

# Machine Vision on a Rover.

Ardupilot GSoC 2018

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## Personal Information:

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## Introduction:

Ardupilot has proved that it is one of the best open source firmware for UAVs. It exceeds being a firmware for drones and now we can see that Ardupilot supports Rovers and Underwater vehicles. The features that Ardupilot provides are many. You rarely need to implement anything by yourself. In the previous year, and while working with the Arducopter, I was amazed about the numerous features such as optical flow and rangefinder support. Last September, I participated in Interdrone exhibition with OttoFly project, on which I spent several months working. In multiple occasions during the exhibition, I noticed one member of the Ardupilot team was playing with the amazing Rover and manoeuvring it through the booths. I asked him once if it is smart and can do SLAM (Simultaneous Localization and Mapping) but he said not yet. In my opinion, if we apply some smart computer vision algorithms on that Rover, it would be much more exciting especially when we can use some efficient hardware for processing like Nvidia Jetson TX1/2 as a companion board and a depth Cameras. There are many suggested features to be added to Ardupuilot starting from collision avoidance, follow a specific path ... and ending with SLAM algorithms for indoor navigation. I prefer to work with Rover because it is easier for testing in my place.

## Tasks:

- *Task 1:* Assembling and preparing hardware.
- *Task 2:* Preparing needed software such as Tensorflow, Keras, OpenCV and PCL, and document all the steps.
- *Task 3:* Example of following coloured line with collision avoidance.

- *Task 4:* Example of following specific preloaded path with collision avoidance.
- *Task 5:* Training SSD neural network for Traffic Signs and test it.
- *Task 6:* Applying algorithm for Lane detection.

## **Timeline May 14 - August 6:**

### **May 14th - May 27th - Task 1-2:**

- Project planning meeting with project mentor.
- Preparing the hardware.
- Preparing the needed software and libraries.
- Writing draft document for all the steps.
- Reading APMrover2 and needed libraries modules.
- Posting on Ardupilot discussion forum the result and progress.

### **May 28th - June 1st - Task 2:**

- Sending and receiving Mavlink messages using serial port in C++.
- Implementing all needed mavlink messages.

### **June 2nd - June 18th - Task 3-4:**

- Applying following coloured line.
- Discussing with the mentor the best scenario for collision avoidance and applying it.
- Applying following specific preloaded path with collision avoidance.
- Doing physical test and capturing demo video.
- Posting the result on Ardupilot discussion forum.

### **June 19th - July 3rd - Task 5:**

- Preparing Traffic Signs dataset for SSD neural network.
- Training the network.
- Doing simulation test using computer + camera and report the accuracy.
- Checking other neural network options.

- Doing physical test and capturing demo video.

### July 4th - July 25th- Task 6:

- Applying algorithm for Lane detection.
- Using the trained network from previous phase for traffic lane detection.
- Doing physical test and capture demo video.

### July 26th - August 4th:

- Finishing delayed work.
- Cleaning the code and pull request to Ardupilot repo.
- Finishing the documentation and submitting it.

## Hardware Requirements:

- Rover vehicle (RTF) works with pixhawk and has GPS and battery.
- Companion board like Nvidia Jetson TX1/2.
- Carrier board for Nvidia Jetson TX1/2.
- [Antenna](#) and [battery](#) for Jetson TX2.
- Depth camera like [ZED](#) camera.

## About Me:

I am a graduate research assistant at University of Oklahoma and pursuing a master degree in Electrical and Computer Engineering. Last year, I worked at Optecks lab on [OttoFly](#) project to build smart SDK for building autonomous drone softwares. I gained a lot of experience during working on that project especially in some awesome libraries, like OpenCV and PCL (Point Cloud Library). We also applied image processing algorithms for obstacle avoidance. All my work with ArduCopter module.

Moreover, I have experience in web and mobile development, image processing, and machine and deep learning. I am really excited to work on the project and planning to work on it even after Summer and maybe apply some interesting things as a thesis topic for the master degree I am pursuing. I am a hard working person especially on such a

cool project and with prestigious mentors although this is my first time to work with Rovers. In case I finished before deadlines, I am planning to work on applying SLAM for indoor navigation.

Here are some related works:

- [OttoFly](#)
- [Controlling Computer Using Handwriting Gestures.](#)