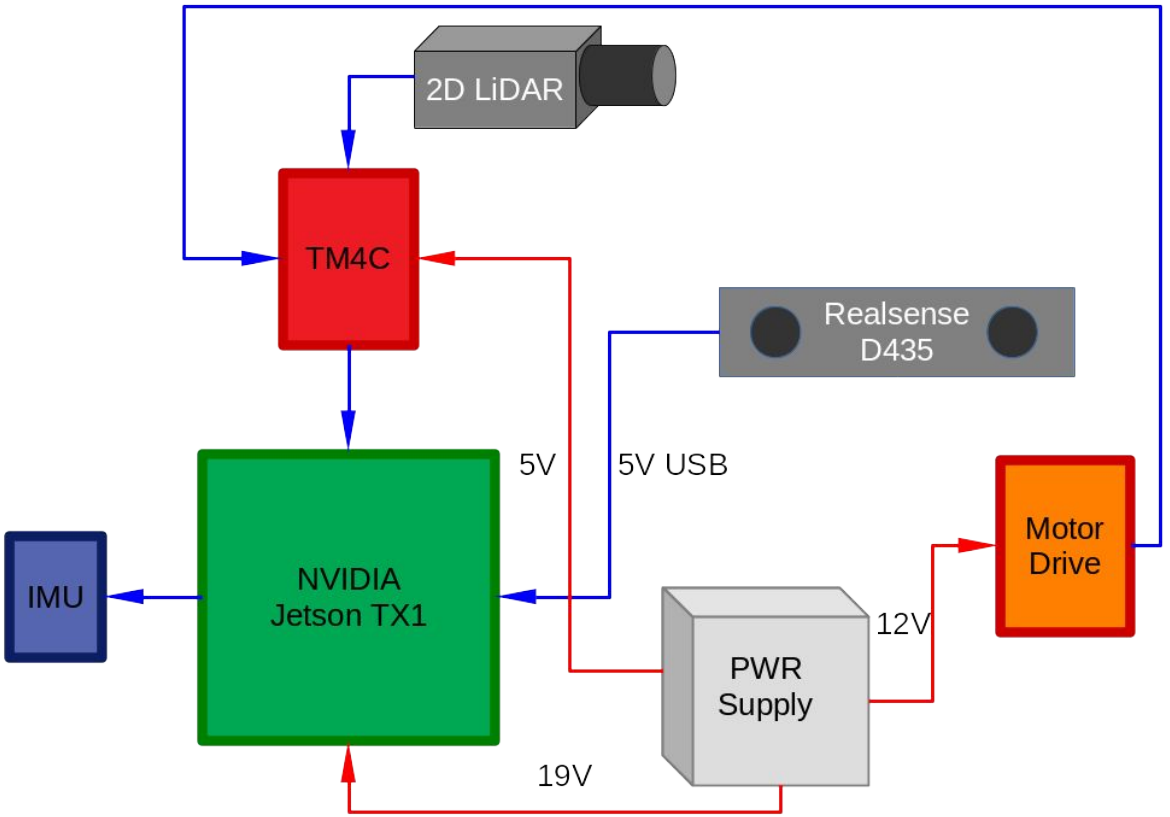
PDR Week 5

3D ROMAP

R Dominick, L Gogley, M Munoz, D Tran

Top Level Block Diagram



Systems Engineering

Requirements

- **The design shall map unknown coordinates through exploration on passable terrain.**
  - Location of choice should not dictate mapping method, i.e. a room vs a field.
- **The design's structural capture shall be capable of producing a visual map.**
  - The scans must produce an image with the desired map.
- **The design shall be capable of 2D SLAM.**
  - SLAM shall be used to handle 2D coordinate recognition, and assist in 3D sampling.
- **The design shall be capable of 3D capture.**
  - 3D capture can be pulled from samples or from real-time/soft real-time capture.
- **The design shall be powered from an independent power supply.**
  - This power source shall provide enough power to explore, at minimum, 20 minutes of capture.

Limitations

- **The design is not confined to low light, visible image capture.**
  - High resolution 3D structural capture is used to compensate for loss of visuals under low light.
- **The design is not confined to autonomous navigation, simply the capability of such.**
  - The design will be capable of mapping and localization, but the platform may not drive autonomously as functionality of mapping is the first priority.
- **The design is not confined to real-time 3D mapping, due to limitations of price and available algorithms.**
  - Real-time 3D is sometimes limited to ability of hardware readout, and may be an unrealistic endeavor. 3D may instead be done from sampling.
- **The design is not interested in object recognition.**
  - Point clouds will be used to simply display raw data, and points on a 2D plane will only be used to determine the explored area.

SLAM

- 2D Tracking
  - Captures 2D representation for birds-eye view
  - Allows for positional data of visual tracked
  - Keeps track of previously explored territory
- 3D Tracking
  - Recognizes elevation difference in tracked territory
  - Allows for tracking regardless of incline/decline

Positional Data

MPU-9250 - 9DoF IMU

- Accelerometer
  - 3 DoF x,y,z
- Gyro
  - 3 DoF roll, yaw, and pitch
- Magnetometer
  - 3 DoF magnetic field detector

Software Engineering

Realsense Software

- Realsense SDK
  - Open-sourced, cross platform
  - Used for point cloud registration and image overlay
  - Official support for robotics use

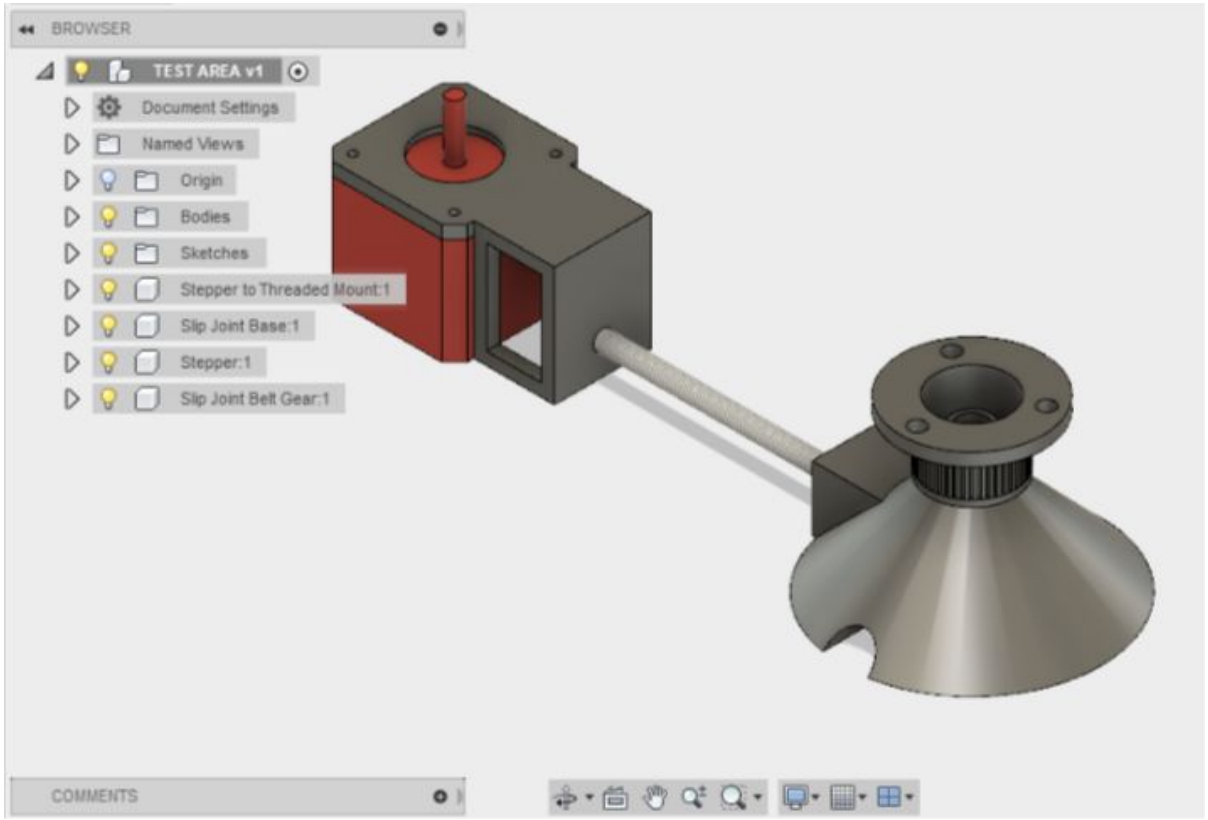
3D Rendering

- OpenGL
  - Open-source license
  - Graphics rendering framework
  - Permits 3D rendering and image overlay
- PCL
  - Permissive open-source BSD license
  - Permits structural capture and representation

Mechanical Engineering

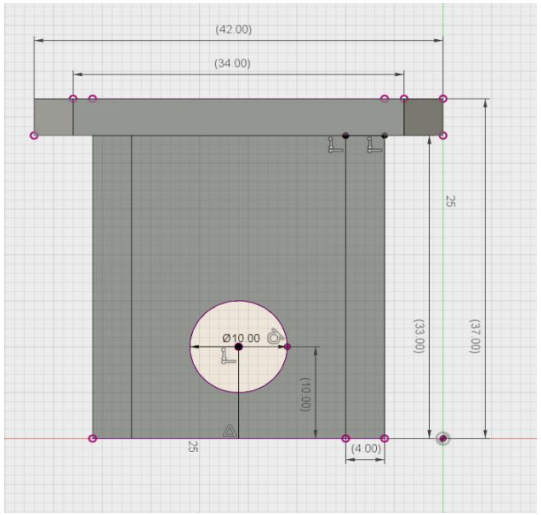
Top Level Motor Assembly

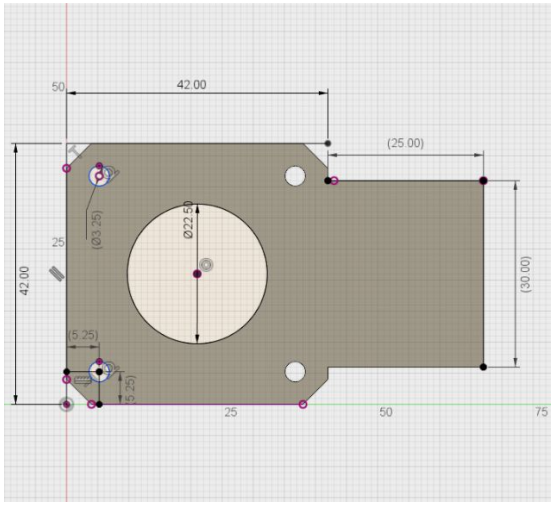
2D capture bay assembly, driven by stepper.

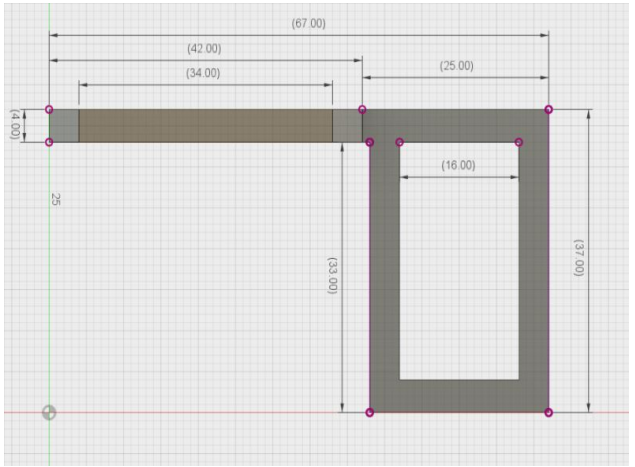


Motor Mount Assembly

Motor drive support assembly

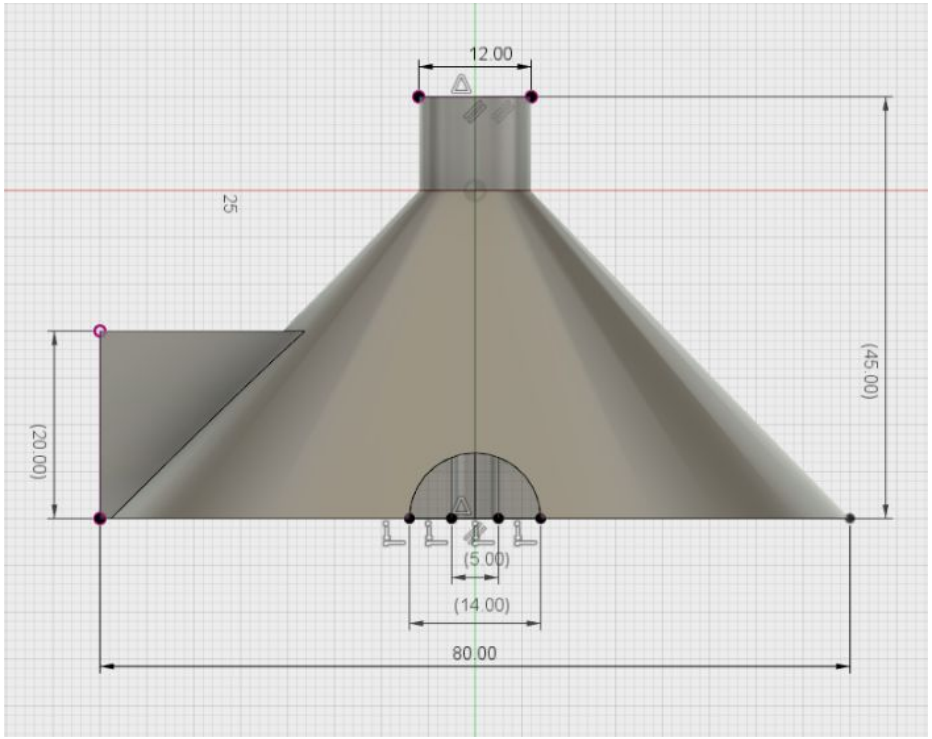


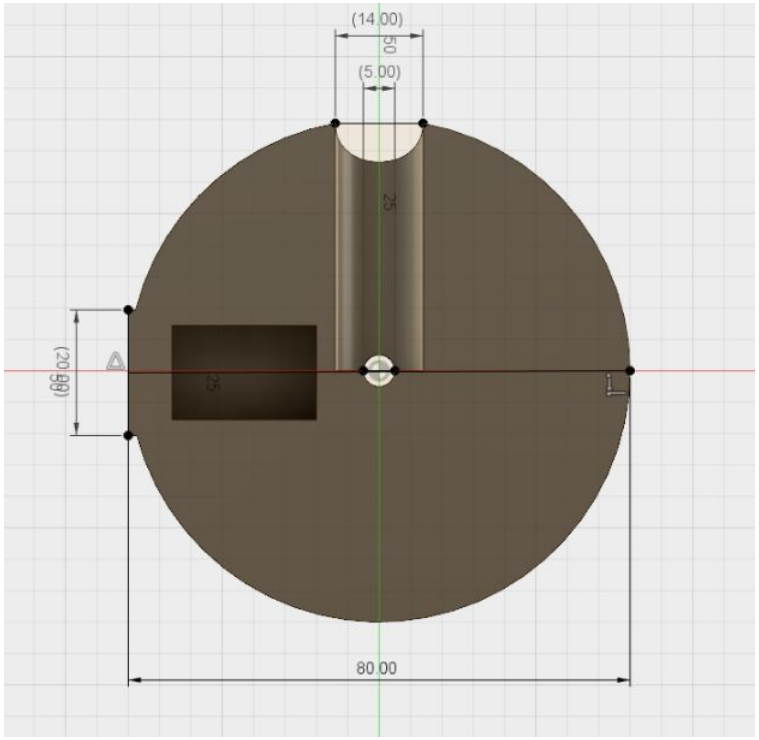




Motor Platter Assembly

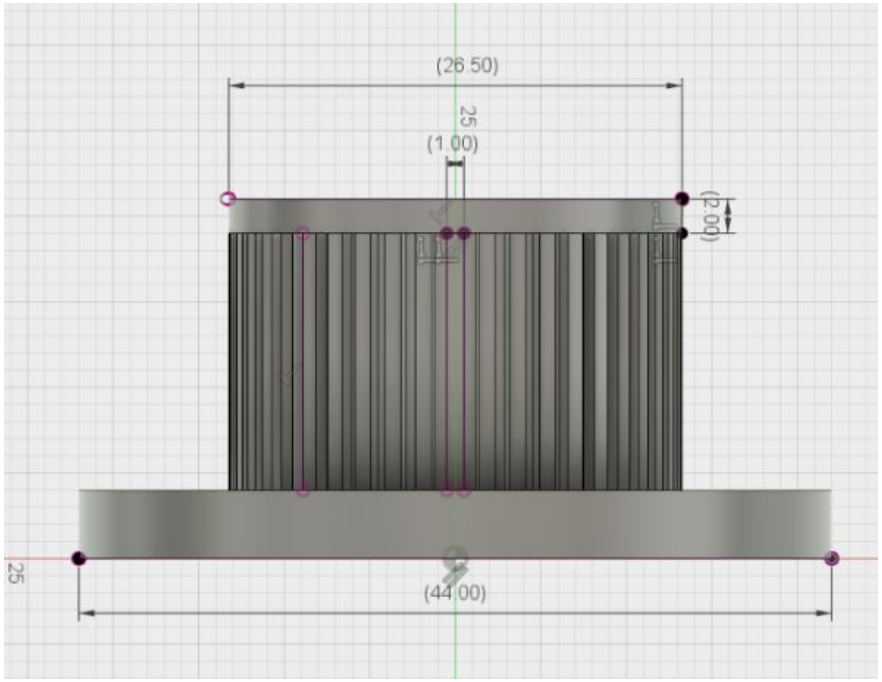
Platter support assembly

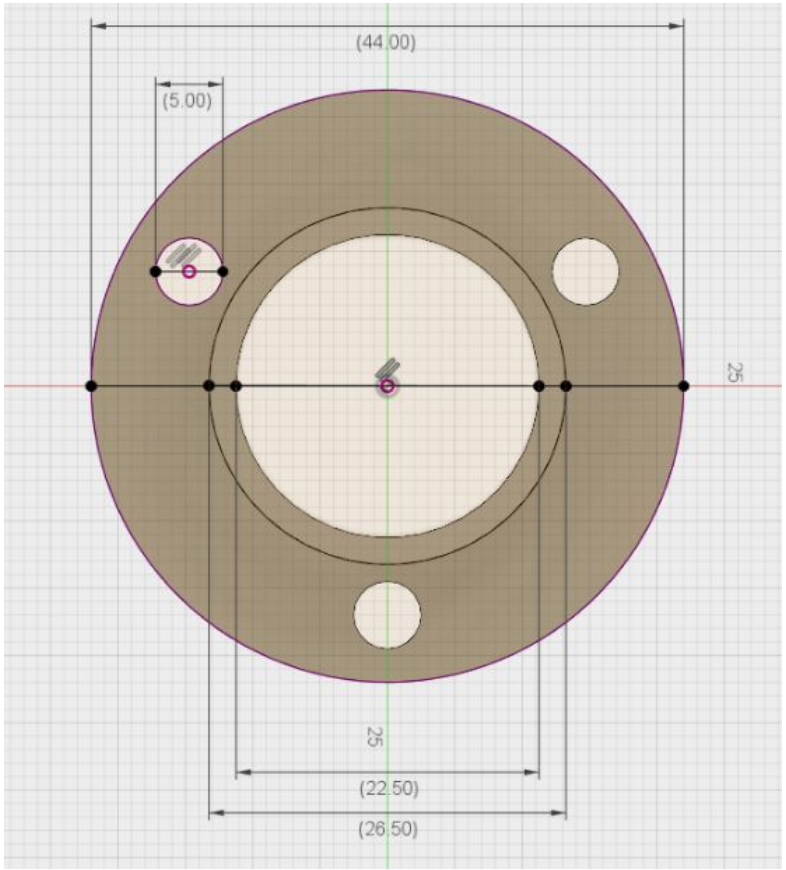




Platter Belt Ring Assembly

Gear Belt Platter Attachment

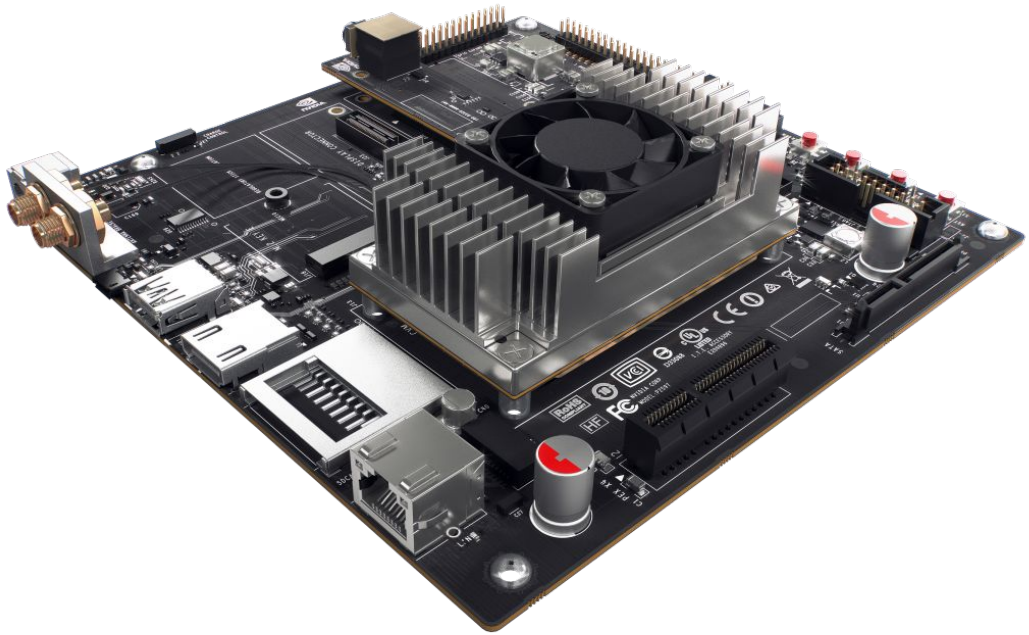




Electrical Engineering

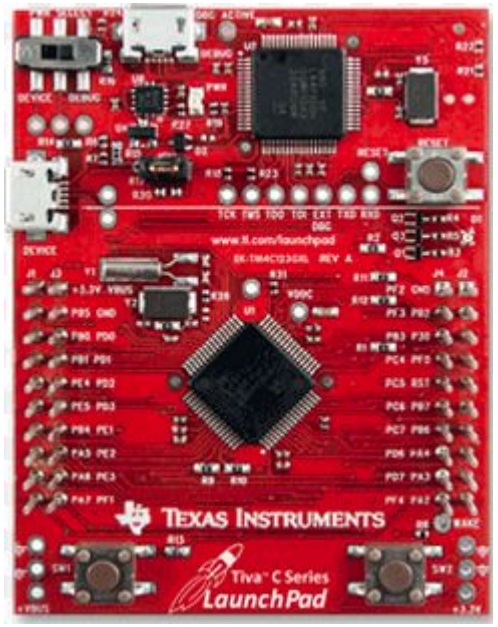
Processing Board

- NVIDIA Jetson TX1
  - 64 bit ARM A57
  - 256 CUDA core GPU
  - 4GB RAM
  - 15W power draw



Microcontroller

- **TI Tiva C Launchpad**
  - TM4C123GH6PM MCU:
    - 80MHz 32-bit ARM Cortex M4
    - 256KB Flash, 32KB SRAM, 2KB EEPROM
    - Two Controller Area Network (CAN) modules
    - USB 2.0 Host/Device/OTG + PHY
    - Dual 12-bit 2MSPS ADCs, motion control PWMs
    - 8 UART, 6 I2C, 4 SPI
  - On-board In-Circuit Debug Interface (ICDI)
  - USB Micro-B plug to USB-A plug cable



3D Capture

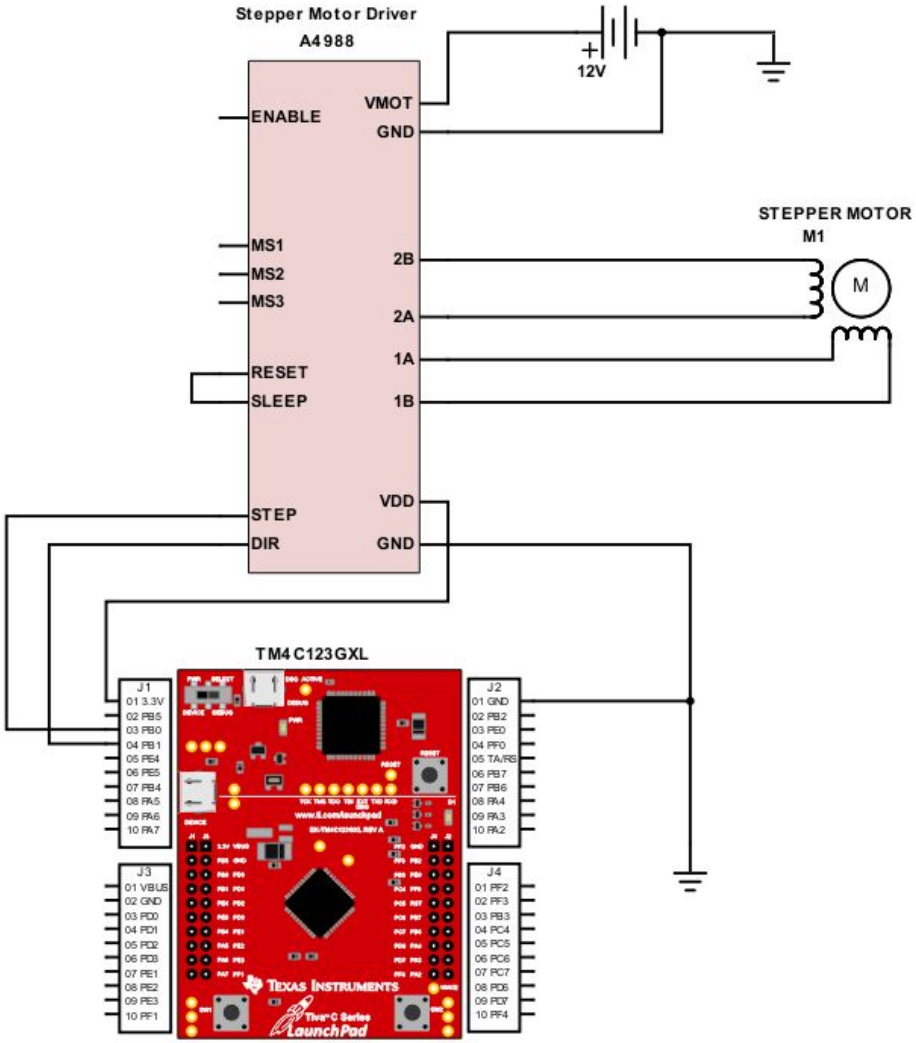
- Intel Realsense D435
  - Allows for image overlay, with point cloud for depth
  - Structured light active IR stereo vision.
  - RGB Camera: 1920x1080
  - Depth: 1280x720 @ 90 FPS
  - Range: 0.1m to 10m
  - RGB camera FOV: 69.4° x 42.5° x 77°
  - IR FOV: 85.2° x 58°
  - Indoor/Outdoor

2D Capture

- PulsedLight LiDAR Lite v1
  - 100Hz sample rate
  - I2C or PWM connection
  - Distance range of 40m
  - Accurate to +/-2.5cm
  - Max current 130mA

Motor Control Circuit

A4988 Driver to TM4C



Power Supply

Devices with corresponding voltage, and current draw in amps.

DEVICE (Amps)	5v	12v	19v
TM4C	0.50		
Jetson TX1			0.80
Realsense (TX1 USB)	0.70		
Stepper Motor		0.40	
LiDAR Lite	0.02		

Power Supply

Voltage supplies, current draw in amps, and total power in watts.

VOLTAGE	CURRENT	PWR 26.1
5	1.22	6.1
12	0.40	4.8
19	0.80	15.2