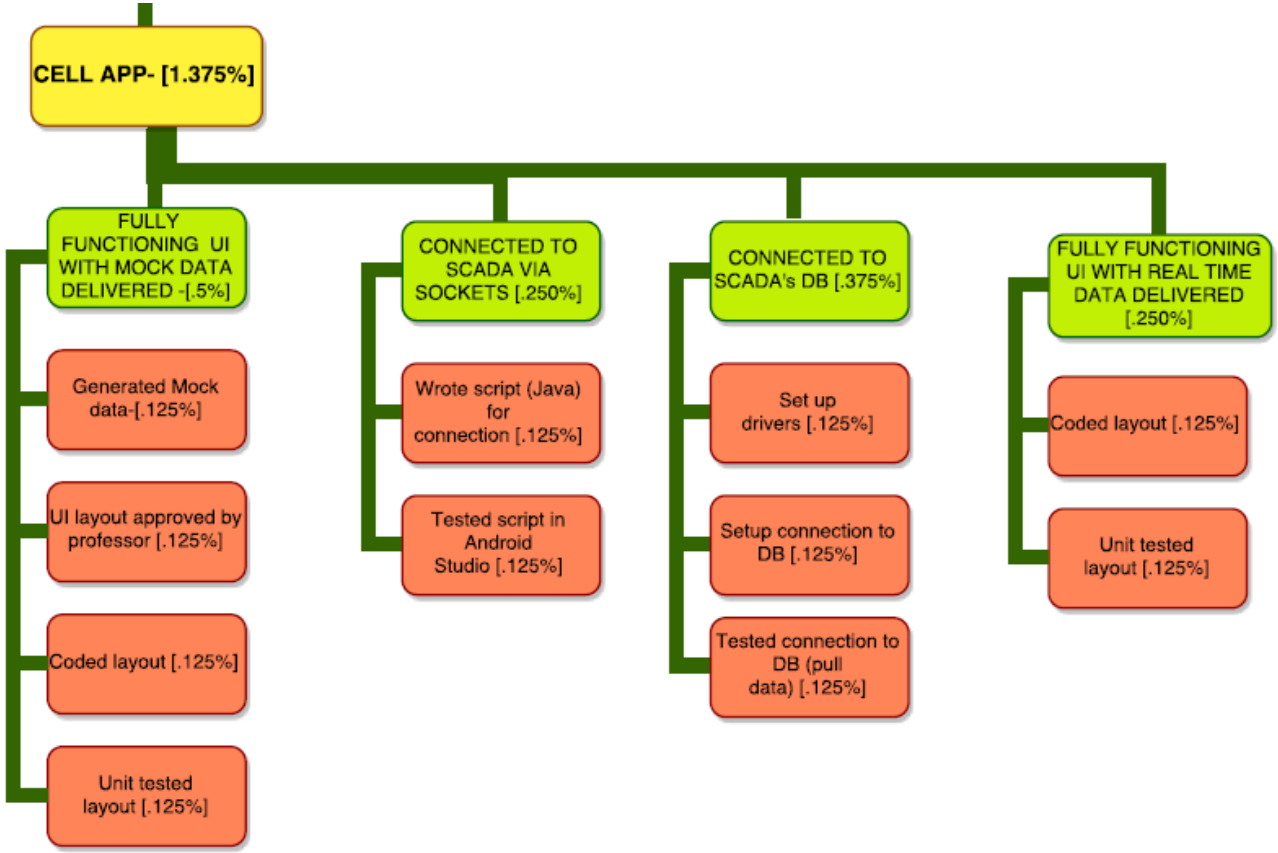
Goals:

- Create a mobile (compatible with Android 6.0+) to display data obtained from SCADA SQLite database

Cell App - High Level Diagram



Cell App - Work Breakdown Structure



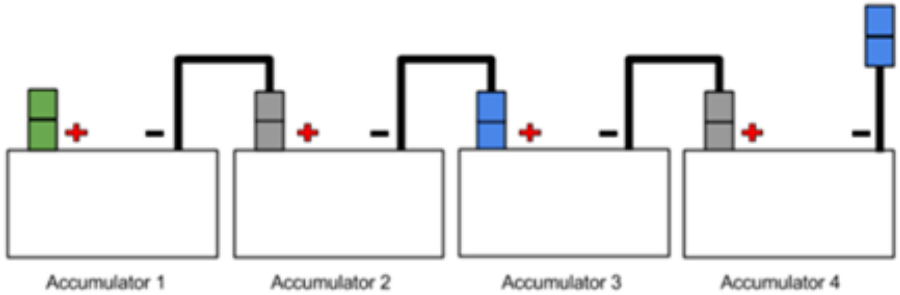
TSV - Current State of Affairs/Goals

Current State:

- Currently produced 1 working pack (Packman and AMS boards)

Goals:

- Assemble and integrate all packs
- Provide telemetry over CAN bus
- Display information on indicators on packs



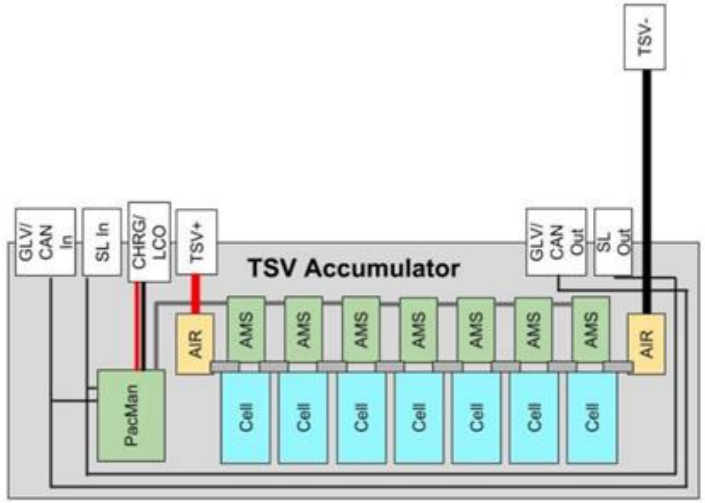
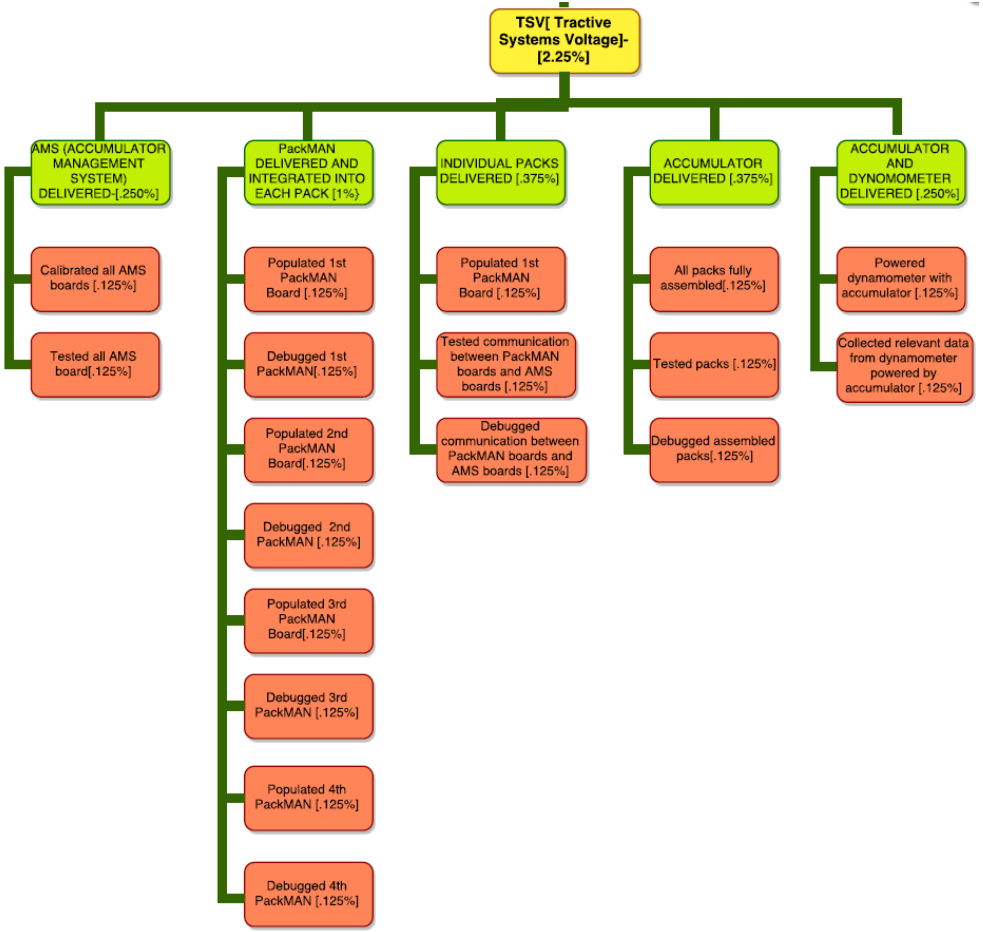


Image Credit: 2016 Final Presentation

TSV - Work Breakdown Structure



Cooling System - Current State of Affairs/ Goals

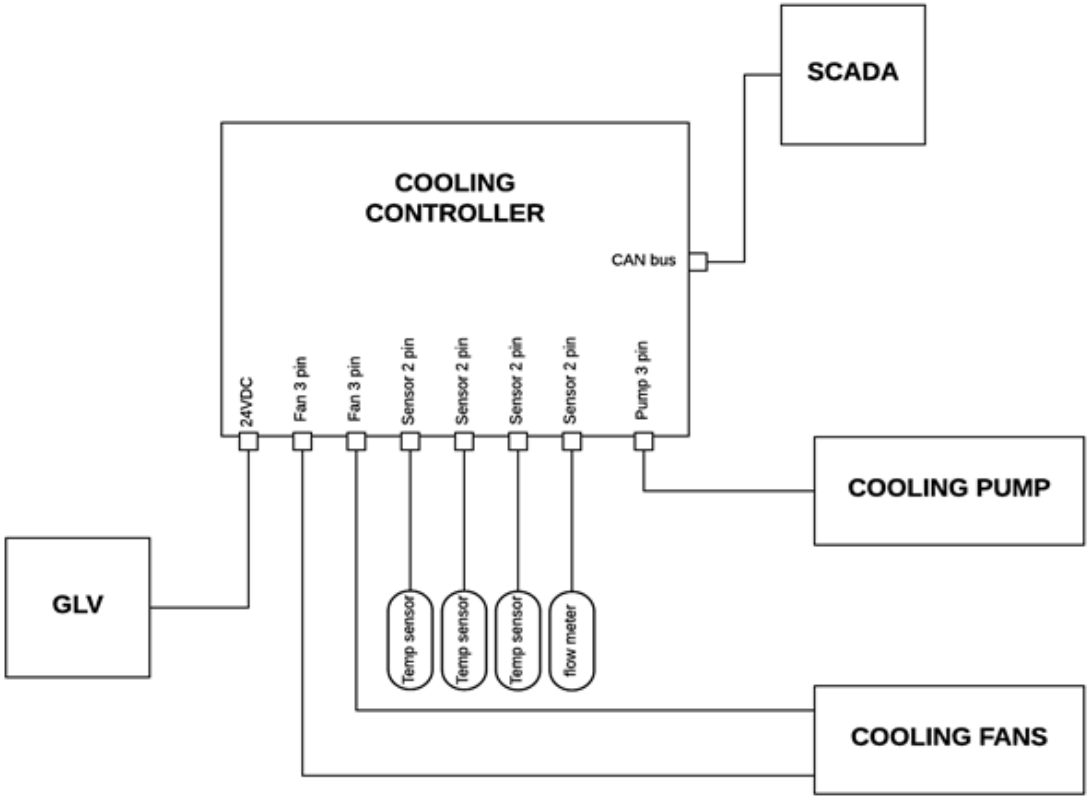
Current State:

- No functional cooling system exists
- Not reusing any parts of the old cooling system

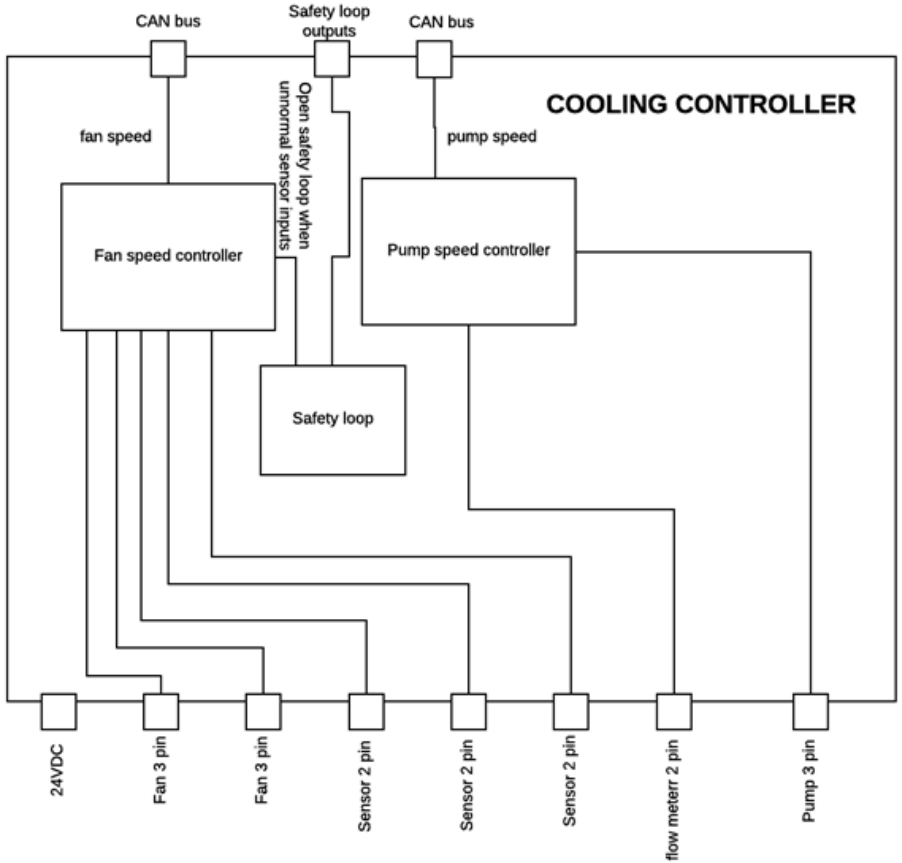
Goals:

- Add CAN bus interfacing
- Program a fully functional system controller
  - Create a cooling system that includes a new pump, two new fans and a radiator
  - System will take measurements and interface to VSCADA and the safety loop

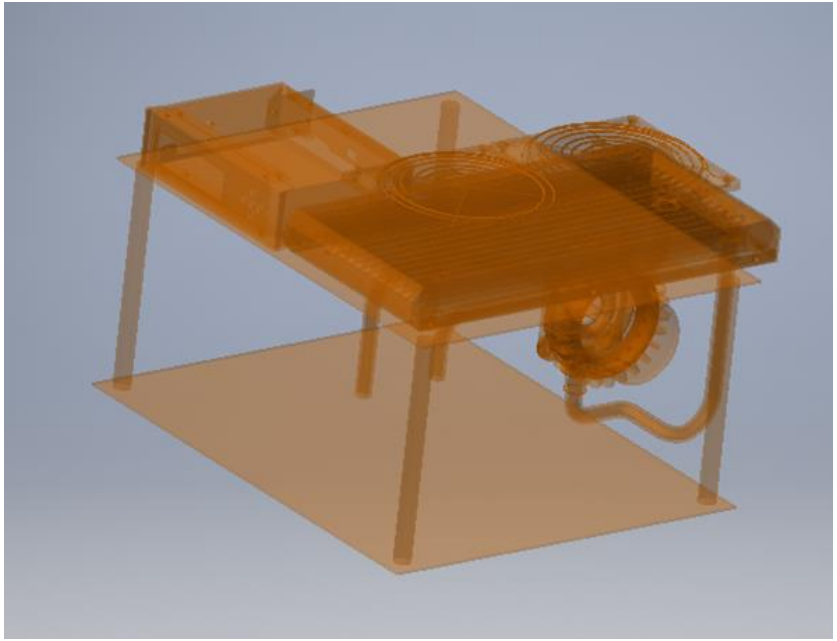
Cooling System - Overall Cooling System Diagram

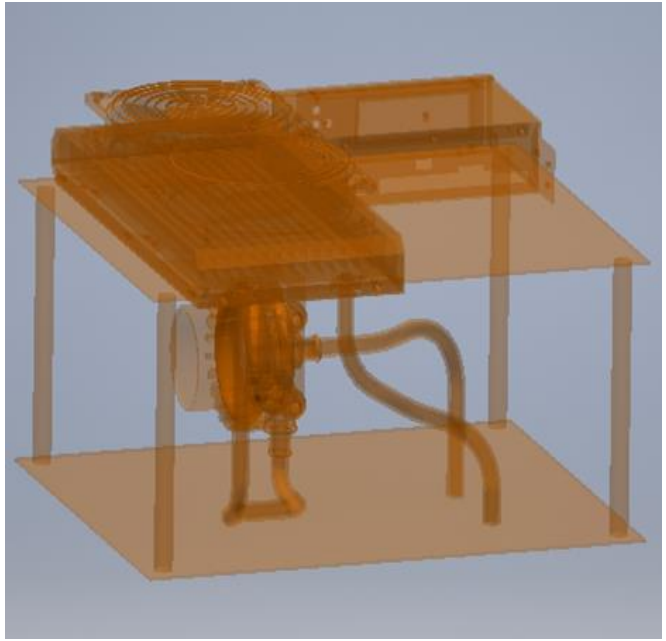


Cooling System - Cooling Controller Diagram

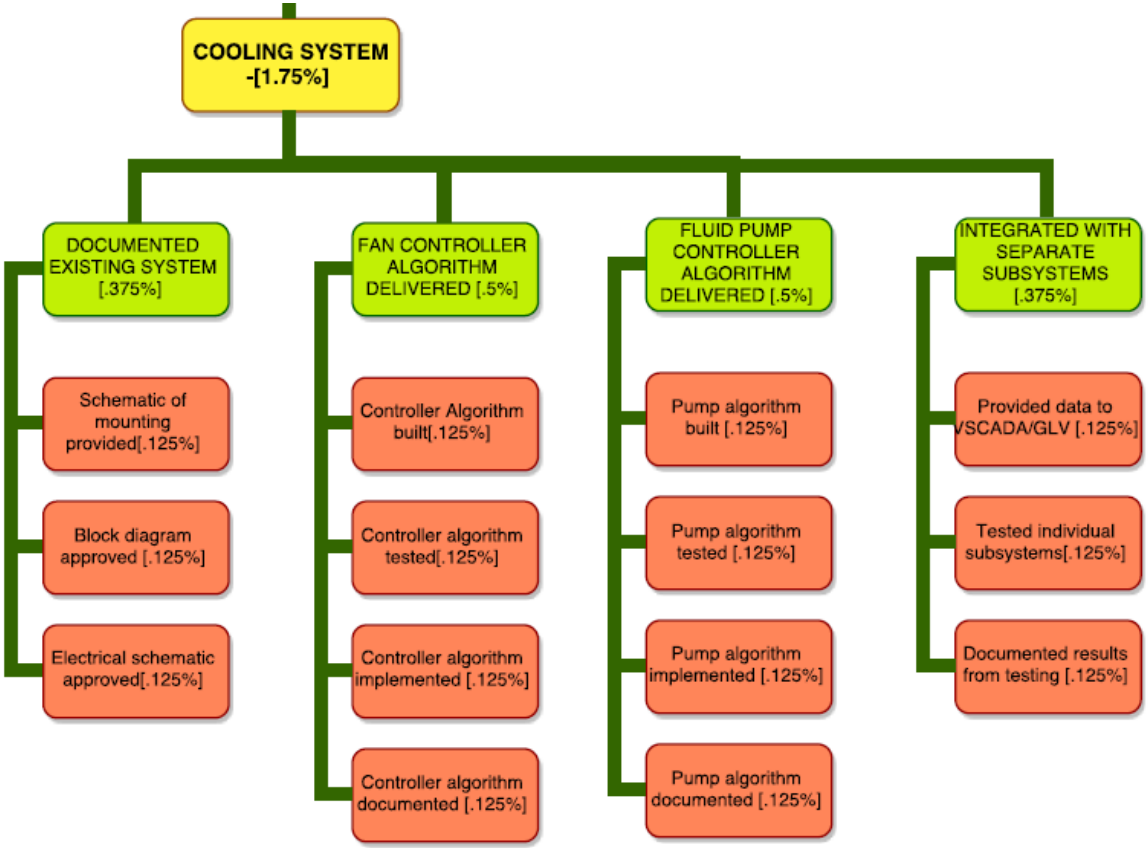


Cooling System - 3D Structure





Cooling System - Work Breakdown



DYNO - Current State of Affairs/ Goals

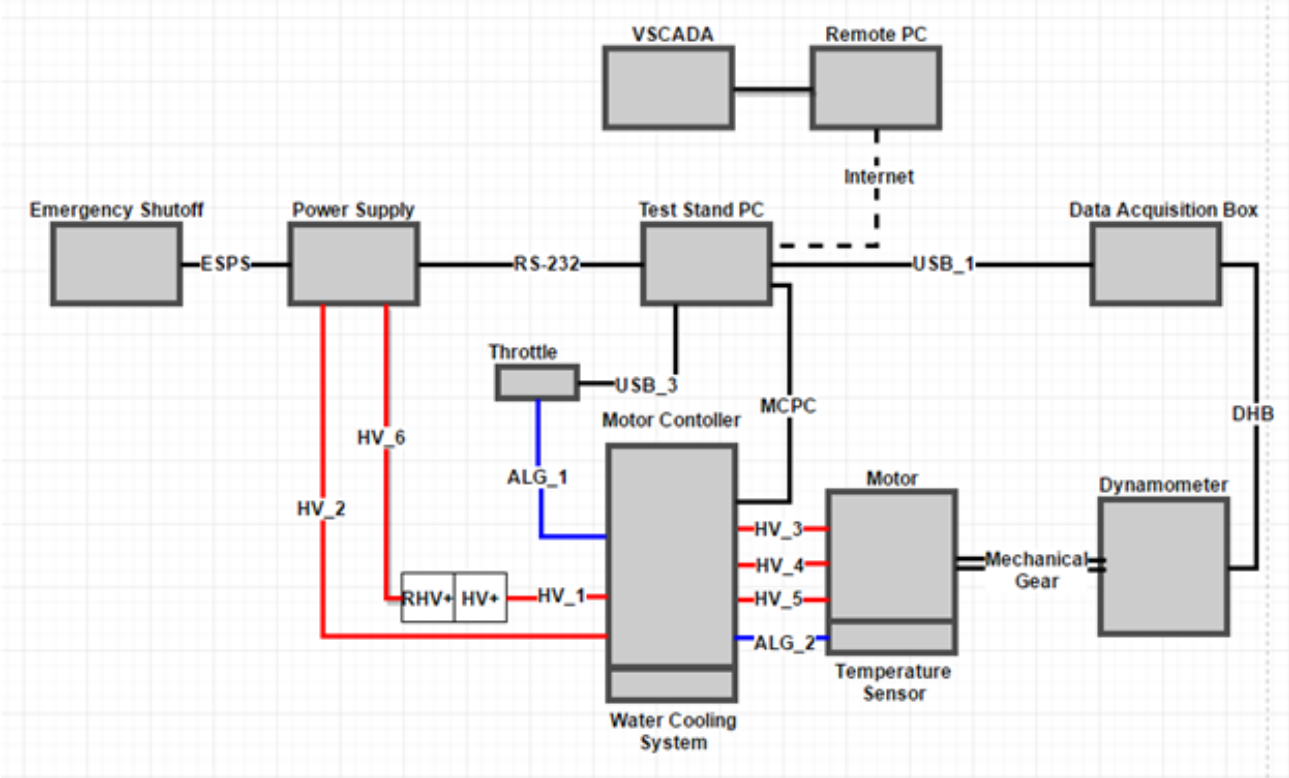
State of Affairs:

- Currently working dynamometer
- Dynamometer has been out of use for a while, so it needs some updates
- The dynamometer system can be controlled from the computer in room 401 or controlled remotely.

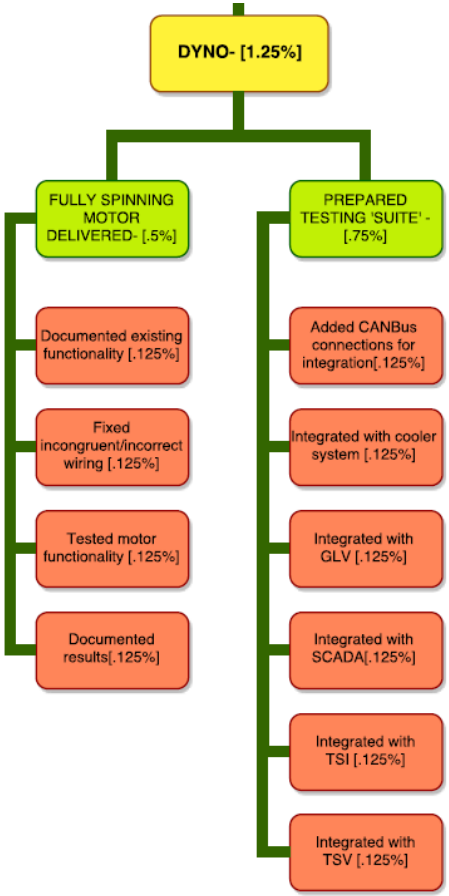
Goals:

- Physical interfaces with TSV and VSCADA need to be updated
- Improve the external velocity sensor setup
- Our goal for this semester is to integrate the dynamometer with the GLV, TSI and TSV to provide communication and power to and from those systems.

DYNO - Overview of Dynamometer



DYNO - Work Breakdown Structure



Physics Modeling - Current State of Affairs/ Goals

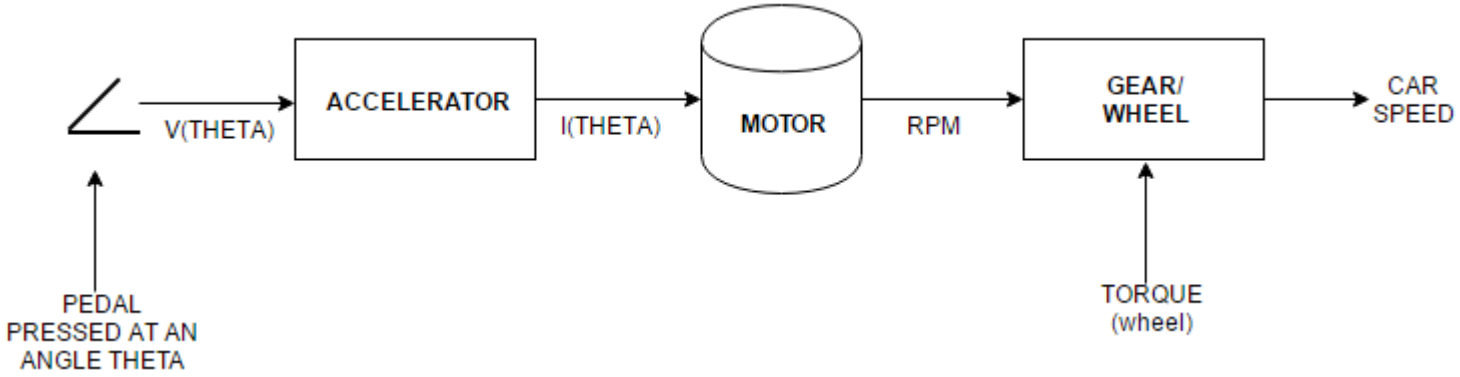
State of Affairs:

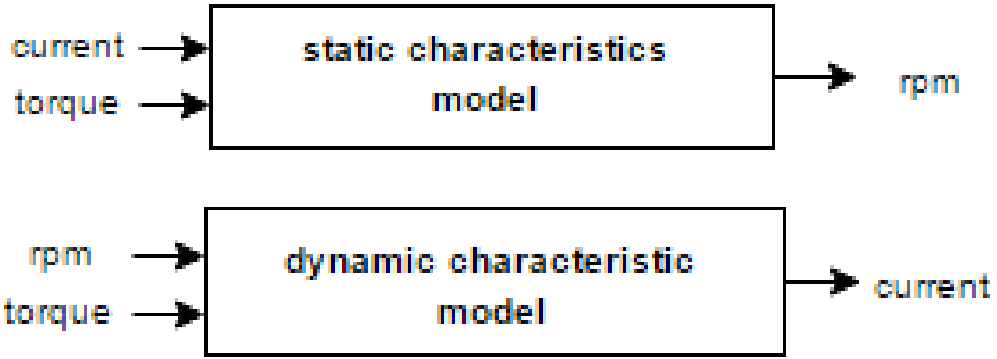
- There exists a high level description of the motor and controller model is described by the static and dynamic characteristic models
- The work already done will be used cautiously, citing the failure to present an accurate model

Goals:

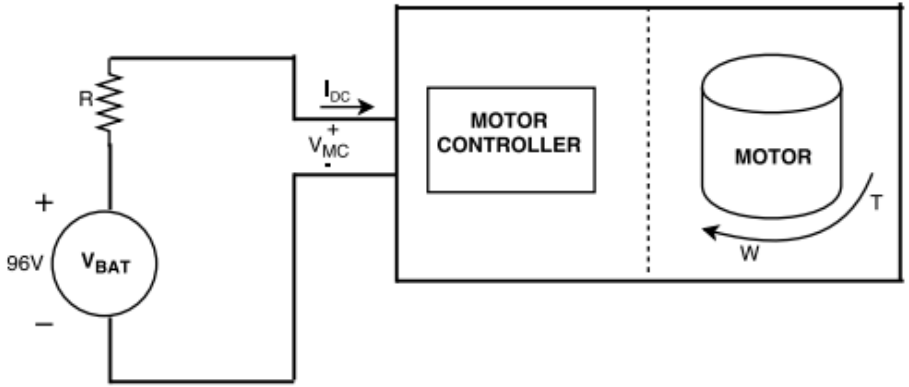
- Realize a virtual simulation of fully integrated car, without the car with SCADA
- Accurate estimation of the controller and motor system loss is necessary for the cooling system team to design for that given worst case
- Accurate design and simulation of cruise control, contingent on accurate physics modelling design and simulation
- Widen the scope of references for resulting conference paper

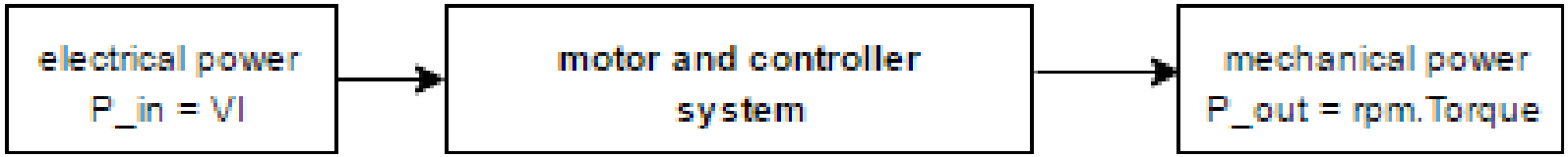
Physics Modeling - System High Level Diagrams





Physics Modeling - Motor & Controller System Diagrams





Cruise Control - Current State of Affairs/ Goals

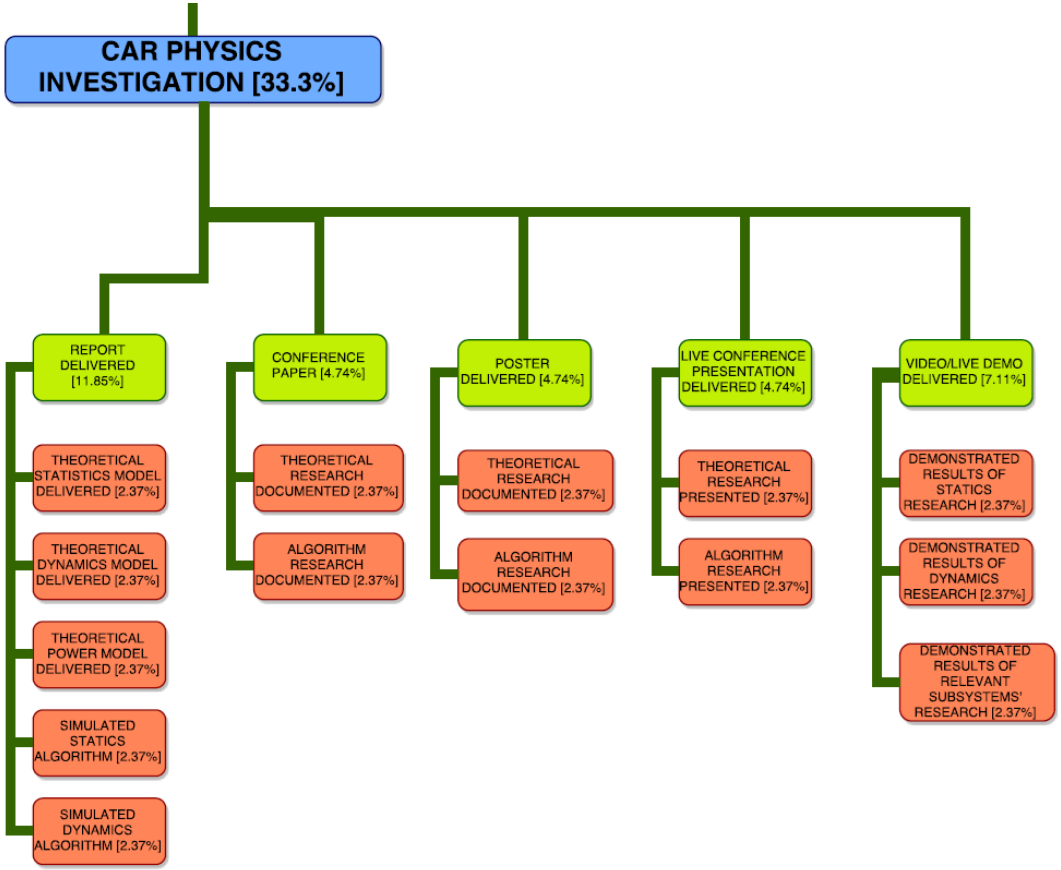
State of Affairs:

- In Spring of 2013 there were some approximations done to the effect of elementarily answering questions on the position, speed and acceleration of the car, and the current and voltage requirements

Goals:

- Finding the full range of speed in mph to run the car at maximum rpm of motor and at varying of gear ratios
- Determine battery duration estimates, battery economy, optimum speed, and maximum acceleration

Car Physics Investigation - Work Breakdown Structure



TSI - Current State of Affairs/ Goals

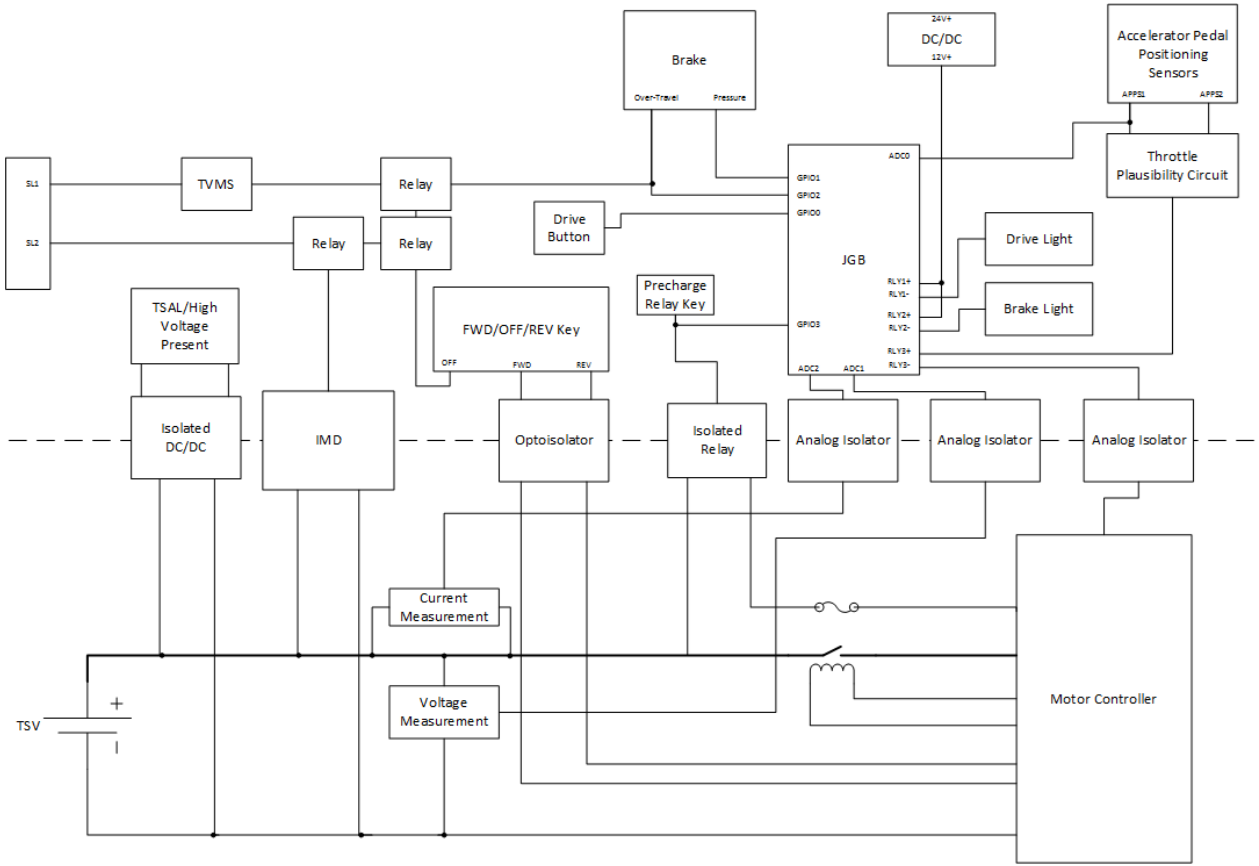
State of Affairs:

- Previous years have designed circuit for voltage and current monitoring
- The proper IMD has already been purchased.
- JGB was be used for communication on the CAN bus.

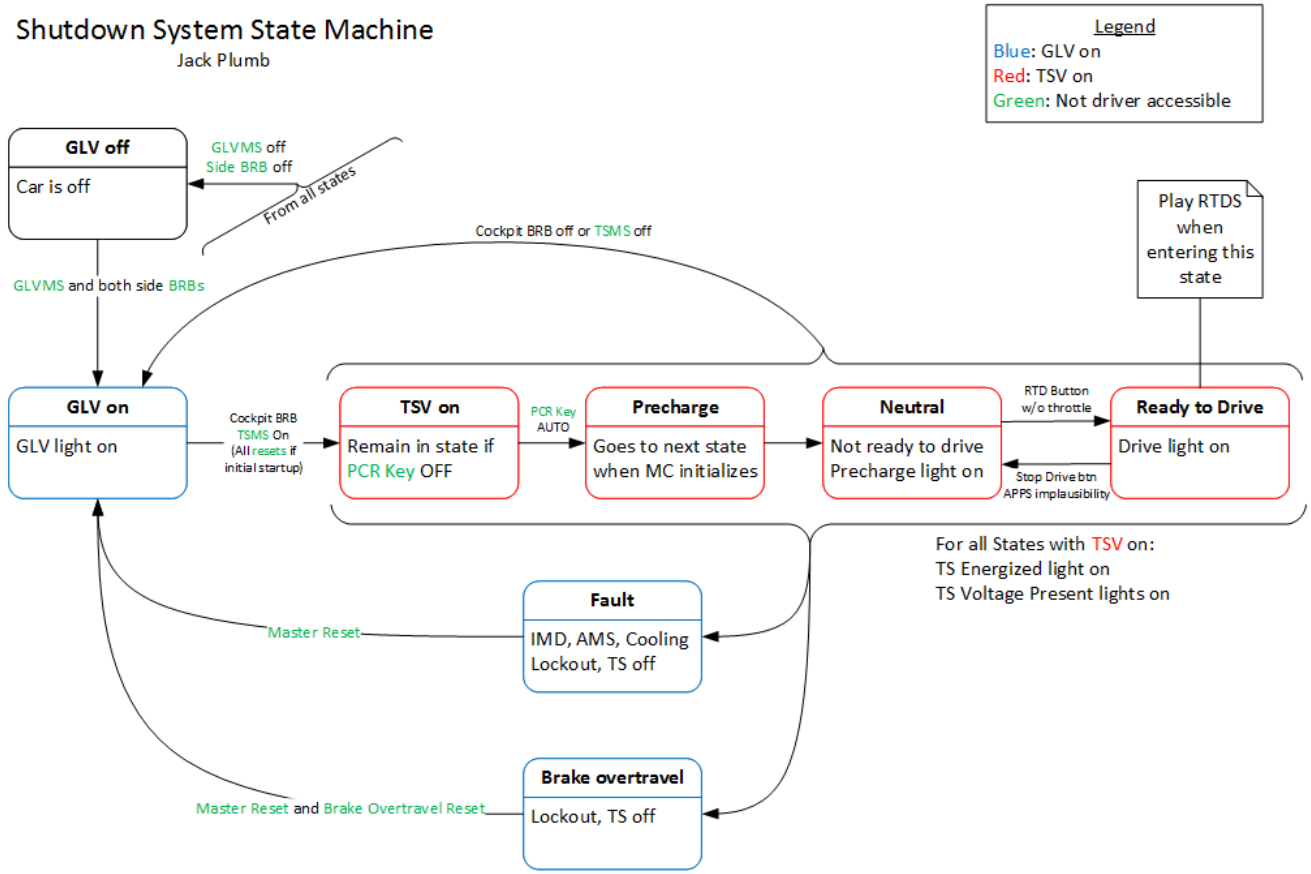
Goals:

- Interface with brake and the accelerator pedals.
- Relevant status lights (brake lights, RTDS, warning lights, etc.).
- Current and voltage information gathered and sent to VSCADA.
- System galvanically isolated, IMD to check for faults.
- Implement safety shutdown FSM as described in Formula Hybrid rules

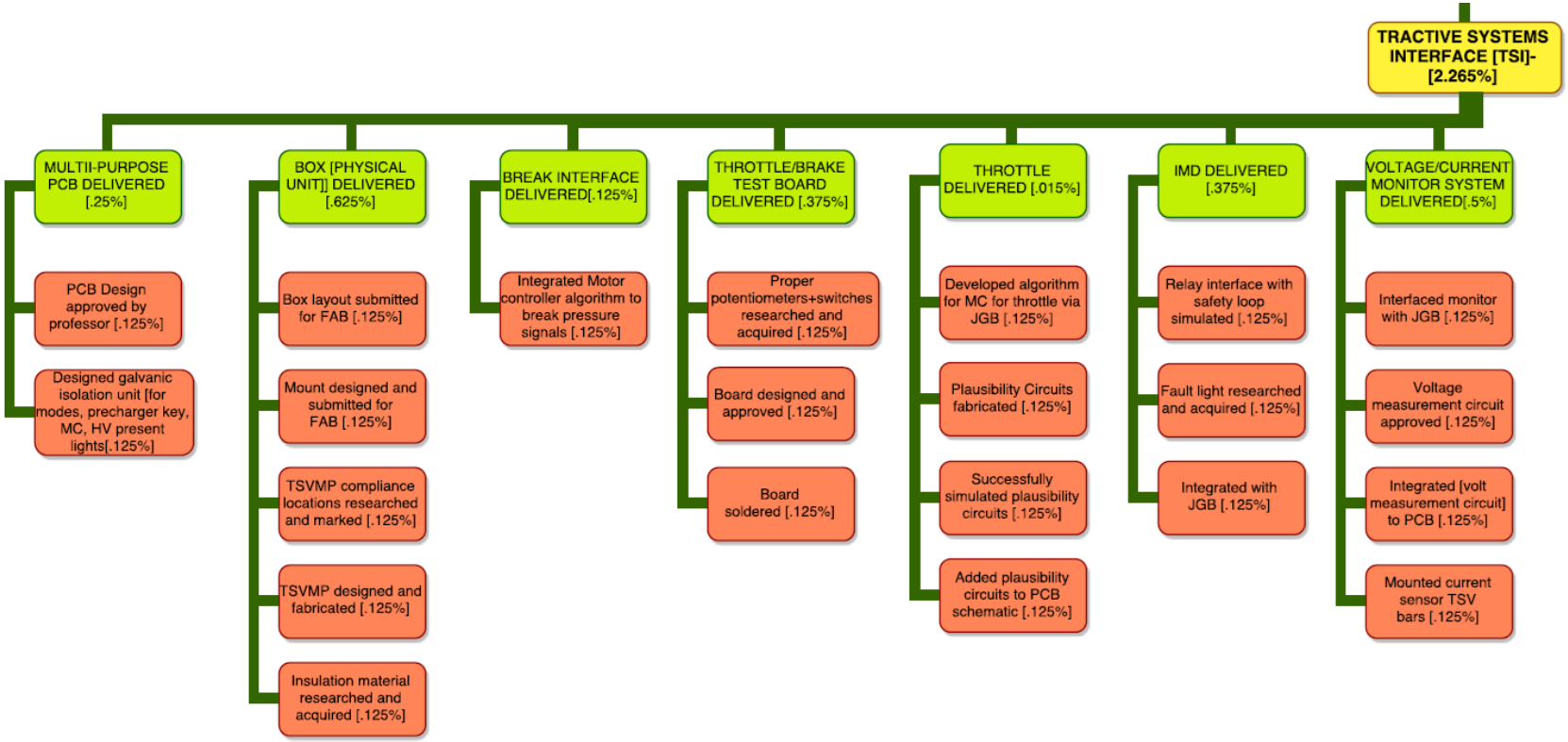
TSI - System Overview



TSI - Shutdown System State Machine



TSI - Work Breakdown Structure



Maintainability

- LFEV 2017 Website
  - https://sites.lafayette.edu/ece492-sp17
- GitHub
  - All code must be commented
- Google Drive

Cost Analysis

Subsystem / Purpose	Allocated Budget
TSI	$400
GLV	$700
VSCADA	$50
Cell App	$125
Controller Cooling System	$500
Interconnect / Cabling / ICD	$400
DYNO	$50
TSV	$600
Physics & Cruise Control	$0
Shipping / Taxes / Miscellaneous	$800
Total Budget	***$3,625***