Automatic Solder Dispenser

Members and Client

Sam Willford - Team Manager, Report Manager

Weekly reports, Project Plan, Design Document, Leading Team Meetings

Jason Austin - Software Lead

Software design, Repository management

Justin Wheeler - Mechanical Lead

Mechanical Design, Mechanical Fabrication

Zach Bumstead - Electrical Lead

Web Page Design, Driver Board Design

Trent Allison - Electrical and Software Integrator

Driver Board Design, Soldered Driver board, Connected Components

Kevin Carlson - Electrical and Mechanical Integrator

Mechanical Descriptions, Design Document, Assist Extruder Design

Client: Lee Harker (From ETG)

Problem Statement

- ETG receives many requests for solder daily
  - Can't leave spools out in public -> they disappear
- Students don't know which solder type they need
  - Takes time for ETG members to educate these students
- Goal is to save ETG time and money by automating this process

Solder Parameters: Flux Composition

- Rosin Core
- Water Soluble
- No Clean

Diameter

- 0.02"
- 0.03"

60/40 Tin Lead

Requirements

- Reduce Solder Waste
- Mobility
- Interactive Display
- Communicate with ETG via email
- Special access for administrators
- Clear top enclosure

Market Survey

- Automatic solder dispenser gun has been created
- But automatic solder dispensing machine has not yet been created
- Comparable device: automatic paper towel dispenser

Potential Risks and Mitigation

- Risks:
  - Solder jam
  - Students reaching in box for more solder
  - Injury due to cutter

- Mitigation:
  - Jam senor
  - Placed solder/cutter to be unreachable

Resource and Cost Estimation

- Box: $115
- Display screen: $65
- Raspberry PI: $40
- PCB: $10
- Servo/Stepper motors: $45
- Extruder: $10
- Car reader: $15
- Other: $65
- Total: ~$365

Budget discussed at beginning of year: $400

Project Milestones and Schedule

Milestone 1 - Decide microcontroller, box, and motors - 9/18/2018

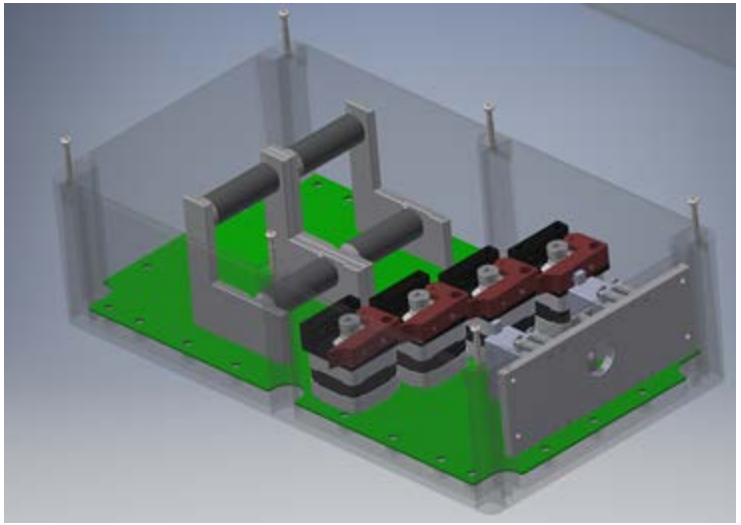
Milestone 2 - Design and create PCB - 11/23/2018

Milestone 3 - Complete mechanical design and creation - 12/21/2018

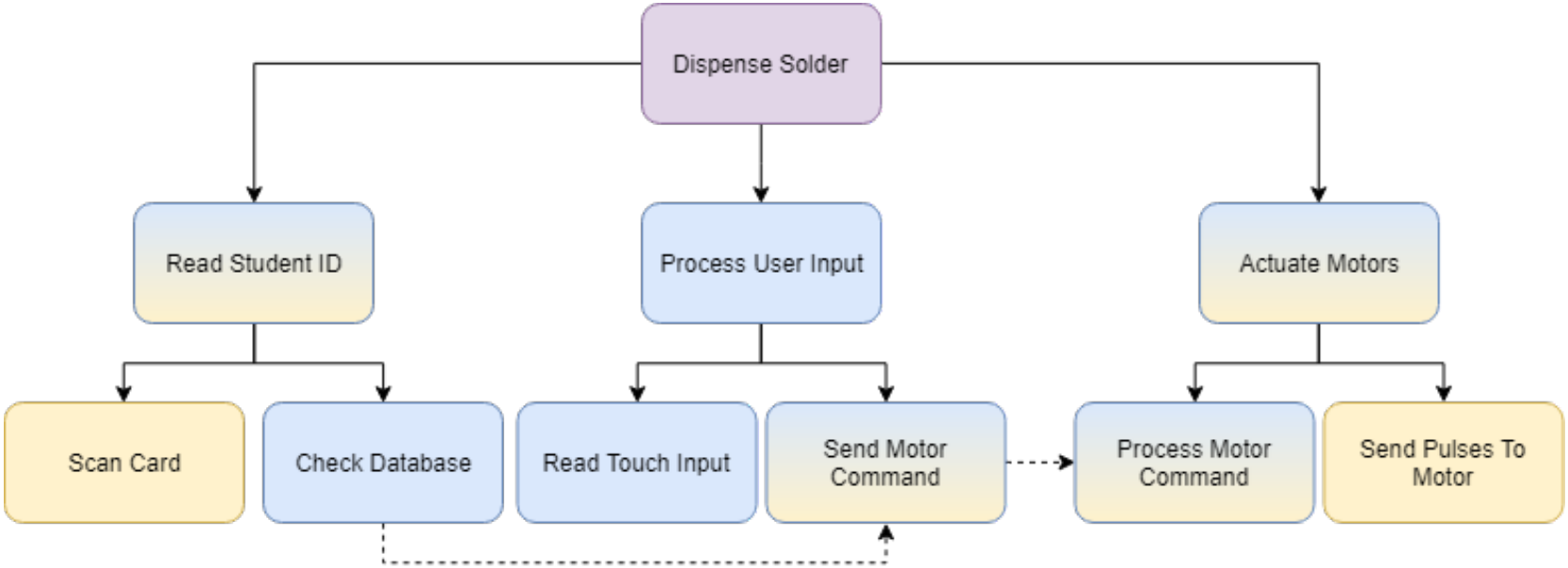
Milestone 4 - Complete programming code - 2/8/2019

Milestone 5 - Integrate all parts inside box and begin testing - 3/22/2019

System Design



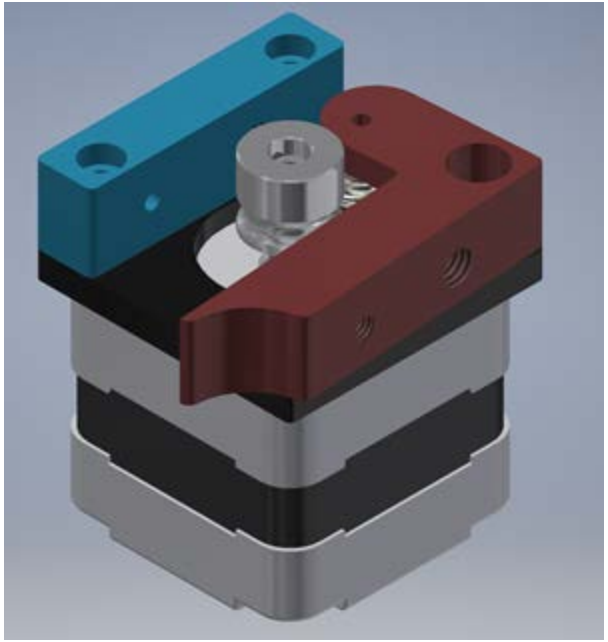
Functional Decomposition



Detailed Design - Mechanical

Extruder

- Provides tension to the solder while feeding it through the system
- Must be able to be reproduced with available tooling/services at ISU without excessive cost
- Material/Machining Options
  - Aluminum - Waterjet Cut and Finished by ETG
  - Aluminum - Boyd Labs
  - 3D Printed - Black Engineering
  - 3D Printed - Design



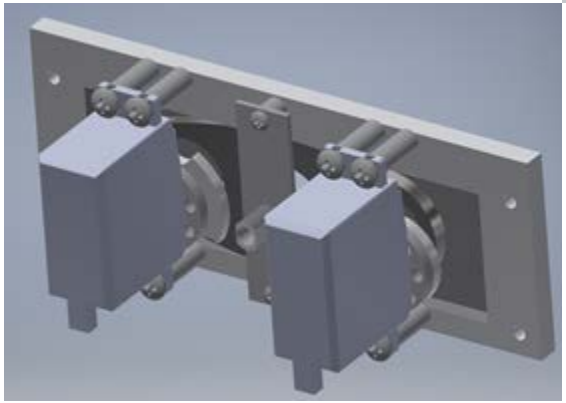
Detailed Design - Mechanical

Spool Mounting

- Gives the spools of solder a place to mount
- Must be extremely serviceable, the point that ETG techs will be touching the most

Cutter

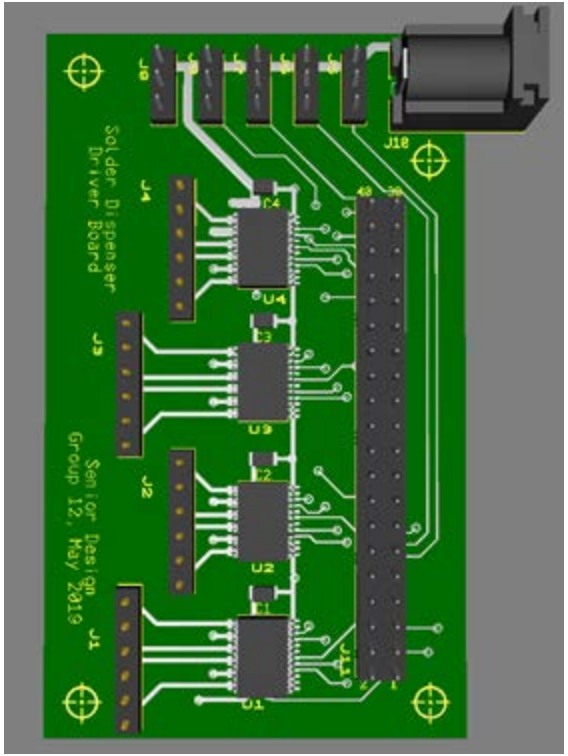
- Must cleanly cut the solder after it has been dispensed
- Must be very repeatable
- For safety reasons it must be shielded from the user so they can't hurt themselves.



Detailed Design - Electrical

- Stepper Motor Driver Board
  - Makes the system reproducible
    - Ease of building
    - Neat / compact
  - Common connector for motors
  - 3 pin headers for servos and sensors

- Power Supply
  - 5V, 2 Amp “wall wart” power supply



Detailed Design - Software

GUI

- Gives the user selectable options
  - Spool selection
  - Desired length
- Must be simple to understand
- Must be usable with a touchscreen interface
- Must provide user with necessary information about currently selected spool

Detailed Design - Software

Access control

- Must allow or deny access to users based on time of last access
- Must send periodic status reports to the ETG
- Must survive power failures

Motor control

- Must drive selectable stepper motor
- Must drive cutter servos
- Must release control of all motors when not in use

Detailed Design - Software

Hardware monitoring

- Prior to mechanical action, software must collect data on device status
  - Possible jams
  - Cover open
- Must report error states to ETG
- Must deny user access to possible jammed spools
- Must deny any motor movement until “Cover Open” status is cleared by admin

HW/SW/Technology Platform(s) used

- Raspberry Pi 3+
- Python
- 7” Touchscreen display
- Custom PCB

Test Plan

- Goal is to finish dispenser early and allow students to use machine
  - Spring Break deadline goal
  - Dispenser will be placed in public for testing
    - Inside TLA in Coover

- We will have time to fix unexpected issues
  - Collect data on jam rates
  - Receive feedback from students on how to improve

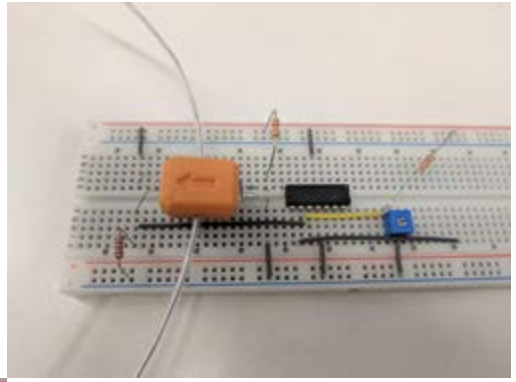
Current Project Status

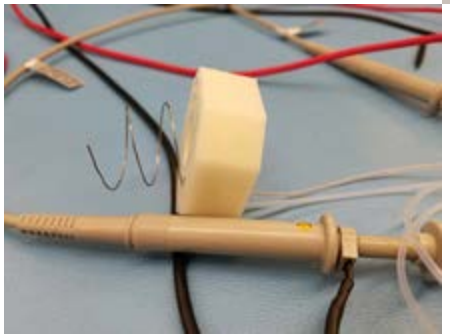
- Solder cutting device and code has been tested
- Plastic extruder and code has been tested
  - Motor control functions have been created
- Parts for aluminum extruder have been cut
  - Needs to be fitted and assembled
- Database is set up
  - Card reader works and can read/write to database
  - Checks for 20 minute waiting time
- First PCB has been created and tested

Approximately on Schedule!

Plan for Next Semester

- Jam-Detection using optical switches
- Coiling solder to make the system more compact
- Sensor to detect when the box has been opened

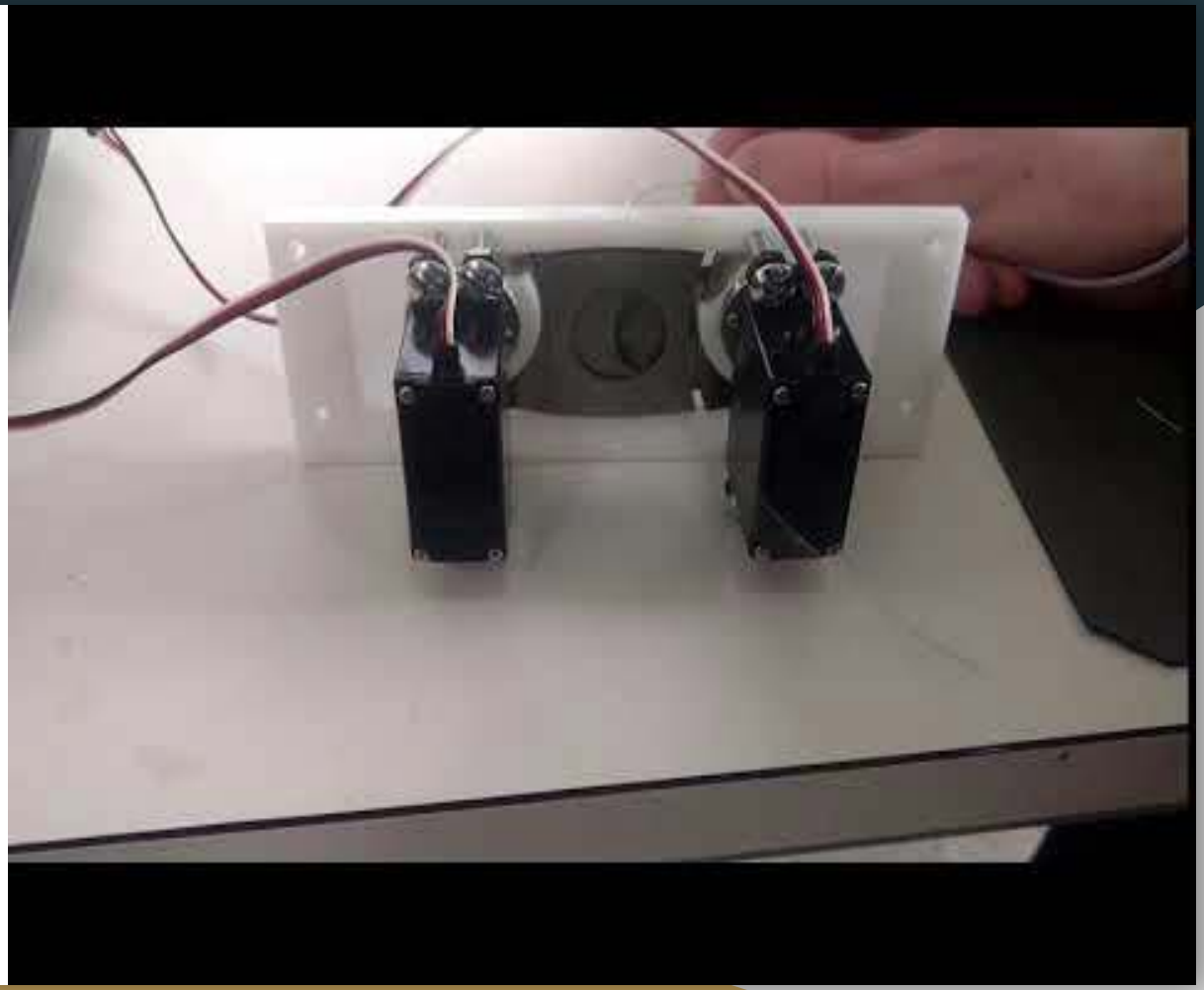




Demo

Thank You

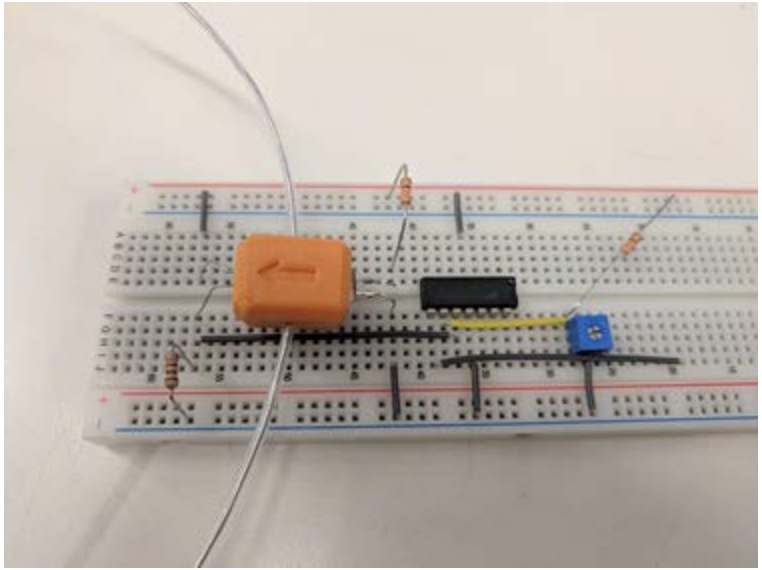
Cutter Video



Extruder & Program

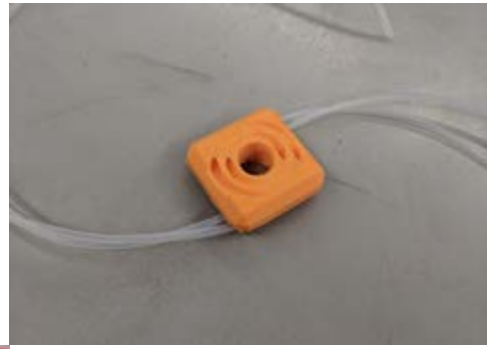
Plan for Next Semester

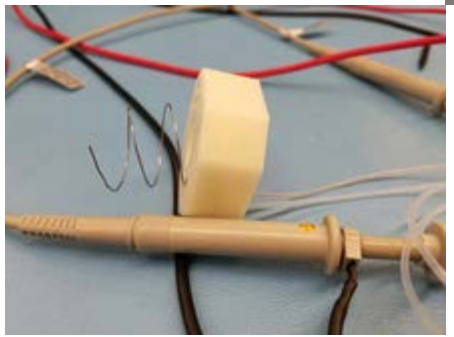
- Jam-Detection using optical switches
  - Programmatic evaluation of a “good” cycle
  - Possible second board design for amplification or simple evaluation for the purpose of abstracting this decision away from the Pi



Plan for Next Semester

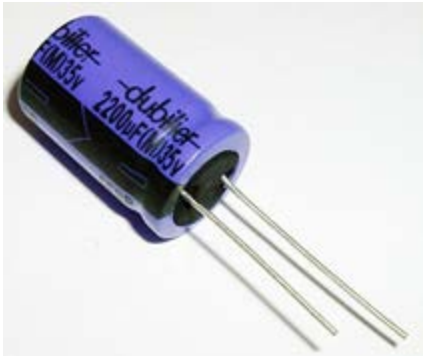
- Coiling Accumulator
  - Removes need for length of tubing at the base of device
  - Demonstrates practical application of additive manufacturing techniques pursuant to goal of acting as a teaching aid
  - Will require significant modification of enclosure





Plan for Next Semester

- Box-Open Sensor
  - Simple micro switch sensor to send email notification to administrators when the box has been opened
  - Possibly using charged capacitor to allow this function for a short time after power loss



Security Concerns & Solutions

Concern	Solution
Access to all student ID numbers	Periodically purge IDs with time > 20’
Access to database information	Purge user and admin db if cover is opened outside of maintenance

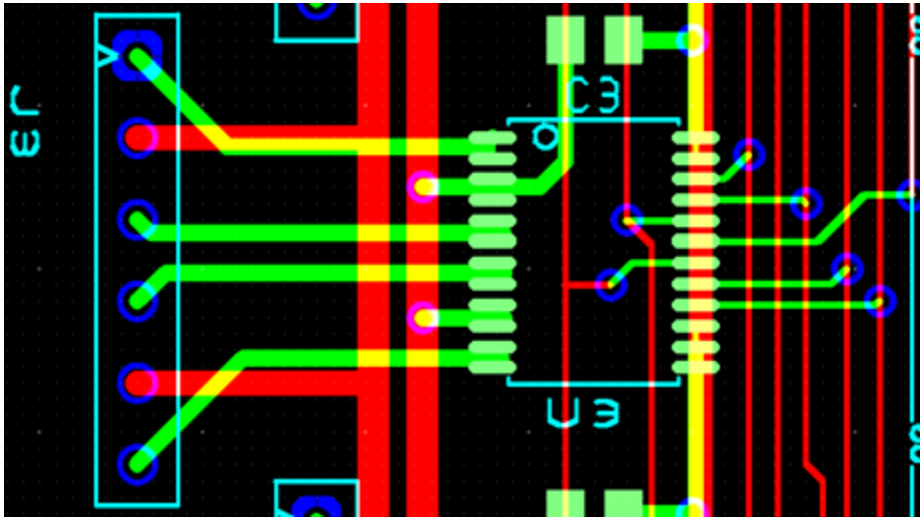
Administration Access

- Normal user access, minus cool down constraint
- Access to configure spool configurations
  - Length of spool
  - Diameter
  - Flux type
  - Composition
- Maintenance options
  - Clear user Database
  - Clear Admin Database
  - Approved open cover access
  - Clear open cover status
- View spool status

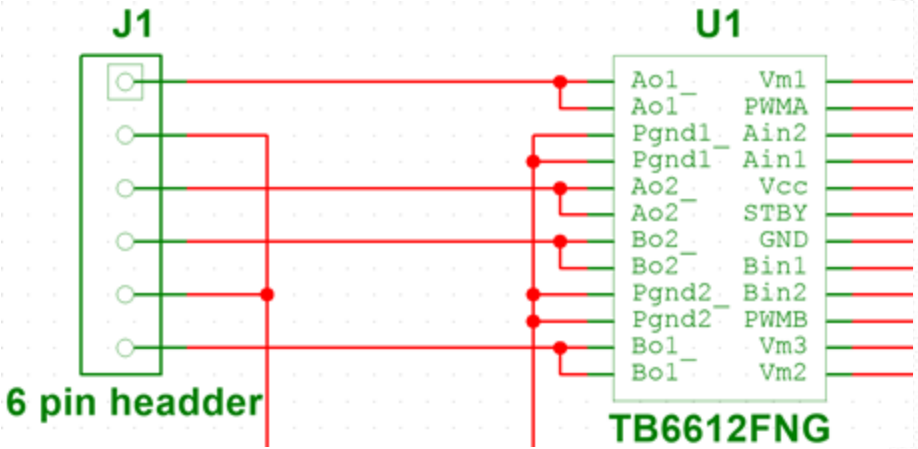
Power Use

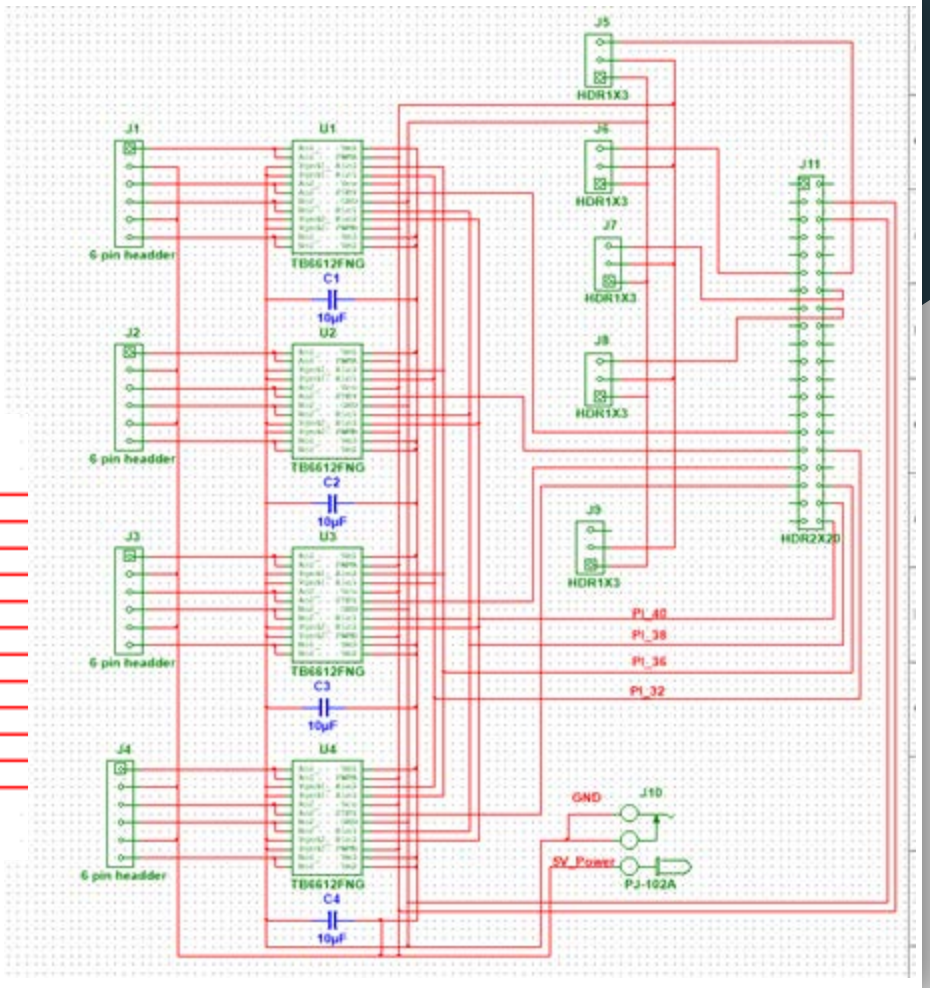
Component	Active Draw	Passive Draw
Raspberry Pi	550 mA	550 mA
Screen	500 mA	40 mA
Stepper Motor	14 mA	0
Servo Motor	800 mA	20 mA
Drivers	1 mA	0
TOTAL	1950 mA	610 mA

Electrical Design



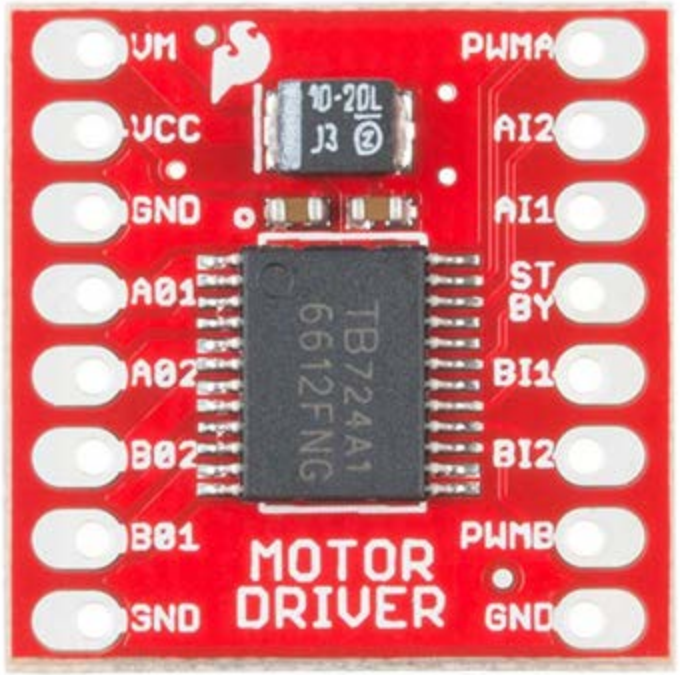
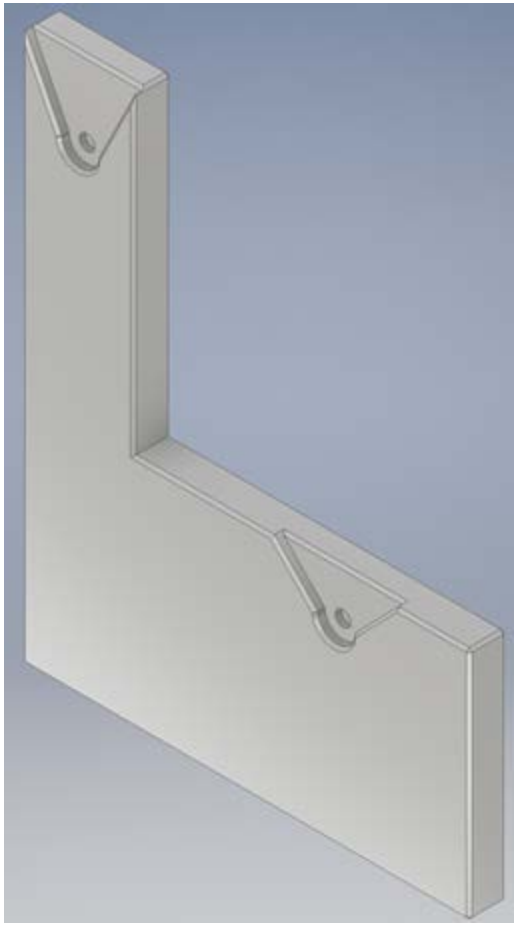
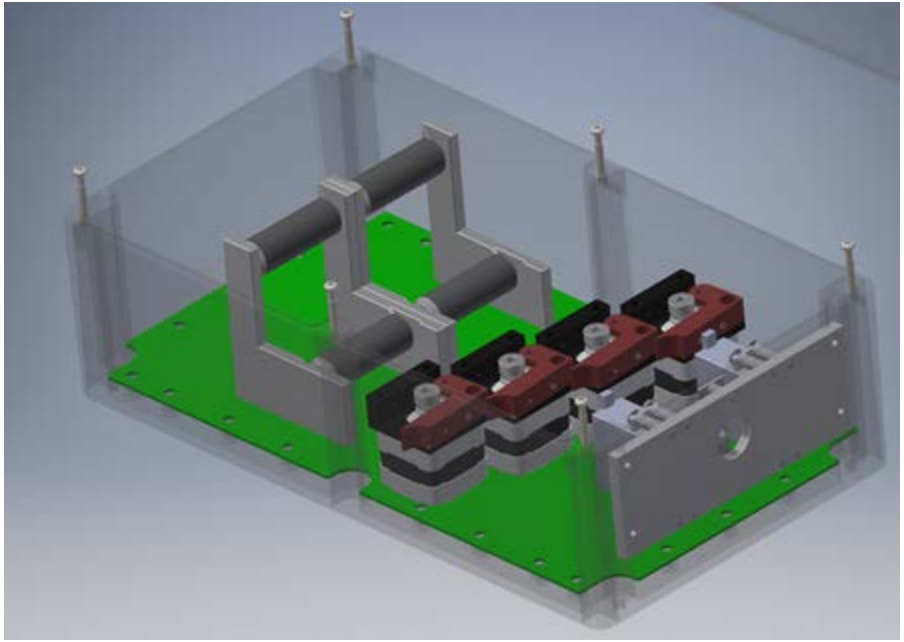
Electrical Design





Electrical Design

- TB6612FNG
  - Dual channel DC motor driver
  - Standby



Spool Bracket