## Team Toucan

Critical Design Report

## The following outlines the technical design of the robot cognition platform. The critical design report includes information in regard to the connection of the sensor to the Jetson Nano, the power components included, and information on the platform itself.

## Sensors

The sensors for the platform will all be connected to the Jetson Nano which will handle the processing required for the platform. The sensors are connected to the nano in accordance with Table 1 below.

|  |  |  |  |
| --- | --- | --- | --- |
| **Point A** | **Point B** | **# of Connections** | **Connector** |
| Jetson Nano | LIDAR | 1 | Ethernet |
| Jetson Nano | LEA-M8T (GPS) | 3 | UART |
| Jetson Nano | Xsens MTI-10-2A8G4 (IMU) | 1 | USB |
| Jetson Nano | e-CAM24\_CUNX  (Camera) | 1 | MIPI CSI-2 |
| LEA-M8T | Antenna | 1 | SMB to TNC Coax |
|  |  |  |  |

*Table 1 – Sensor Connections*

### IMU

The inertial measurement unit will be connected to the Jetson Nano via USB and powered by the Jetson Nano. The IMU will be placed on the middle level of the platform.

### LIDAR

The LiDAR will be connected to the Jetson Nano via ethernet and will be powered by one of the extra power connections that outputs 12 volts at 5 amps. The LiDAR will sit at the top of the platform to ensure that there is no obstruction to the 360-degree field of view.

### Camera

The camera was connected to the Jetson Nano via MIPI CSI-2. The camera was placed on the middle level of the platform and faced towards the front of the platform in order to get a view of what was in front.

### GPS

The GPS was connected to the Jetson Nano via UART (Universal Asynchronous Reciever-Transmitter). The GPS was placed on the side of the platform.

## Power Components

The power components for this project require high amperages to work as intended. The LiDAR requires 12V at 3A, The Nano requires 5V at 2A, and the extra ports require various high amperages of 3, 5, and 10A. The GPS and IMU are powered from the Jetson Nano and their power requirement is included in that amount. To meet these requirements with a 16V-36V LiPo battery source, DC/DC converters are used to convert the power to each of the sensors and ports. These DC/DC converters also require additional external components to meet Class B requirements for EN55032 emissions guidelines to be used in residential areas. The Circuit Schematic for this power design can be seen in Figure 2 below. Additional information on the external components used can be found in the appendix.

Diagram, schematic

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*Figure 2 – Circuit Design for Platform Power*

The DC/DC converters used in this design are as follows:

* CP40\_1233036 - provides 12V at 3A
* CP40\_1790018 – provides 3V at 5A
* CP40\_1180018 – provides 5V at 8A
* RSDW60G-12 – provides 12V at 5A
* PQQE50-0240550D – Provides 5V at 10A

The external components need to be placed on PCBs designed to account for the large amperages used by the system. In the scope of this project, the PCBs are designed to meet the standard of the OSH Park PCB manufacturer in Oregon. A 3d rendering of the PCB design can be seen in the figure below.

Diagram

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*Figure 3 – PCB 3d Rendering*

The Connections for the platform are summarized in the Table below. Table 2 summarizes how the power connections are implemented to provide power to the individual components. Most of the connections are soldered wire with a few being wire pin terminals.

|  |  |  |  |
| --- | --- | --- | --- |
| **Point A** | **Point B** | **# of Connection** | **Connector** |
| Battery | Wire A (6 AWG) | 2 | EC5 |
| Wire A | CP40B Externals | 6 | Soldered 14 AWG Wire |
| Wire A | PQAE50 Externals | 2 | Soldered 14 AWG Wire |
| Wire A | RSDW60G Externals | 2 | Soldered 14 AWG Wire |
| CP40B Externals | CP40B DC/DC | 6 | Wire Pin Terminal |
| PQAE50 Externals | PQAE50 DC/DC | 4 | Wire Pin Terminal |
| RSDW60G Externals | RSDW60G DC/DC | 4 | Wire Pin Terminal |
| CP40B DC/DC (5V) | Jetson Nano | 2 | Wire Pin Terminal |
| CP40B DC/DC (12V) | LIDAR | 2 | Soldered 14 AWG Wire |
| CP40B DC/DC (3.3V) | Port A | 2 | Female to Male Pin Connector |
| PQAE50 DC/DC (5V) | Port B | 2 | Female to Male Pin Connector |
| RSDW60G DC/DC (12V) | Port C | 2 | Female to Male Pin Connector |

*Table 2 – Platform Power Connections*

## Platform

The finalized platform has been changed from being 3D printed to being comprised of multiple carbon fiber pieces. The levels of the platform are now 300 by 300 mm thin sheets of carbon fiber. The supporting legs are carbon fiber and will be held together with screws. The completed platform with all the sensors attached is depicted below.

A picture containing indoor

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*Figure 4 - Finalized Platform*