GSSM Smart Golf Cart

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Traditional Golf Cart

- Manual Control
- Unsafe
- Liability
- Requires Knowledgeable Drivers
- Battery Level Concern

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Smart Golf Cart

- No Driving Experience Necessary
- Takes Users from Hole to Hole with a map
- Auto-Exchange when Battery is Low
- Auto-Return Abandoned Cart
- Constant Location (Asset Protection)
- Numerous Safety Features
- Carts Networked Together

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PROTOTYPE

(ENHANCED ENTERTAINMENT SYSTEM)

PROTOTYPE

(4 SEAT CONFIGURATION)

Golf Course Features

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Fleet Rollout

- Modification Kit to enable Fleet Reuse
  - New life for old carts
  - No need for new fleet
  - Saves $$$

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User Control

- Hole Selection
- Auto-Navigates to selected holes
- Avoids Legal complications of self driving cars
  - Easy Rollout

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Game Management

- Keep Score
  - Synced between carts if swapped
  - Compatible phone app
- Order Snacks & Beverages
- Call Front Desk
- On-Cart Wifi Hotspot
  - **Only in cellular-Model

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Central Management and Asset Protection

- Constant Centralized Location Tracking
  - Tracks Missing Carts using Geofencing
  - Know what carts are in use and where they are
- Users can exchange carts with a low-battery
  - Prevents stranded players
  - No more towing Carts

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Equipment Needed

- Base stations located around course
  - **For Non-Cellular Carts
- Central Management Computer
  - Software application

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College Campus Features

Autonomous Transportation

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Stations Located across campus

- Easy Access to carts
- Access via University ID
  - RFID/NFC Scanner
- Takes students to locations across campus
  - Within station network
- Easy, Safe, and Automated Student Transport
- Carts distribute themselves to minimize dead zones and wait times
  - More carts to high traffic areas

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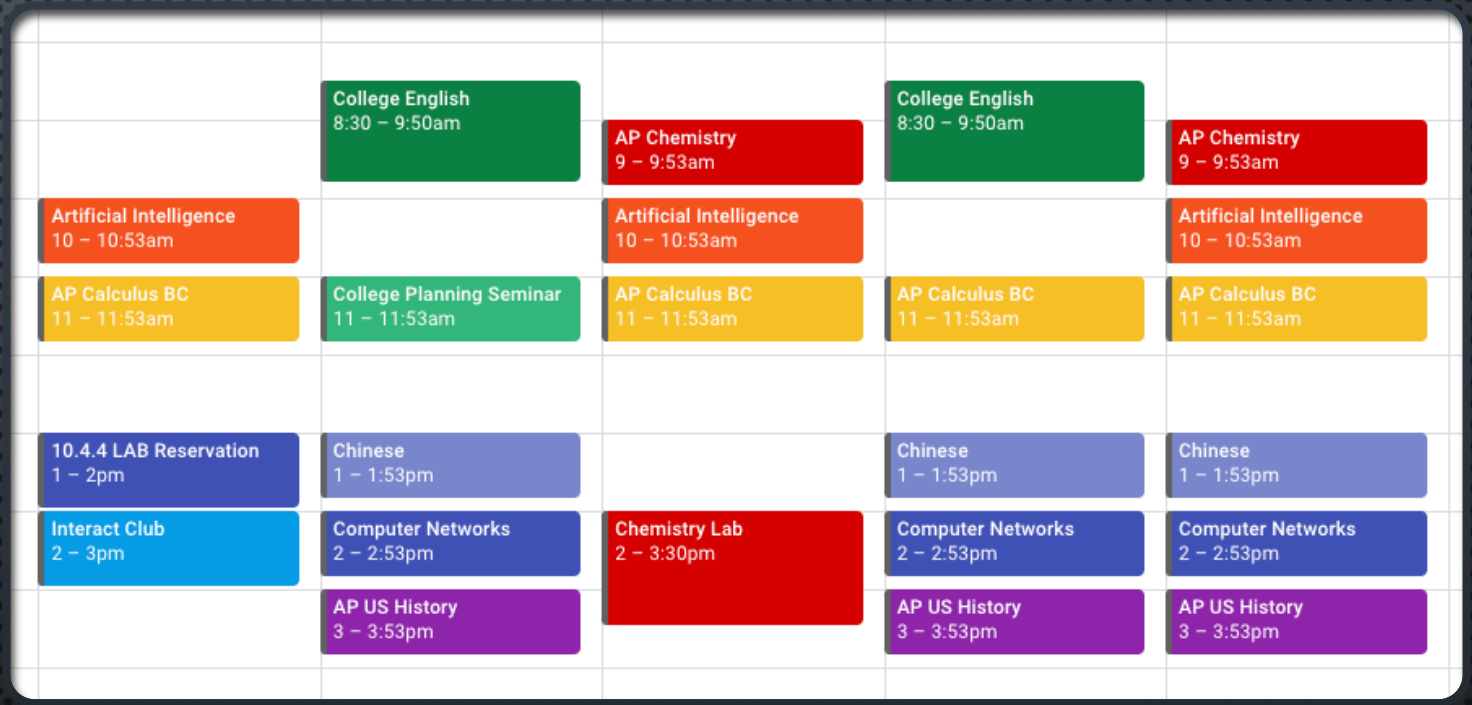
COURSE SCHEDULE INTEGRATION

- INTEGRATES WITH POWERSCHOOL AND OTHER LMS/STUDENT MANAGEMENT PLATFORMS
- BASED ON ID, TAKES STUDENTS TO THEIR CLASS BUILDINGS
  - HELPS NEW STUDENTS GET TO CLASSES



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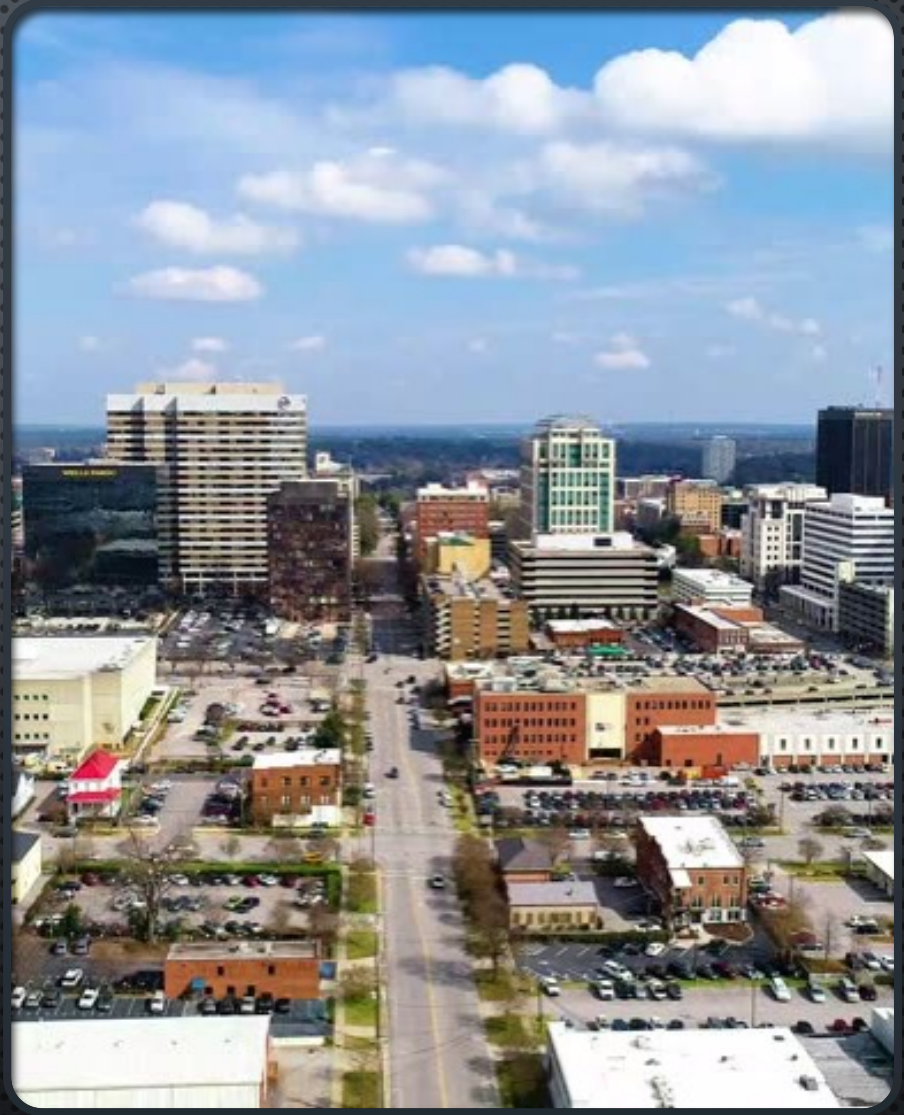
Intelligent Route Planning

- Multiple destinations per cart
- Minimizes travel time
- Nearest destination first
- Priority given to class buildings
  - Closest to Class time – Nearest Destination

Central Management

- Track location to find stolen carts
- Traffic/Usge analysis
- Usage information collection
  - Serve advertisements to nearby locations
- Remote control over any cart



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Equipment Needed

- Base stations located around course
  - **For Non-Cellular Carts
- Central Management Computer
  - Software application
- Cart Stations
  - Request kiosks

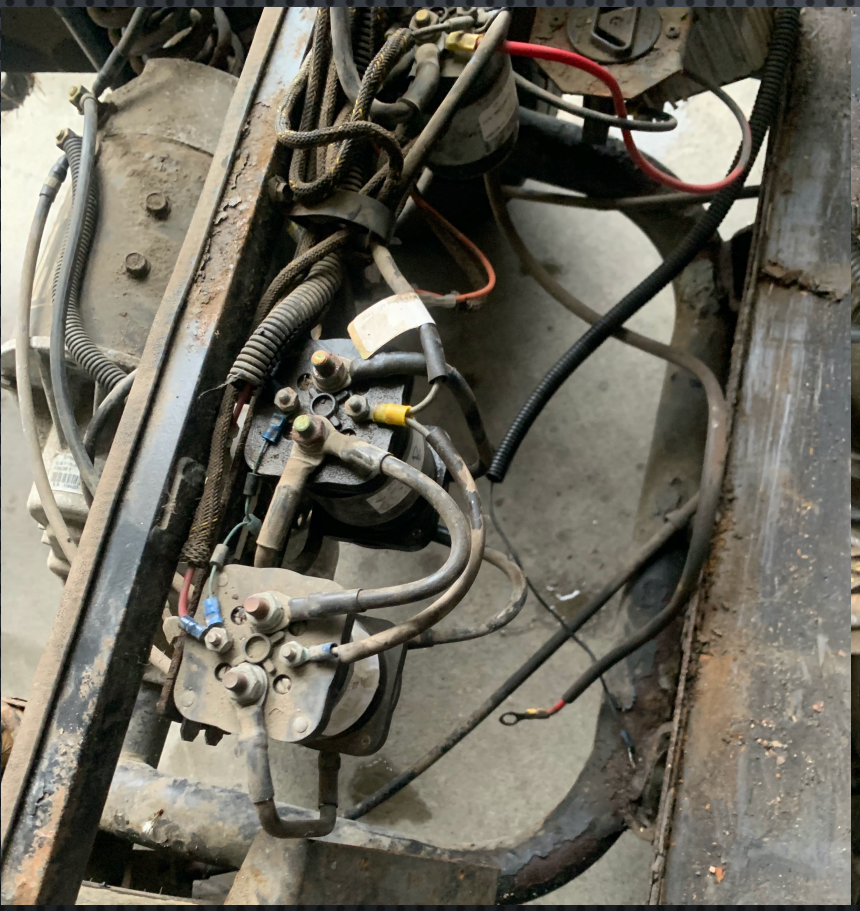
Building

PURCHASED CART

EARLY BEGINNINGS

- Batteries Needed Replacement
- New Charger
- Only reverse solenoid was functional

DISASSEMBLED CART



DieHard
GOLF CAR
DANGER
POISON
PUSH
ZONE

REPAIRED CART

CONTROL SYSTEM

(KIT COMPONENT)

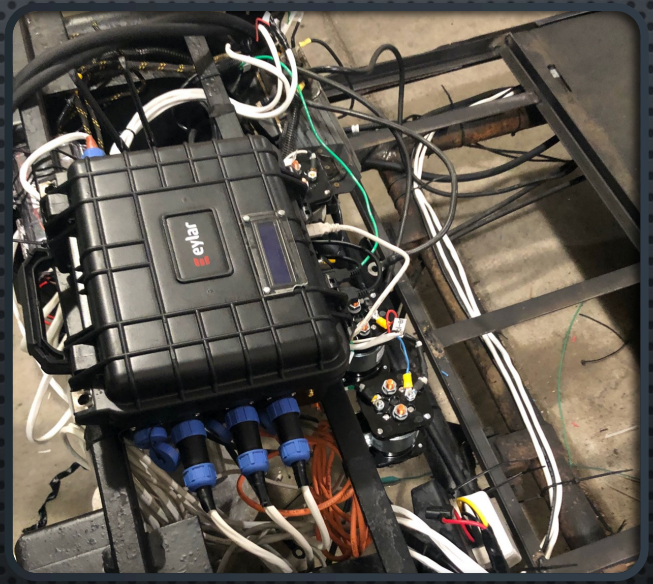
TOBSUN
TOBSUN

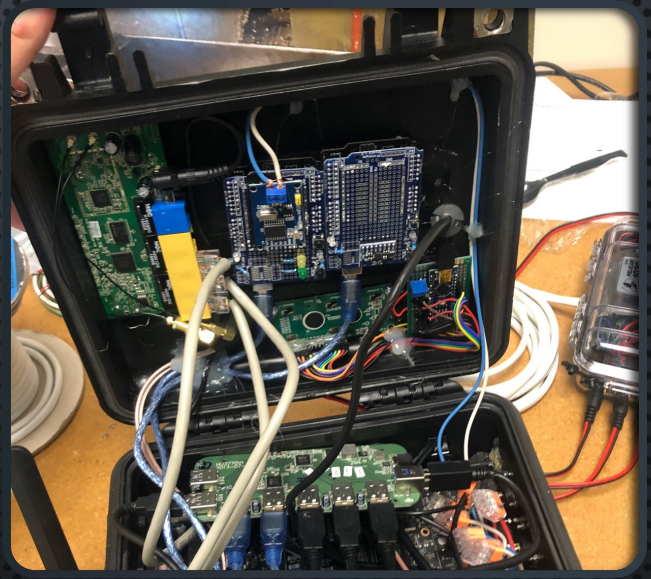
DREMEL
evlar

Designed with Modularity

Universal Drive Computer

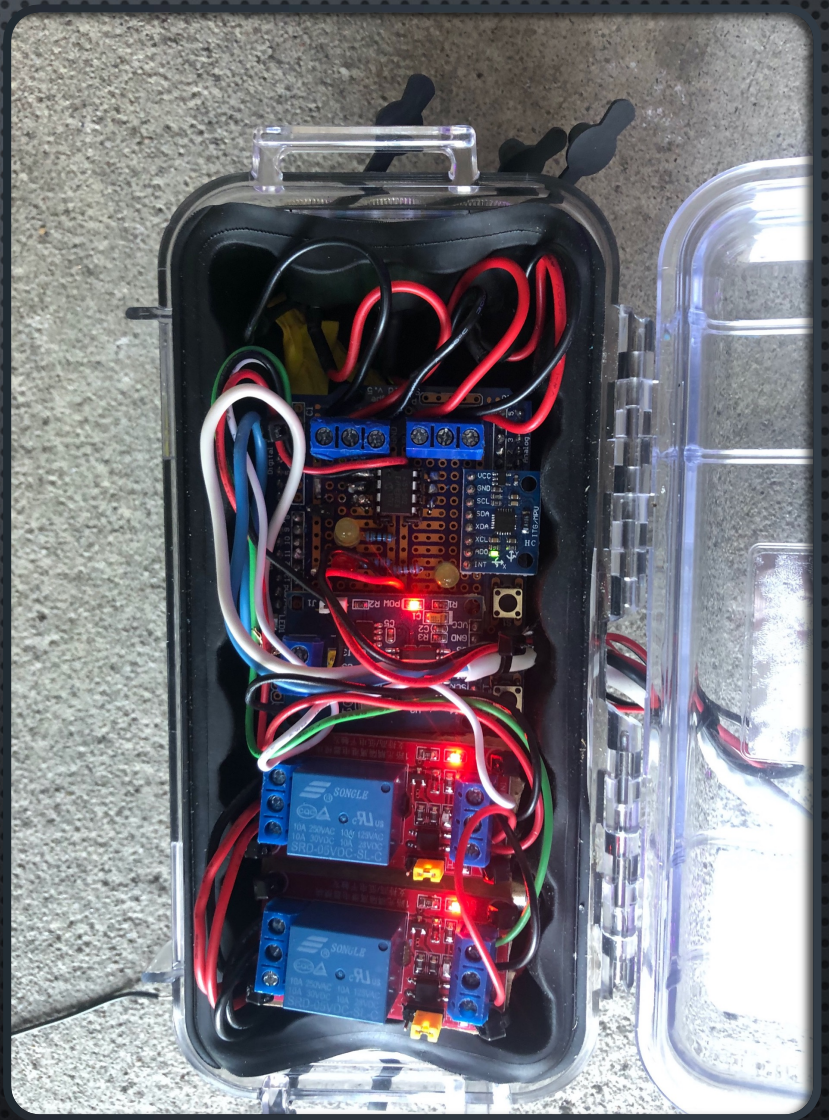
- 4x Bus Interfaces
  - CAN
  - 12v Power
  - Optional Expansion
- 2x Gigabit Ethernet
- 3x USB 3.0
- 1x USB B Pass-Through
- Integrated CAN Adapter
- Programmable LCD
- GPS
- 3-axis Motion Processor
- Short Range 802.11AC wifi





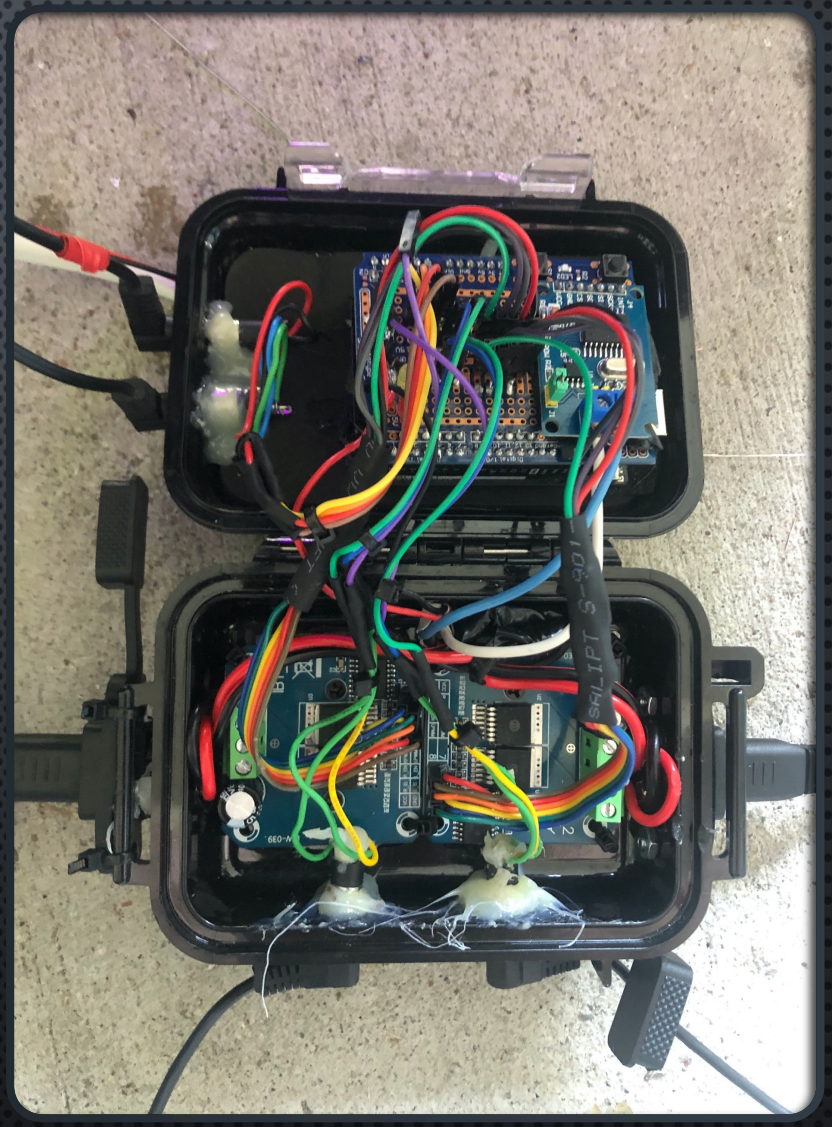
Drive Control Emulation Module

- Controls Key-Switch-Based Cart Drive Systems
  - Forward and Reverse
- Emulates Accelerator Pedal
- Uses Existing Pedal as AUX HID
- Aux 3-Axis Motion Processor
  - Dedicated for detecting Complete Stops

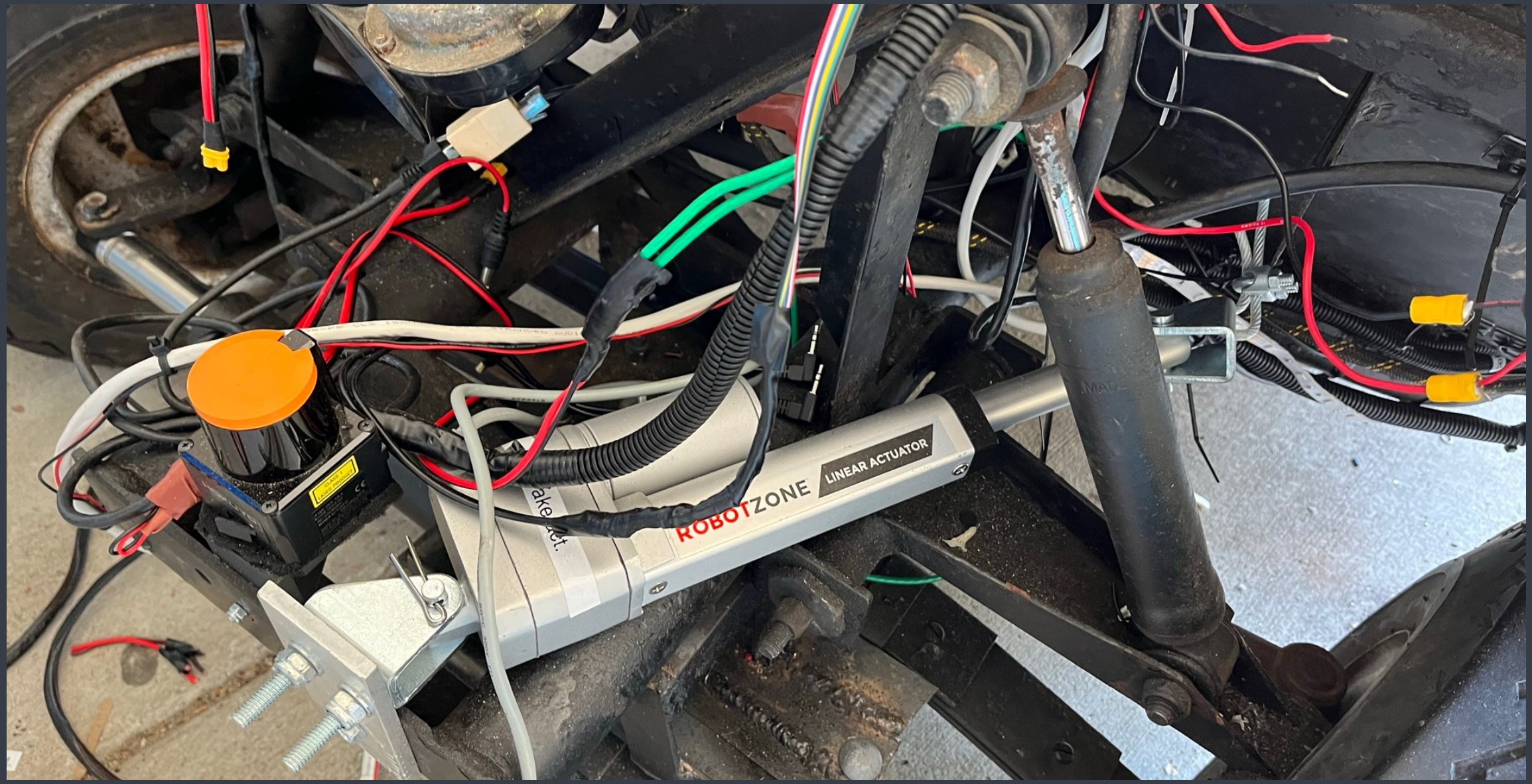


STEERING & BRAKE CONTROL MODULE

- Controls Brake and Steering Actuator
- Actuator Position Tracking
- Steering Wheel Encoder Feedback
- Brake Pedal Detection



BRAKES


ROBOTZONE
LINEAR ACTUATOR

STEERING CONTROL

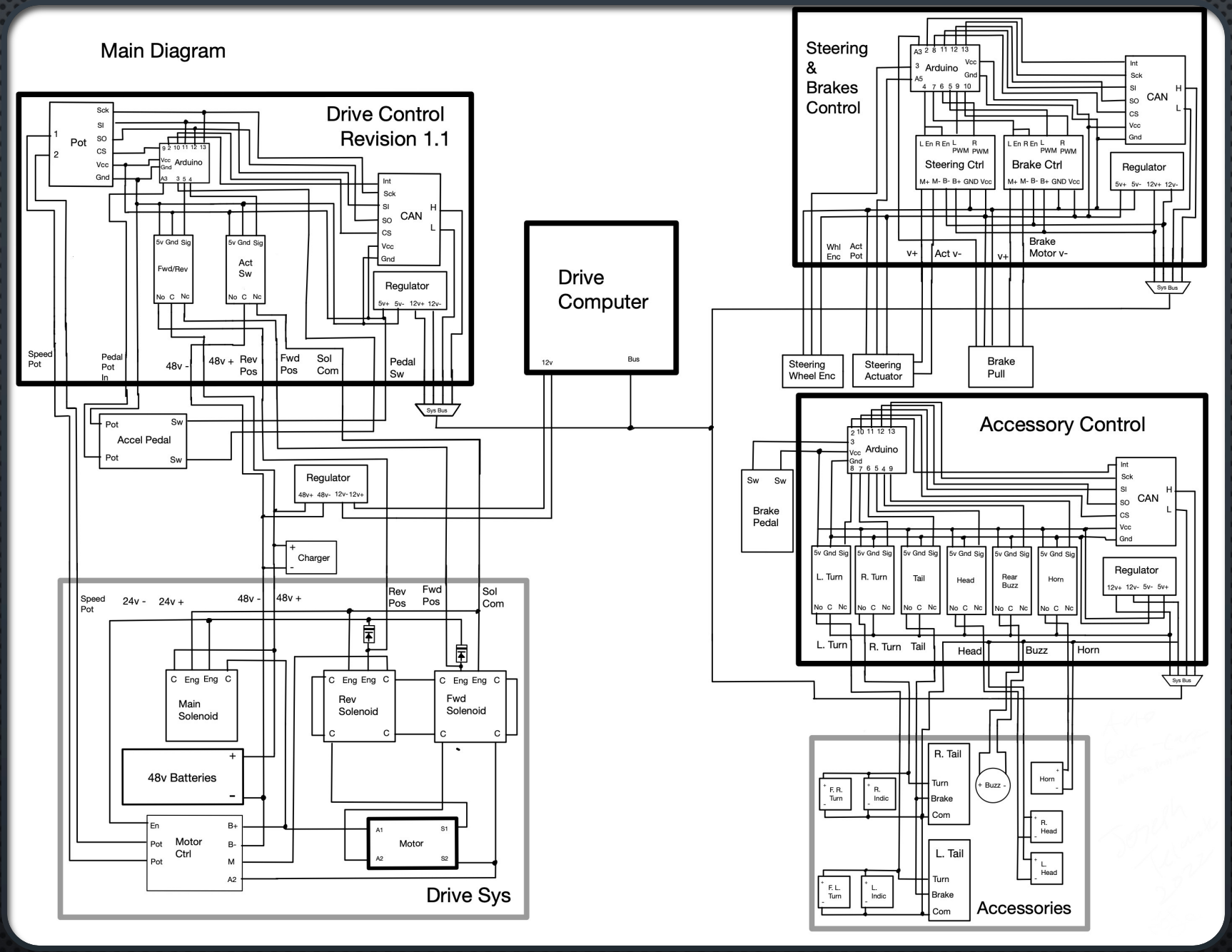
steering act.

Accessory Control Module

- Controls Turn Signal Timing
- Controls Head and Tail Lights
- Horn Control
- Expansion Relays (Extra Lights)
- **Only Required for Street-Legal Carts

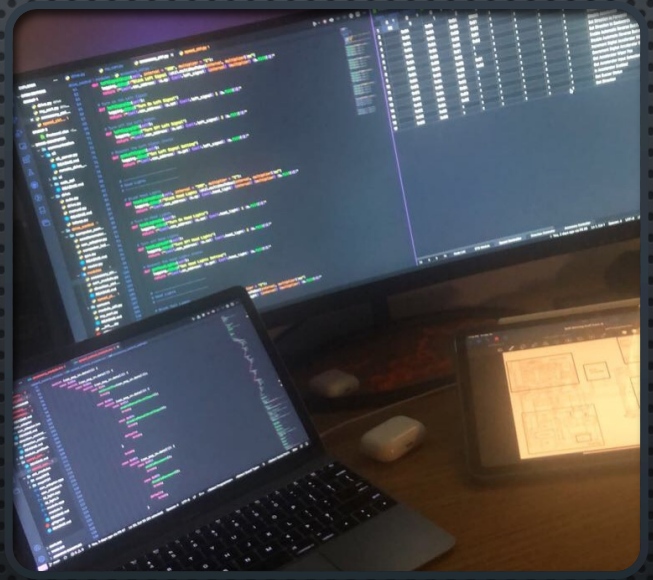
ELECTRICAL SAFETY FEATURES

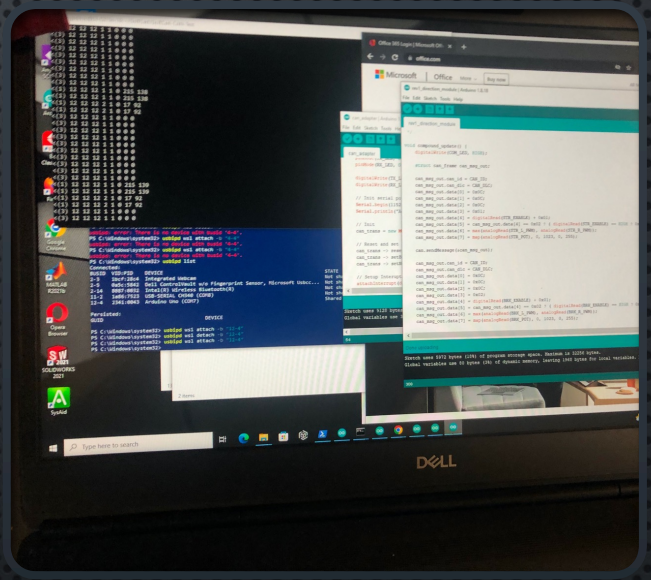
- 12v Mains Power Switch
- 12v Control Power Switch
- 48v Drive Solenoid Disconnect
- Fuse on 12v Regulator
- Auto-Reclosing Breaker


Main Diagram
Drive Control
Revision 1.1
Pot
Sck
SI
SO
CS
Vcc
Gnd
Arduino
CAN
Int
H
L
Fwd/Rev
Act
Sw
5v Gnd Sig
No C Nc
Regulator
5v+ 5v- 12v+ 12v-
Speed
Pot
Pedal
Pot
In
48v -
48v +
Rev
Pos
Fwd
Pos
Sol
Com
Pedal
Sw
Sys Bus
Accel Pedal
Pot
Sw
48v+ 48v- 12v- 12v+
Charger
Drive
Computer
12v
Bus
24v -
24v +
Main
Solenoid
Rev
Solenoid
Fwd
Solenoid
C Eng Eng C
48v Batteries
Motor
Ctrl
En
B+
B-
M
A2
A1
S1
S2
Drive Sys
Steering
&
Brakes
Control
A3 2 8 11 12 13
3
A5
4 7 6 5 9 10
L En R En L PWM R PWM
Steering Ctrl
Brake Ctrl
M+ M- B- B+ GND Vcc
Whl
Enc
Act
Pot
v+
Act v-
Brake
Motor v-
Steering
Wheel Enc
Steering
Actuator
Brake
Pull
Accessory Control
2 10 11 12 13
3
Vcc
Gnd
8 7 6 5 4 9
Sw
Brake
Pedal
L. Turn
R. Turn
Tail
Head
Rear
Buzz
Horn
12v+ 12v- 5v- 5v+
Buzz
R. Tail
Turn
Brake
Com
L. Tail
F. R.
Turn
R.
Indic
F. L.
Turn
L.
Indic
R.
Head
L.
Head
Accessories

FIRMWARE

- Custom Libraries
- Does not user Arduino Standard Library
- Direct Port Register Modification
  - 5x Speed Increase
- Custom Communication Scheme
- 4000 Lines of C/C++
  - Not including drive computer





AUTONOMY AND REMOTE CONTROL

Control Options

Intelligent Navigation

- Collision Avoidance
  - Vehicles and other Obstacles
- Object Detection
  - People and Road Signals
- Pathfinding
  - Avoids Obstacles

Manual/Teleoperated

- Uses existing wheel and pedals
- Can be controlled Remotely
  - Computer Console
  - SSH Terminal
  - Game Controller

Safety Features

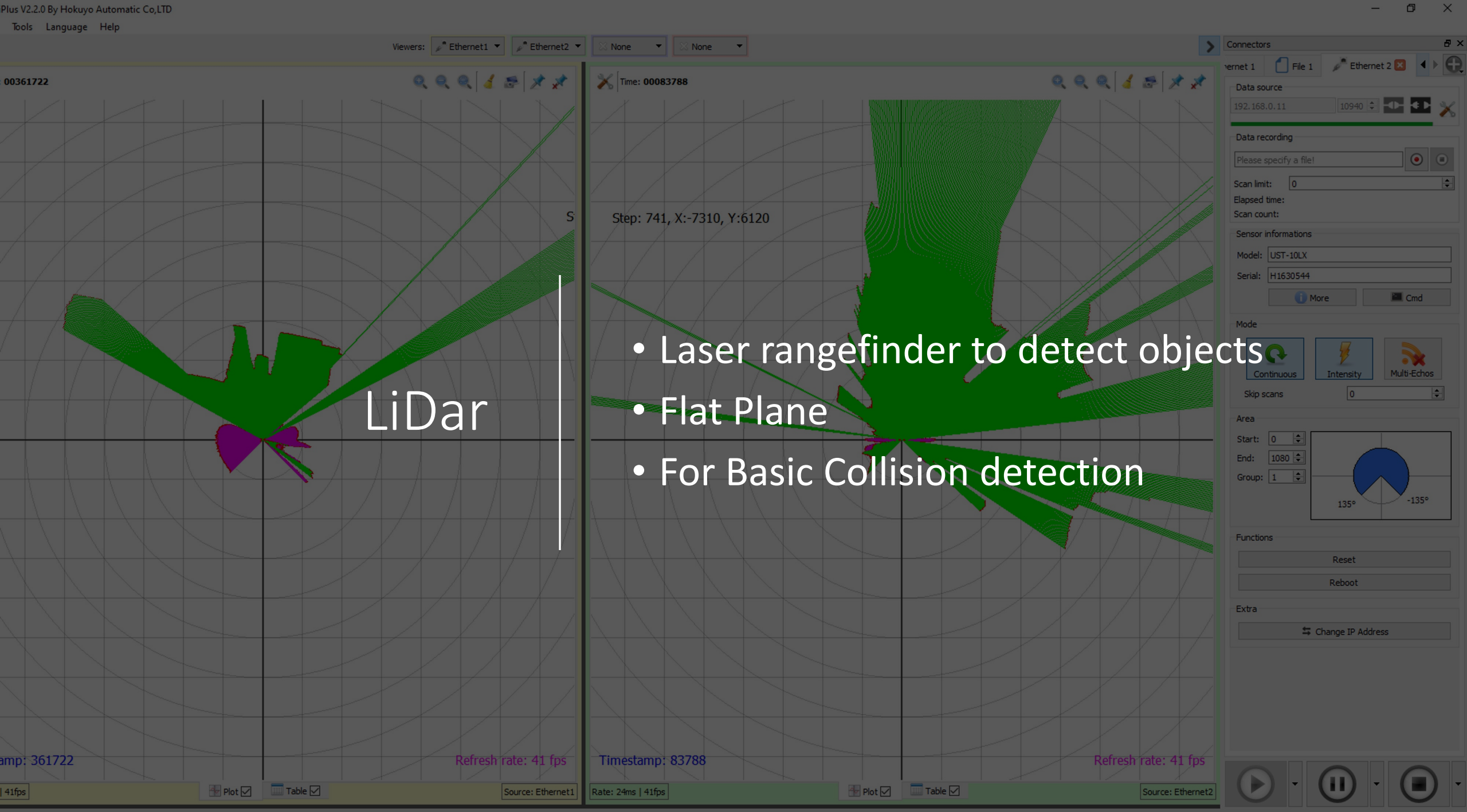
- Constantly Tracks Objects
  - Hard stop if too close
- Multiple Emergency Stops
  - Touchscreen
  - Brake Pedal Hold switches to manual
  - Kill Switches
- Software Speed Limits
- Actions that could damager hardware prevented
  - Burnouts
  - Quickly switching Forward/Reverse

TOUCH USER INTERFACE

- Route Planning
- Manual Control
- Accessory Control
- Entertainment System
- Application-Specific Uses
  - i.e. Golf Scoring

LONG RANGE WIFI

- LONG-RANGE 2.4GHZ WIFI
  - LOW BANDWIDTH COMPARED TO DRIVE COMPUTER WIFI
- FOR TELEOP CONTROL
- SPECIFIC TO NON-NETWORKED MODELS



LiDar

- Laser rangefinder to detect objects
- Flat Plane
- For Basic Collision detection

LIDAR

- Laser rangefinder to detect objects
- Flat Plane
- For Basic Collision detection
- Located on Front and Rear

STEREOSCOPIC CAMERAS

- Object Detection
- Depth Maps
- Advanced Collision Detection
- Pathfinding
- Object Tracking
- Located on Front and Rear

DEMO TIME!!!