



Autonomously Following Forest Paths with a Mobile Robot using Semantic Segmentation

Pieter Fiers r0708591

Simon Germeau r0708896

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- Droneport Sint-Truiden
- Drone Surveying (agriculture, insurance, construction...)
- Rover kit, motoren, batterijen



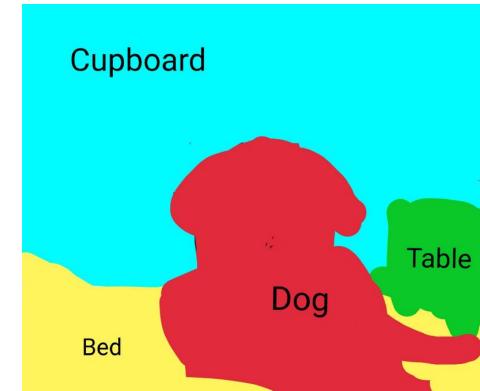
Model

Prior art

- **Giusti et al.**
A Machine Learning Approach to Visual Perception of Forest Trails for Mobile Robots
- **Smolyanskiy et al.**
Toward Low-Flying Autonomous MAV Trail Navigation using Deep Neural Networks for Environmental Awareness

Semantic segmentation

- Is a pixel road or not?
- Mask



Garima Nishad

Datasets

- Freiburg (Deepscene)
- Giusti (Switzerland)
- Steentjes

Freiburg (DeepScene)



deepscene.cs.uni-freiburg.de

Giusti



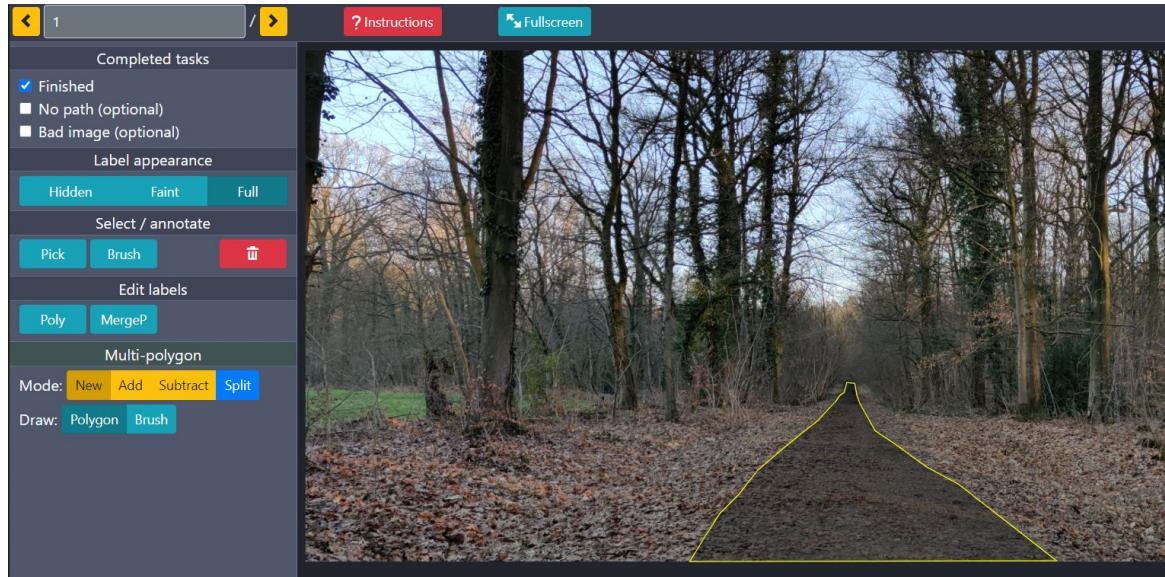
people.idsia.ch/~giusti/forest/web/

Stentjes



Stentjesbos Kampenhout

Labeling tool

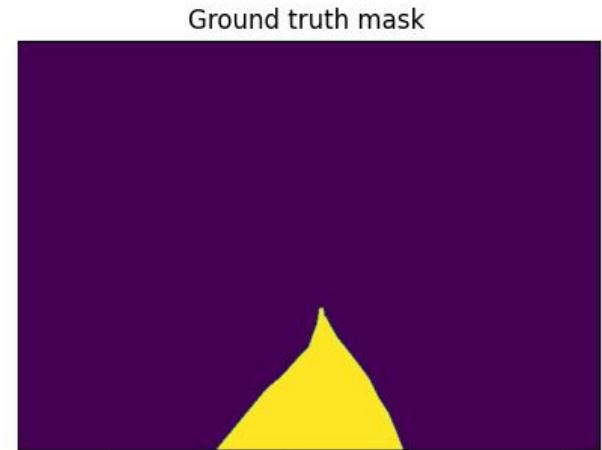


drone-label.pfiers.net

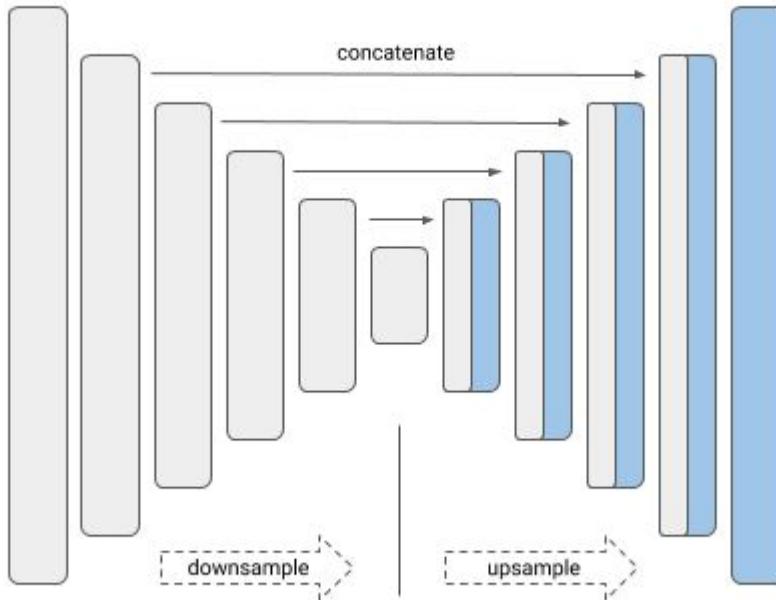
- Crowd sourced data
- Json to mask

Augmentations

- Not enough data
- Randomizer
- Hue, flip, crop....



Model

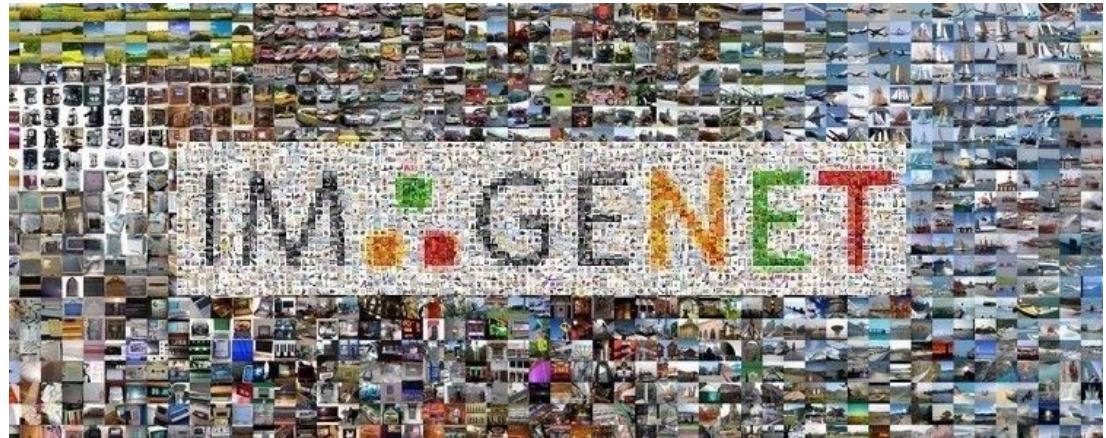


Segmentation models

- Unet
- EfficientNetB3
- Tensorflow (Keras)

Transfer learning

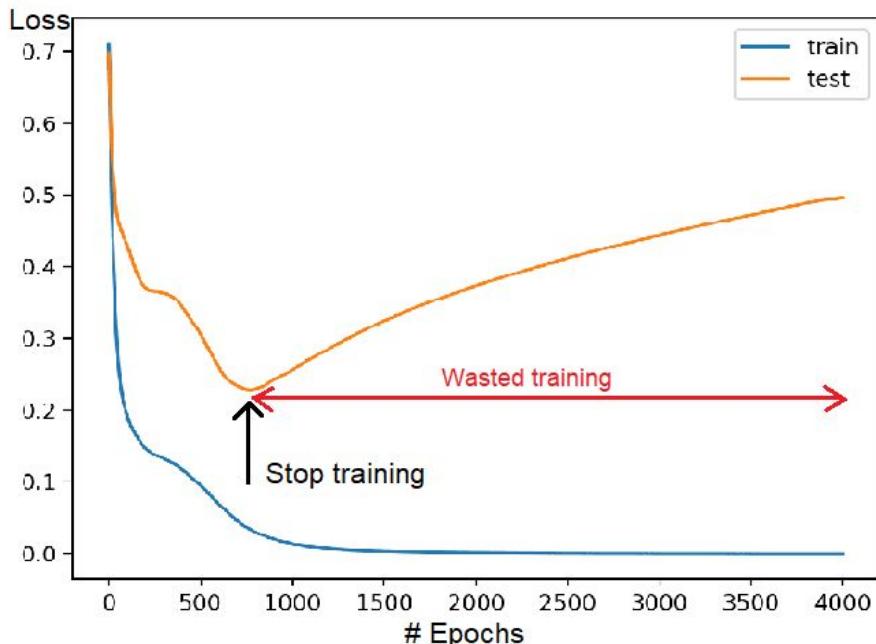
- Headstart
- 2012 ILSVRC ImageNet



Imagenet

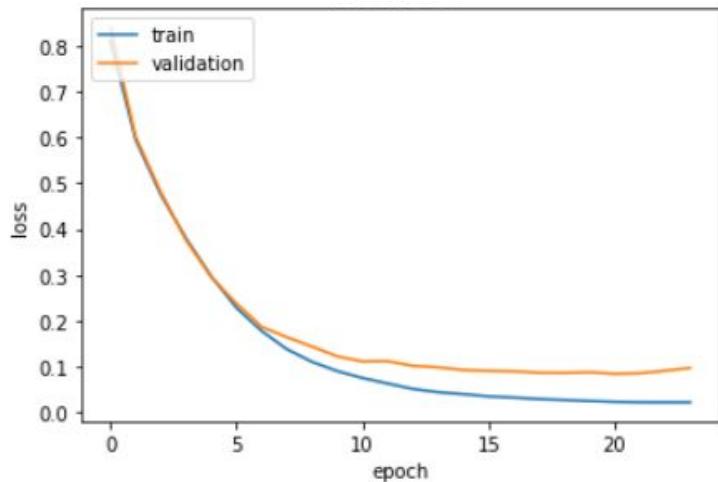
Training

- 70% Training
15% Validation
15% Test
- Batch size = 16
- Early stopping
- Loss = Dice + Binary focal

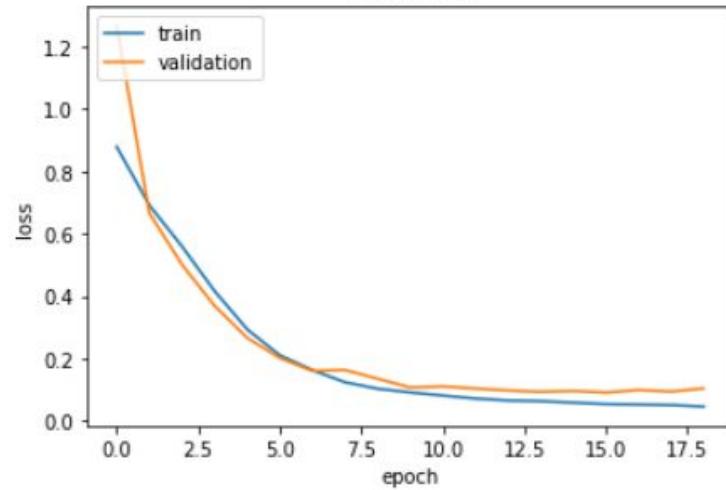


Freiburg

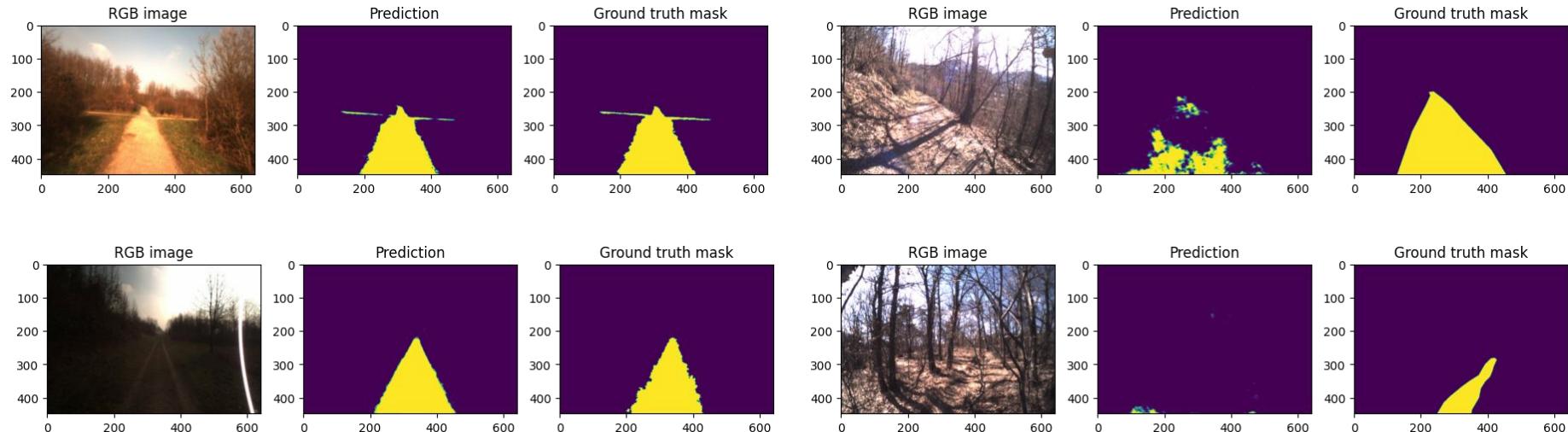
No aug



Aug

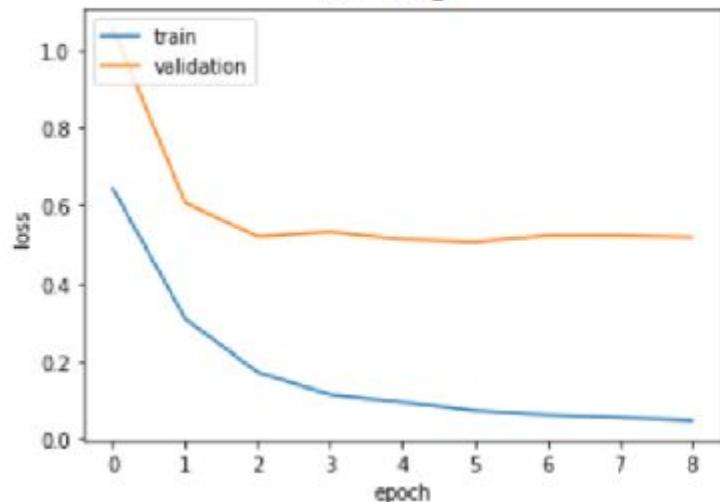


Freiburg results

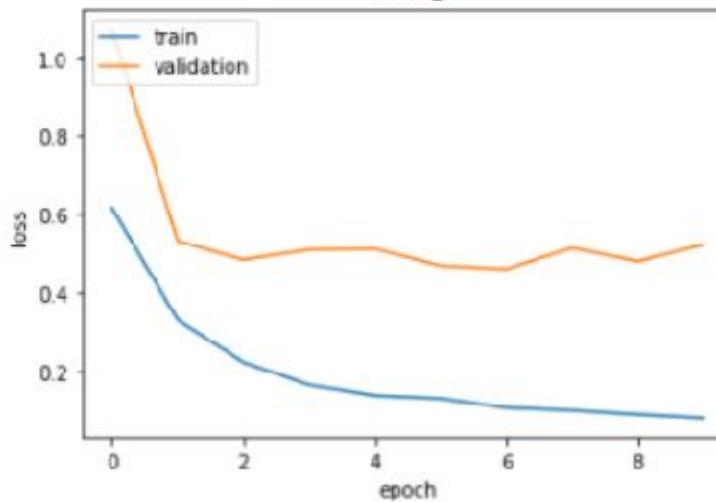


Giusti

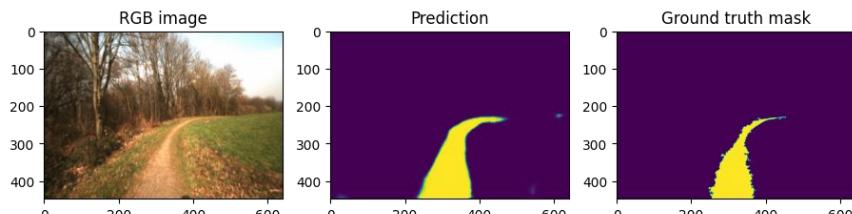
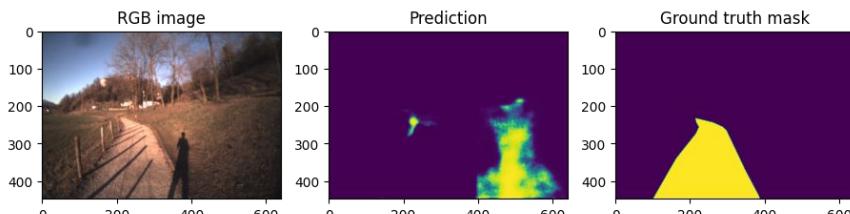
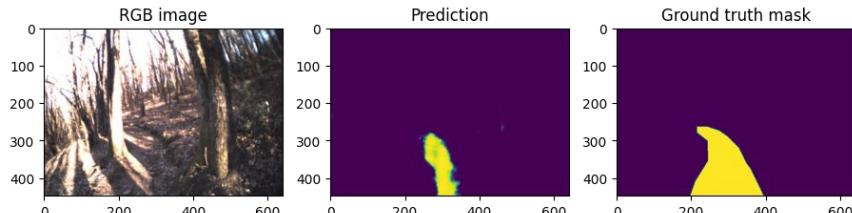
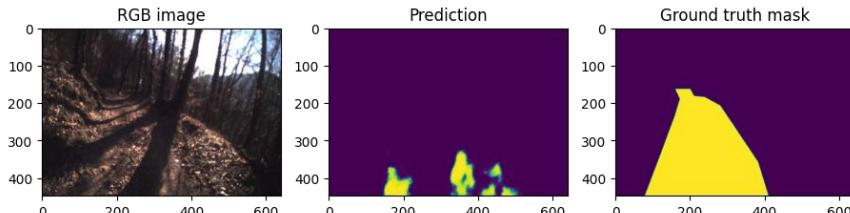
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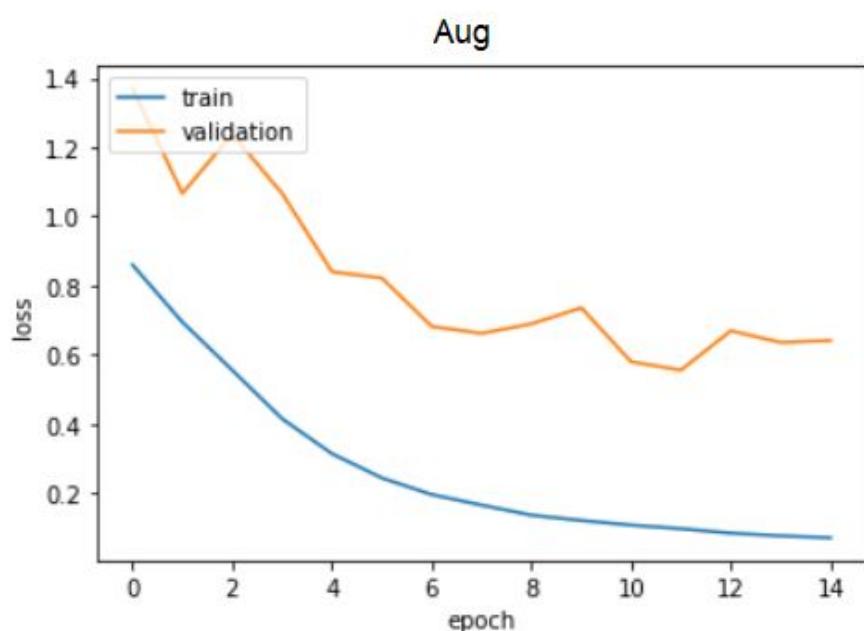
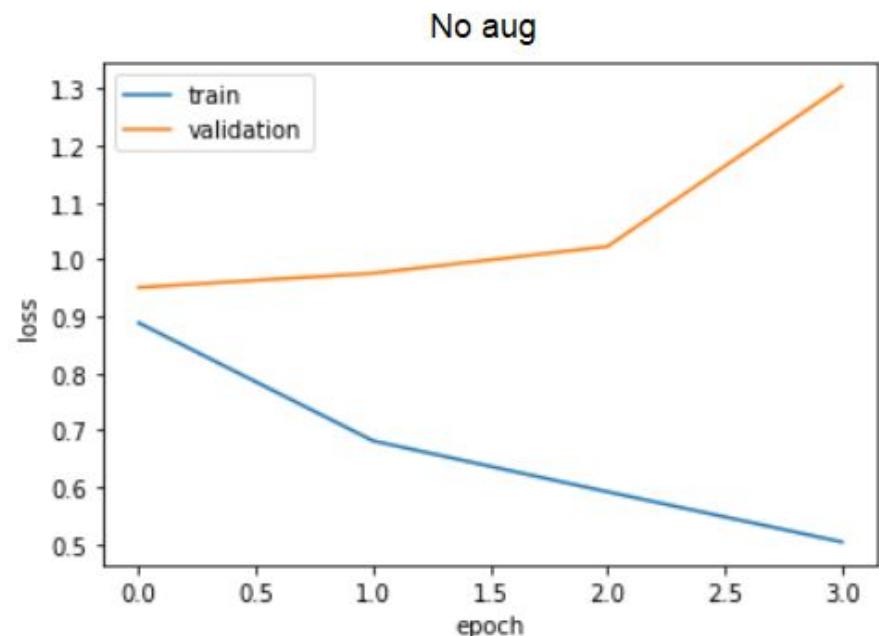
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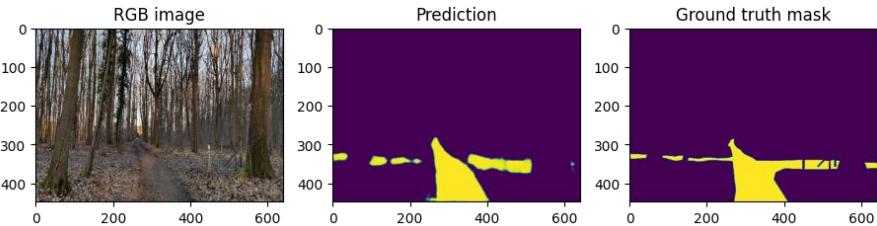
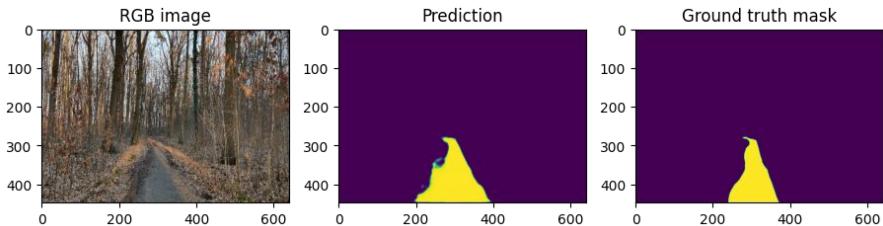
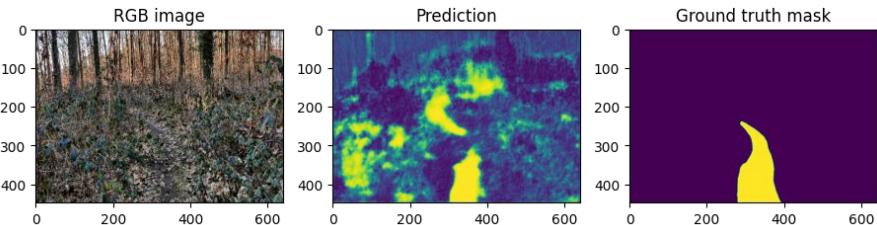
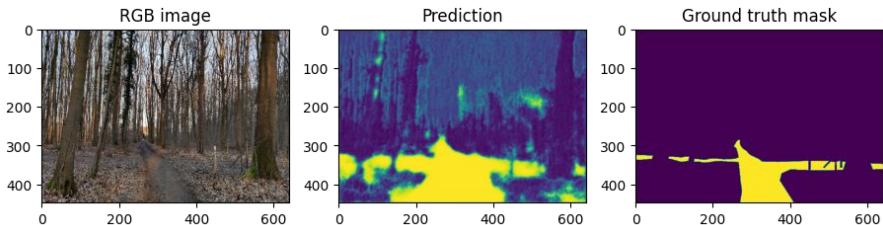
Giusti results



Steentjes

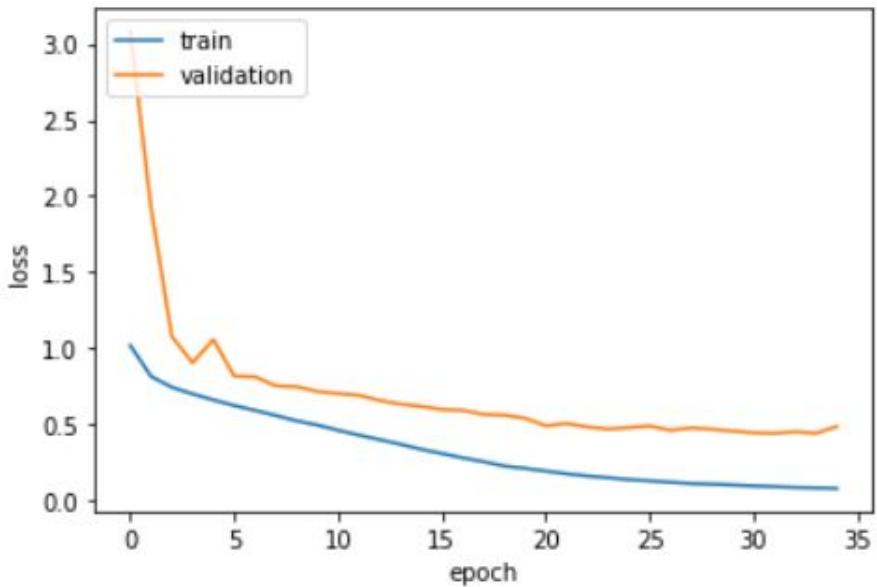


Steentjes results

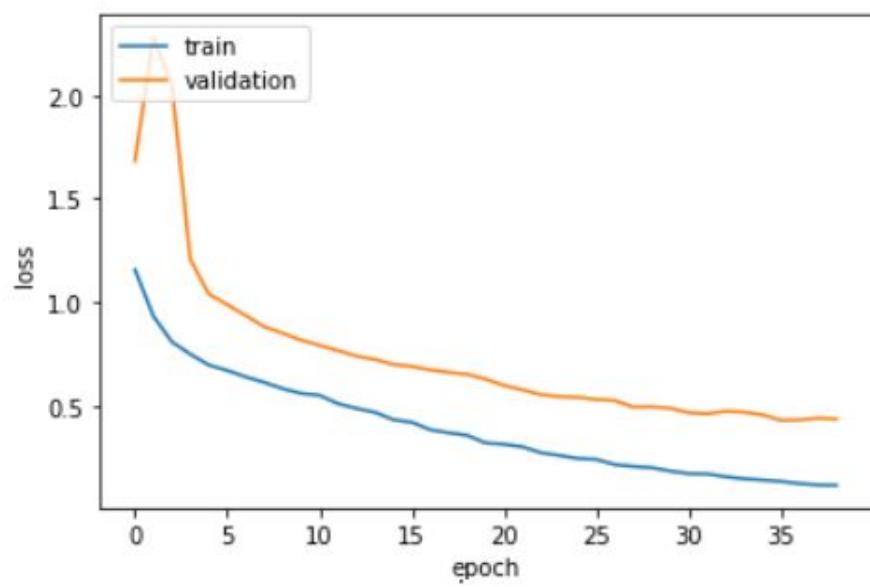


Freiburg + Giusti + Steentjes

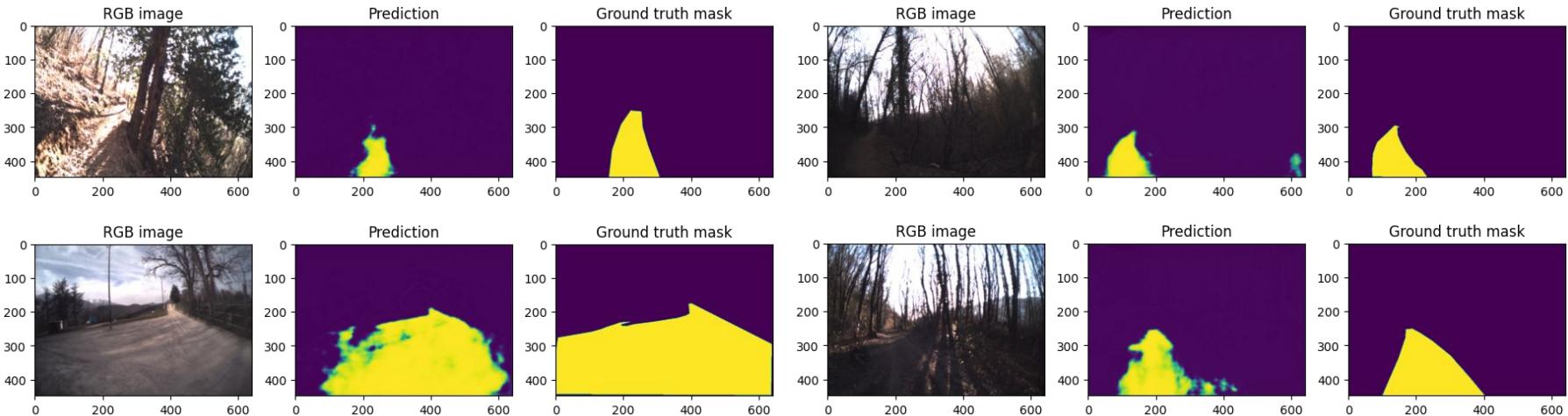
batch size 16



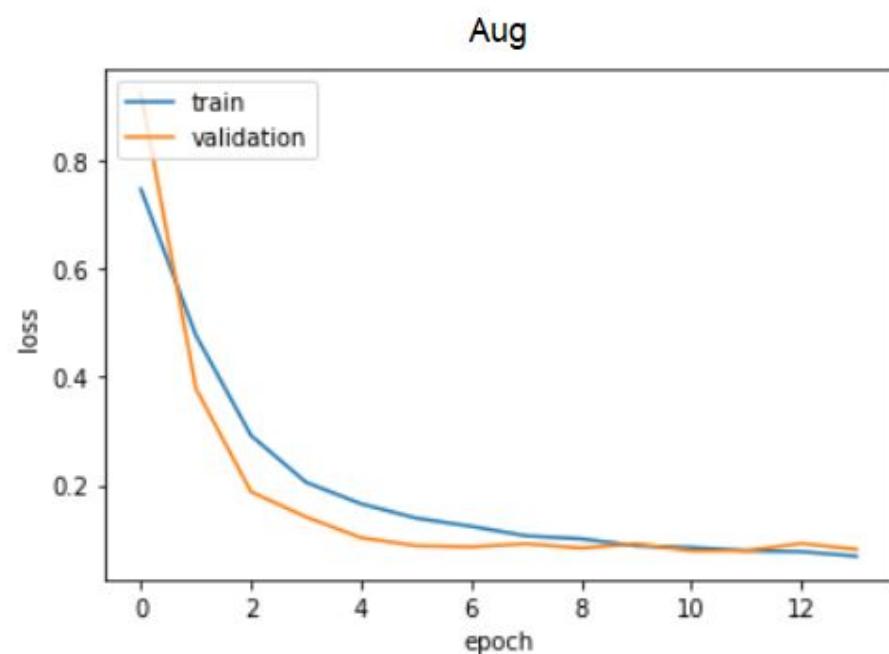
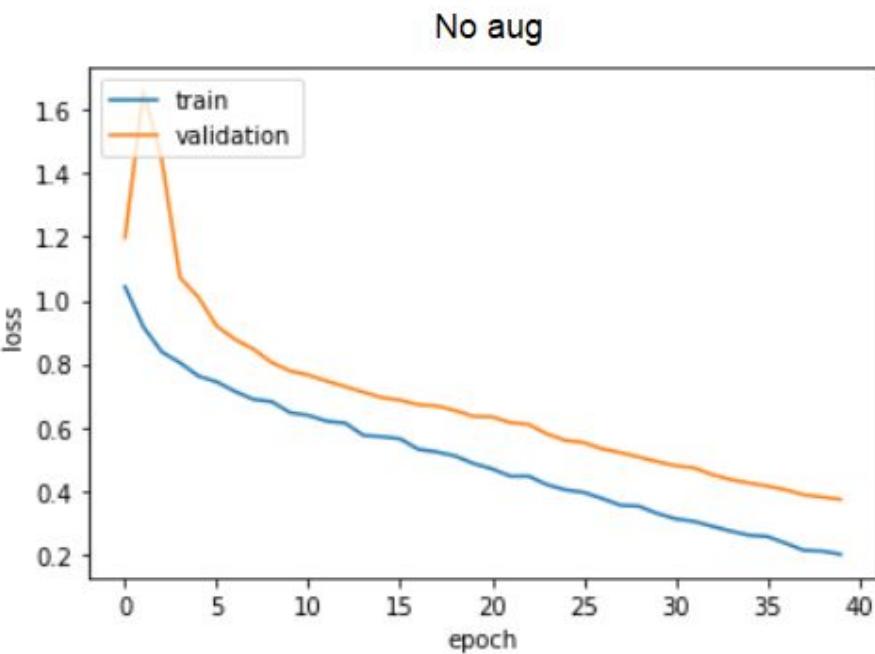
batch size 32



Freiburg + Giusti + Steentjes results

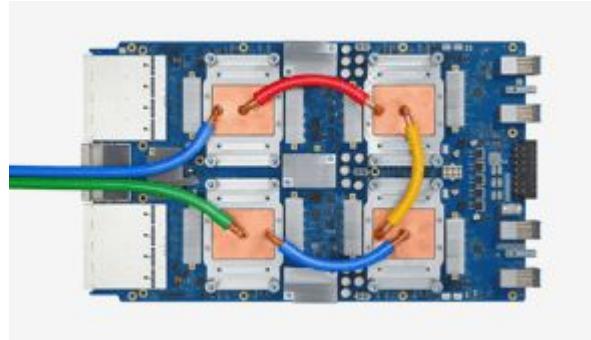


Freiburg + Steentjes



TPU

- Google Cloud Platform
- Machine Learning ASIC
- Can't run python code

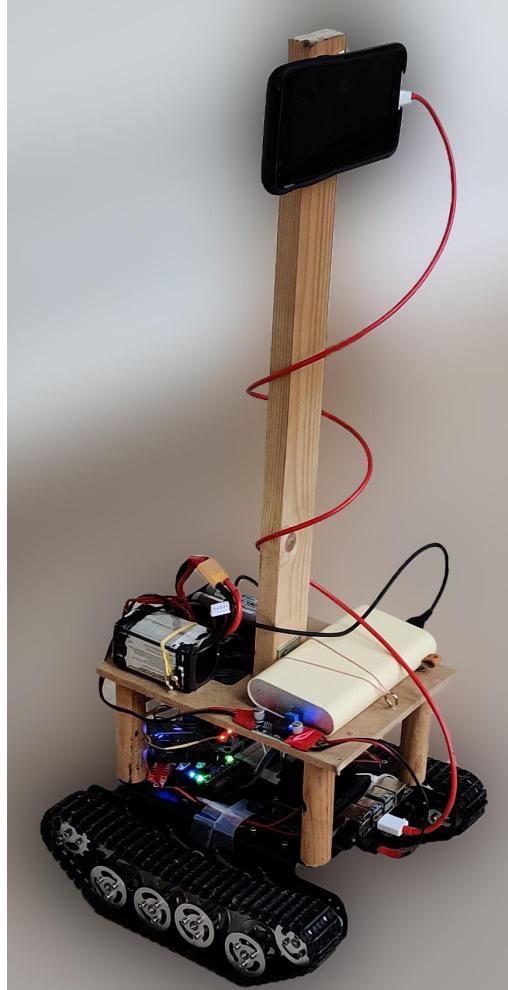


Google Cloud Platform



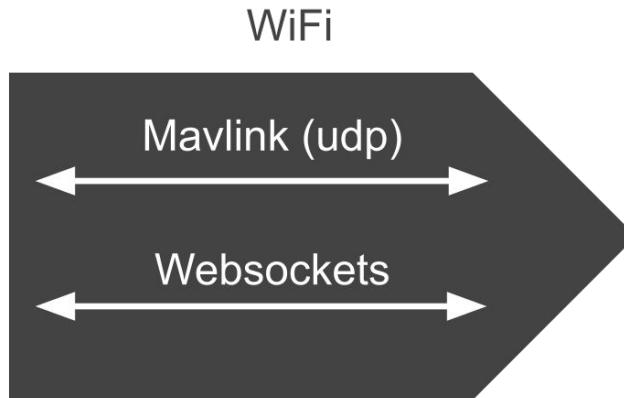
Google Cloud Platform

Rover

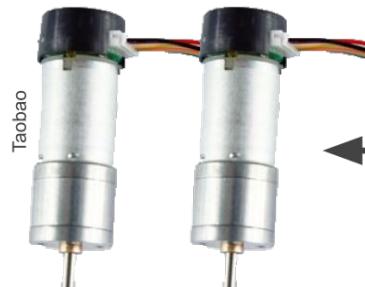




Manual control



Serial

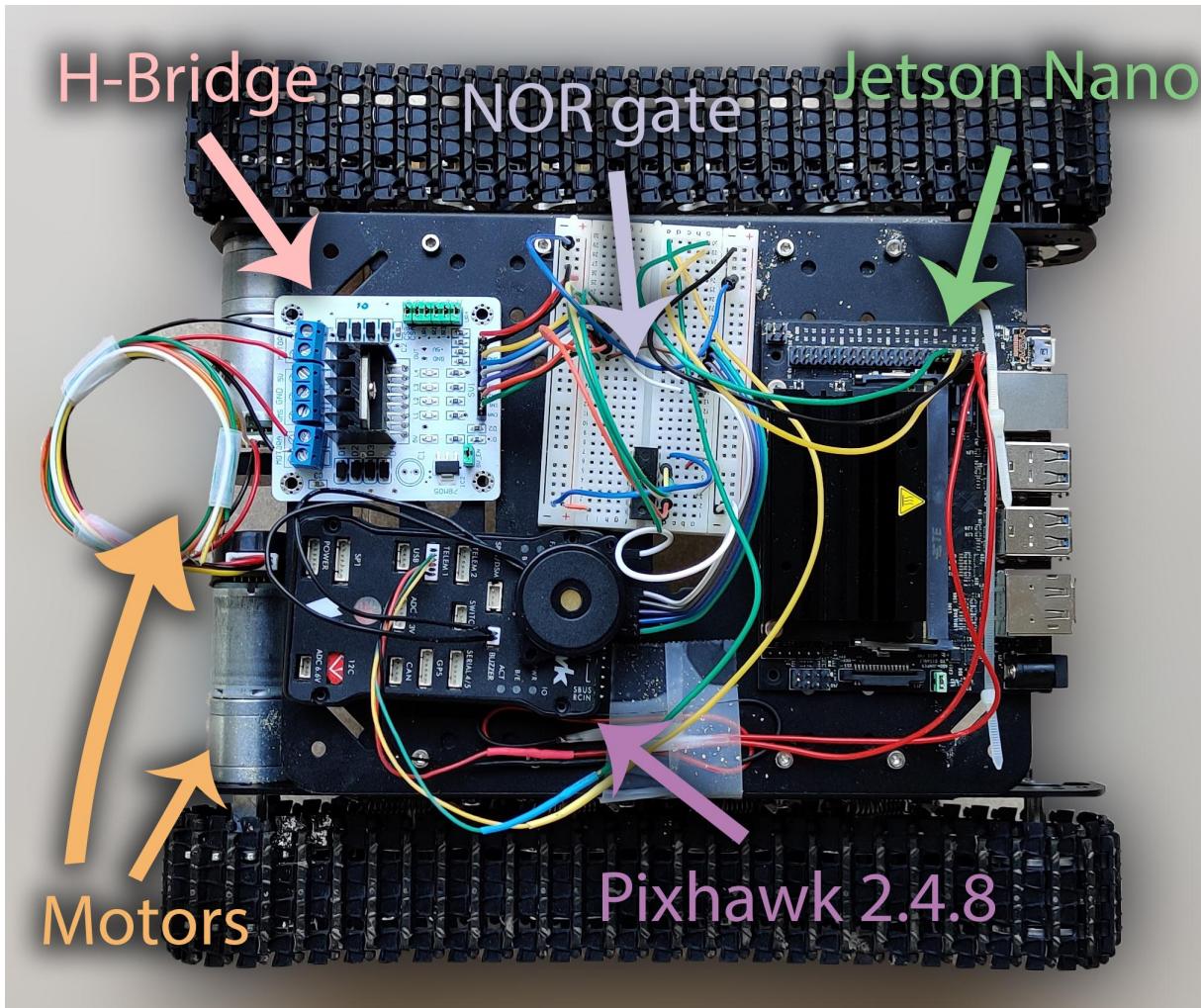


Taobao

Via H-Bridge



ProBots



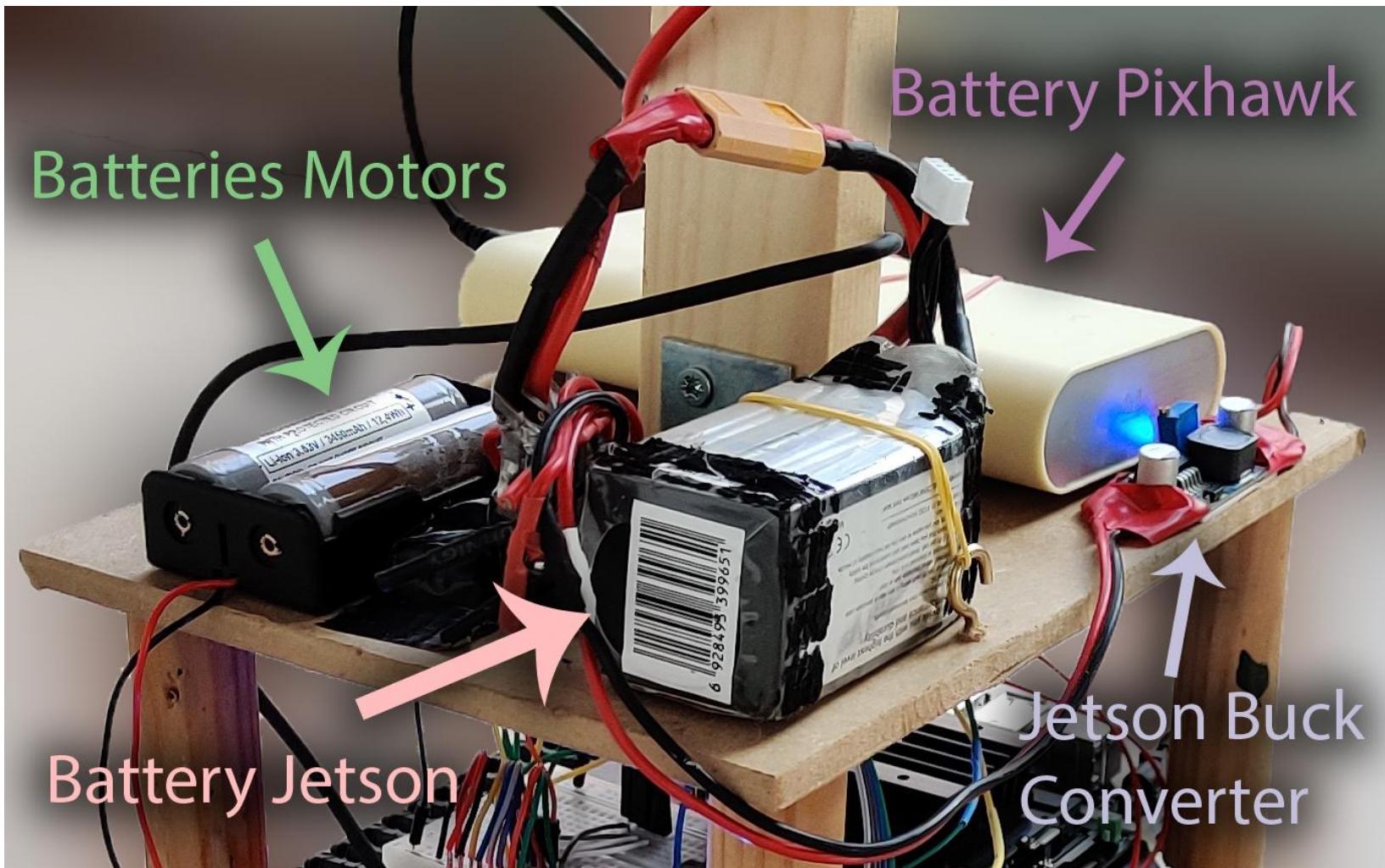




Image feed



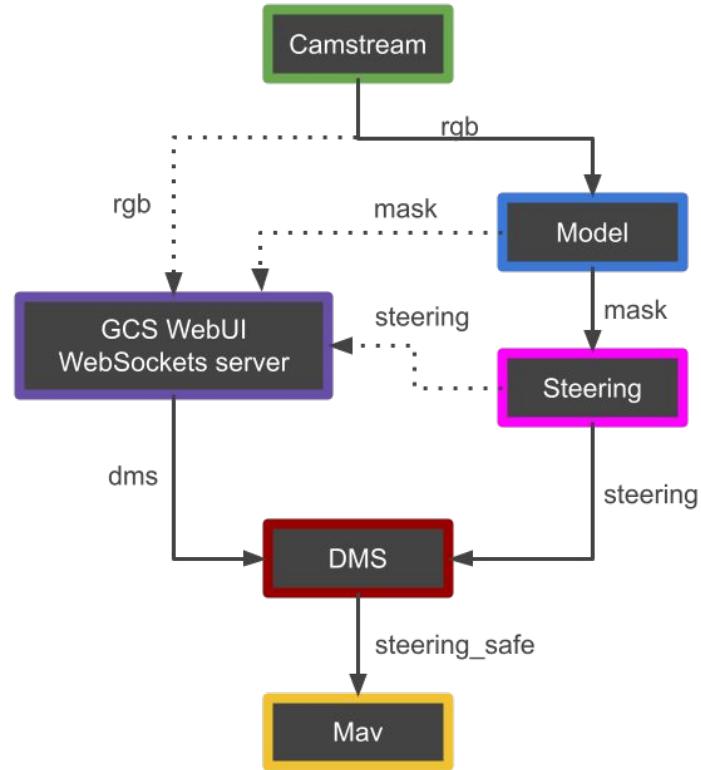
Control



Dead man's switch



Functional Diagram ROS



Conclusion

Further improvements

- On-drone inference
- More environments
- Autonomous decision making
- ...

Applications

- Surveying
- Transport
- Remote assistance
- ...

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