

Automatic Solder Dispenser



Members and Client

Sam Willford - 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, Sensor Board Creation

Trent Allison - Electrical and Software Integrator

Driver Board Design, Populated Sensor Board, Software Assistant

Kevin Carlson - Electrical and Mechanical Integrator

Assist Mechanical Design, Bracket Creation

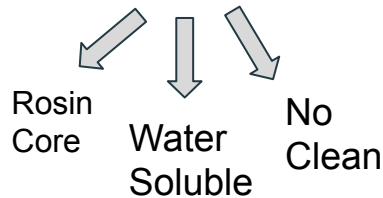
Client: Lee Harker (From ETG)

Problem Statement

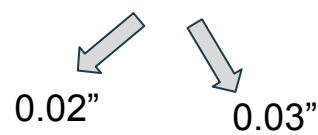
- ETG constantly receives requests for solder
 - Can't leave spools out in public -> they disappear
- Students don't know which solder type they need
 - Takes time for ETG members to educate these students
- Goal is to save ETG time and money by automating this process



Solder Parameters: Flux



Diameter



Composition



Requirements

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



Market Survey

- Automatic solder dispenser gun has been created
- Comparable device: automatic paper towel dispenser
- Niche device for a very specific application



Potential Risks and Mitigation

- Risks:
 - Students reaching in box for more solder
 - Injury due to cutter
 - Students opening box
- Mitigation:
 - Output tubing designed to make reaching into box/accessing cutter impossible
 - Box-open sensor



Resource and Cost Estimation

- Box: \$115.00
- Display screen: \$60.00
- Raspberry Pi: \$39.99
- PCB: \$41.25
- Servo/Stepper motors: \$79.60
- Extruder: \$10
- Card reader: \$18
- Hardware/Misc: \$40.00
- **Total: \$403.24**

Budget discussed at
beginning of year: \$400

Project Milestones and Schedule

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

Finished on-time

Milestone 2 - Design and create driver board - 11/23/2018

PCB was designed, but needed updates

Milestone 3 - Complete mechanical design and creation - 2/8/2019

Completed, but extruder was later re-designed

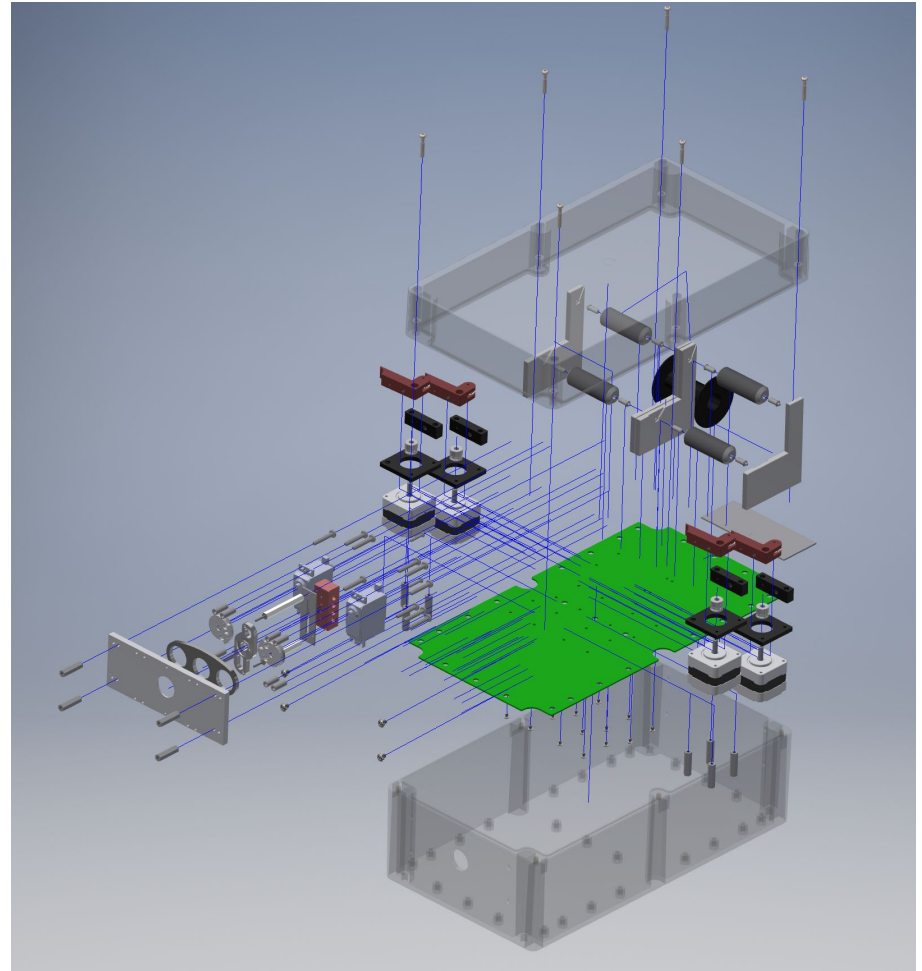
Milestone 4 - Complete programming code - 2/8/2019

Basic code completed, improvements were added throughout

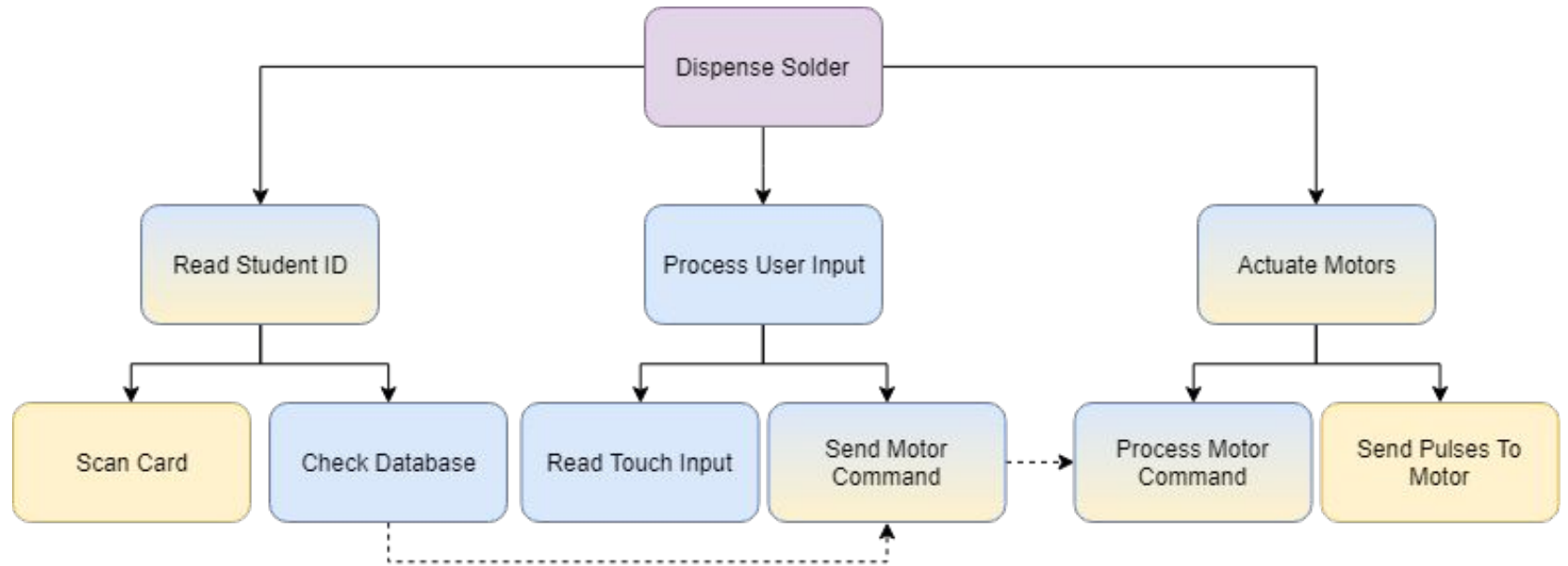
Milestone 5 - Integrate all parts inside box and begin testing - 3/22/2019

Integrated testing was pushed back due to PCBs and extruders being redone

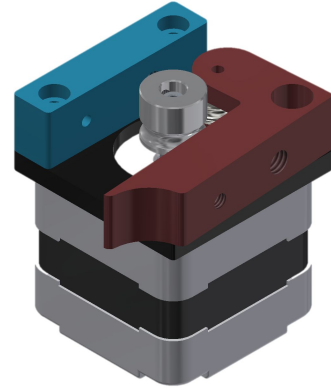
System Design



Functional Decomposition

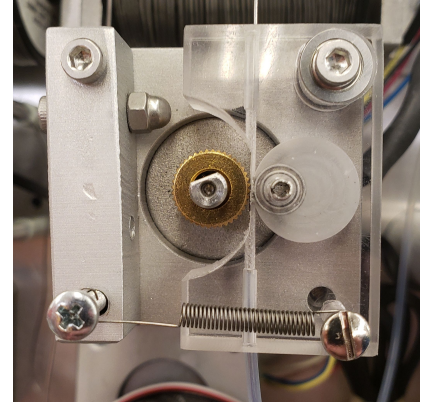
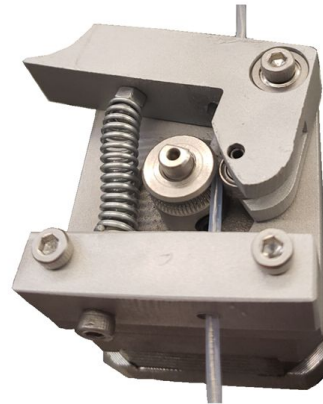


Detailed Design - Mechanical



Extruder

- Provides tension to the solder while feeding it through the system
- Must be reproducible 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
 - **Plastic re-design - CNC Machine by ETG**



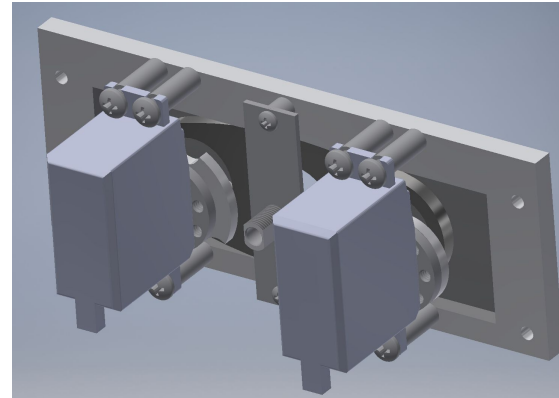
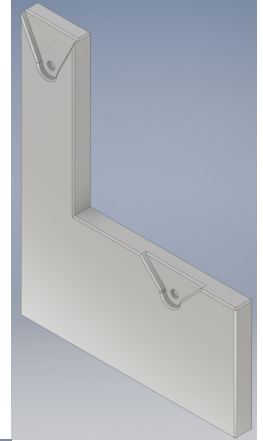
Detailed Design - Mechanical

Spool Mounting

- Gives the spools of solder a place to mount
- Must be serviceable, ETG will have to replace rolls

Cutter

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



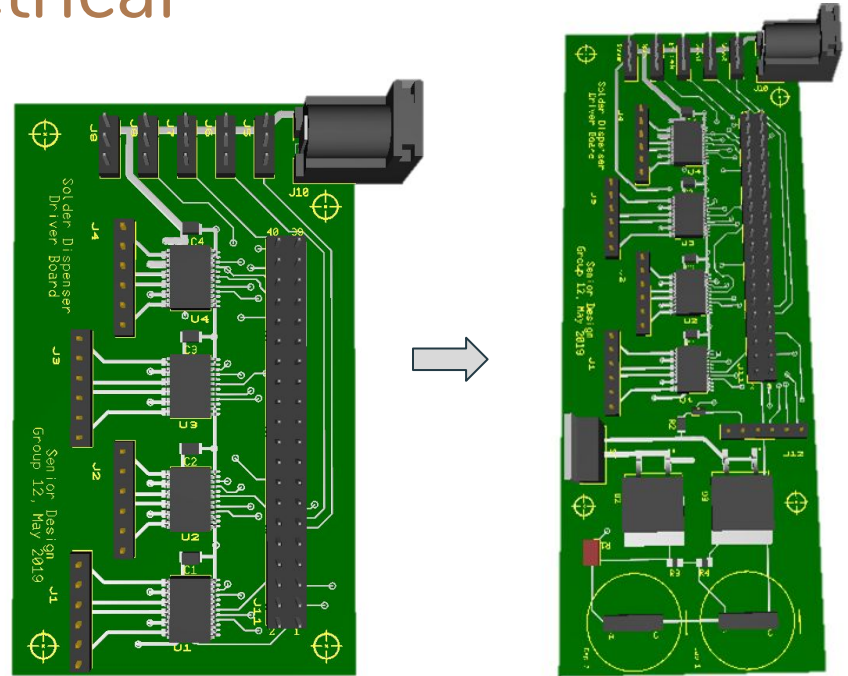
Detailed Design - Electrical

- **Stepper Motor Driver Board**

- Makes the system reproducible
 - Ease of building
 - Neat / compact
- Common connector for motors
- 3 pin headers for servos and sensors
- Supercapacitors for safe shutdown

- **Power Supply**

- 6V, 3.75 Amp “wall wart” power supply



Detailed Design - Software

GUI

- Gives the user selectable options
 - Spool selection
 - Desired length
- Simple to understand
- Usable with a touchscreen interface
- Provides user with information about each spool



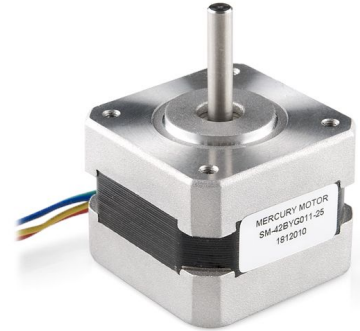
Detailed Design - Software

Access control

- Allows and denies access to users based on time of last access (admin are exempt)
- Power failures are not an issue

Motor control

- Drives selectable stepper motor
- Drives cutter servos
- Releases control of all motors when not in use



Detailed Design - Software

Data storage

- Users IDs
 - Cooldown of 20 minutes prevents over drawing solder
- Admin IDs
 - Stored until cleared
 - New Admin can be added via ID swipe in admin config
- Solder properties are stored to ensure correctness on reboot
 - Flux type
 - Diameter
 - Remaining length

Detailed Design - Software

Hardware monitoring

- Software monitors the device status
 - Power loss
 - Cover open
- Reports either of these error states to ETG via email
 - If power is lost, it safely shuts down to avoid corruption of the SD card

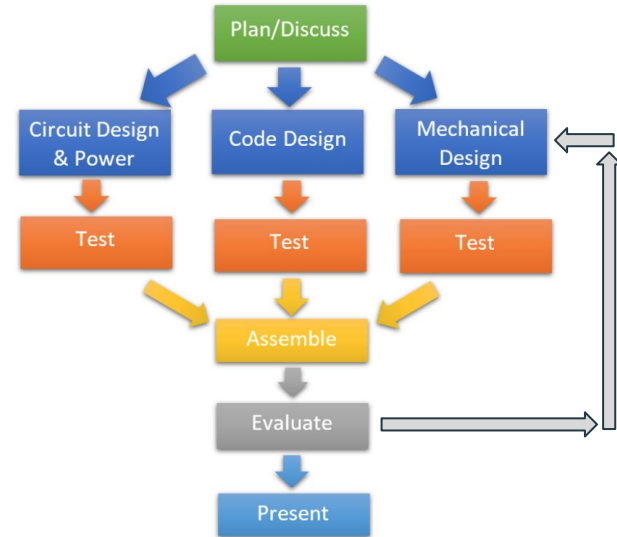
HW/SW/Technology Platform(s) used

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



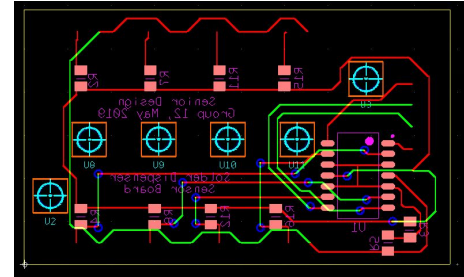
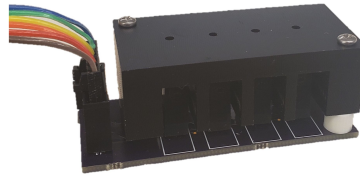
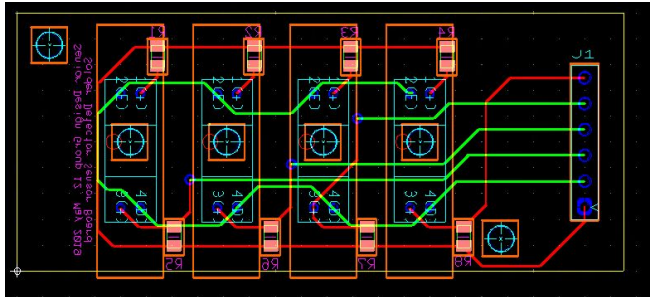
Test Plan

- Each individual component was tested
 - Extruder, cutter, driver board, software
 - Several revisions of driver boards were created
- After integrating the pieces, we tested again
 - Had trouble with the extruder jamming
 - Designed new extruder
 - Tested again



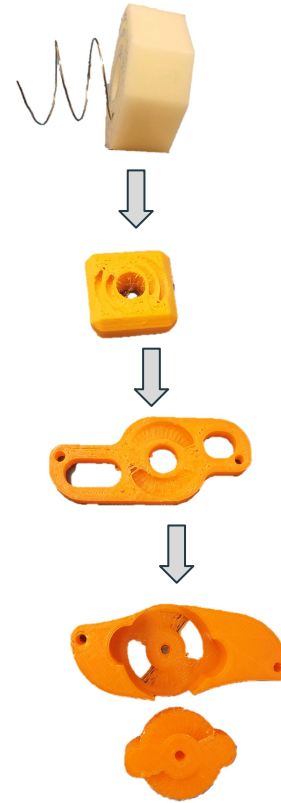
Future Ideas

- Jam-Detection
 - We designed 2 possible jam detectors
 - Opto-interrupter and photoresistors/diodes
 - This sensor board would detect when solder was (or wasn't) present
 - Did not use because sensor failed more often than dispenser
- Priming and Retracting
 - Code exists to handle this, only requires the sensor



Future Ideas

- Coiling Accumulator
 - Removes need for a long tube at the base of device
 - We iterated through several designs
 - Extruder had a hard time pushing solder through coils
 - Idea shelved due to issues with reliability

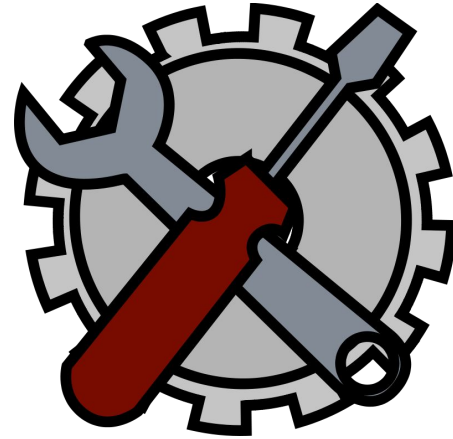


Security Concerns & Solutions

Concern	Solution
Access to all student ID numbers	Periodically purge IDs with time > 20'
Admin access across terms	Added function for an admin to clear other admin from the DB

Administration Access

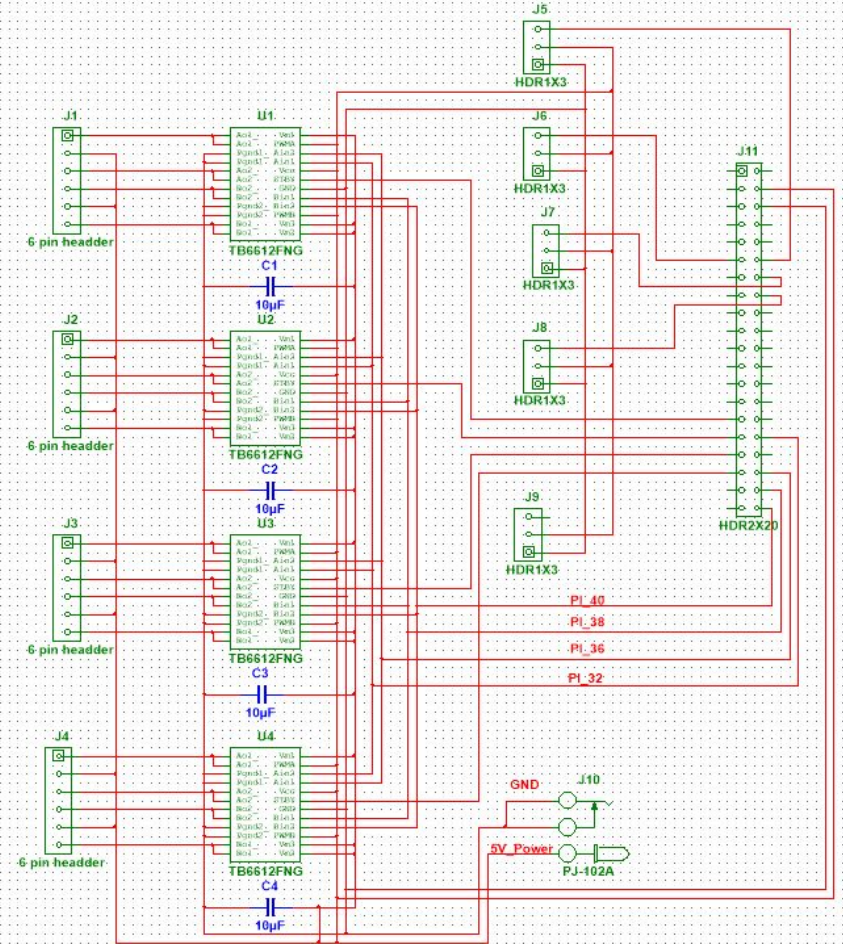
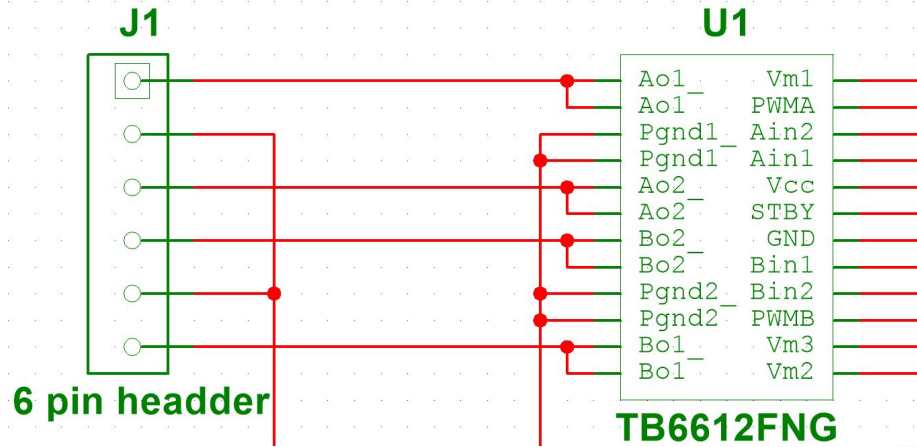
- Normal user access, no timeout
- Access to configure spool configurations
 - Diameter
 - Flux type
- Maintenance options
 - Clear user Database
 - Clear Admin Database
 - Load a new roll
- Email settings
 - Sender email and password
 - Target email



Power Use

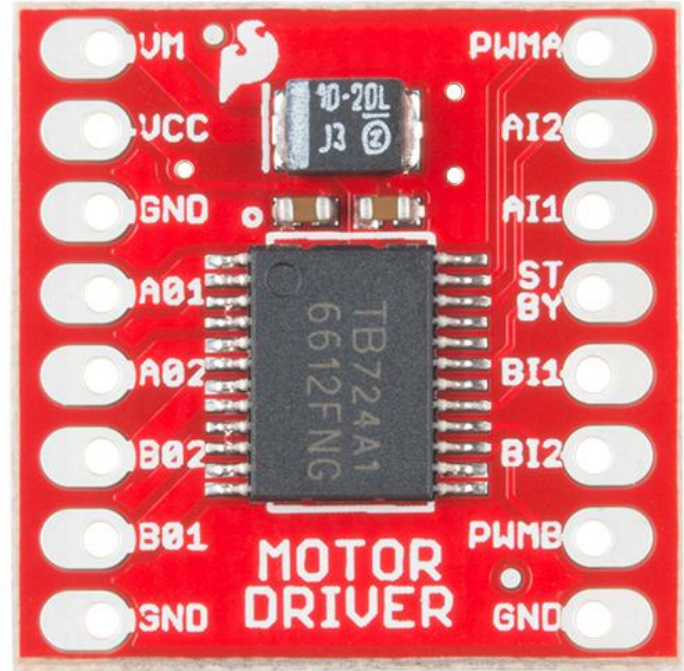
Component	Active Draw	Passive Draw
Raspberry Pi	550 mA	550 mA
Screen	500 mA	40 mA
Stepper Motor	14 mA	0
Servo Motor	800 mA	20 mA
Drivers	1 mA	0
TOTAL	1950 mA	610 mA

Driver Board



Stepper Drivers

- TB6612FNG
 - Dual channel DC motor driver
 - Standby



Spool Bracket

