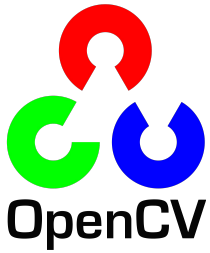
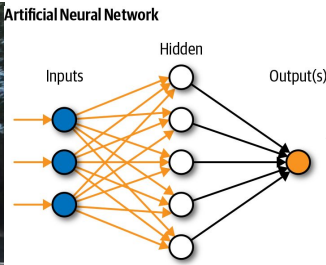
Building a simple platform to train autonomous RC cars

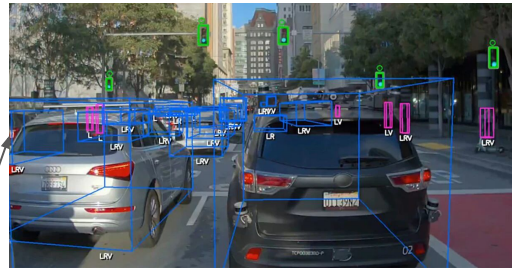
Huan K. Tran

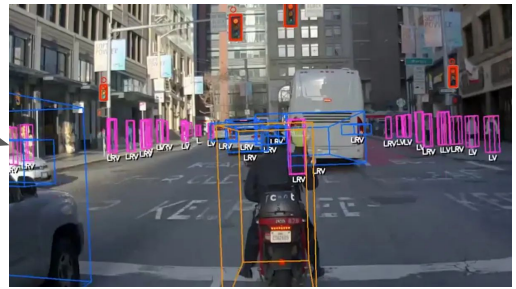


University of Minnesota
Driven to Discover℠

Problem description







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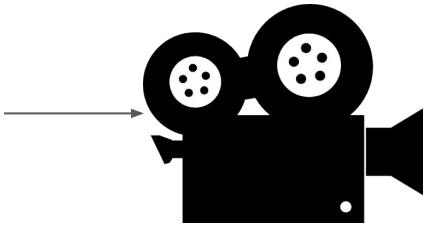
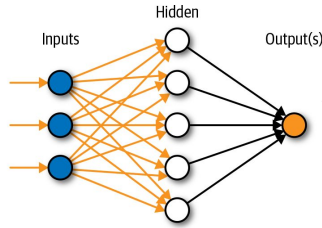




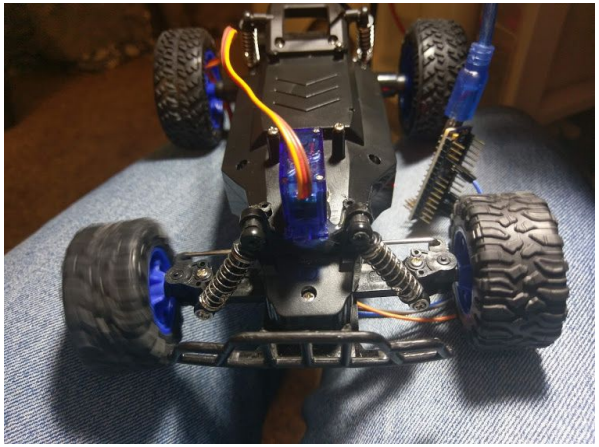
Related work

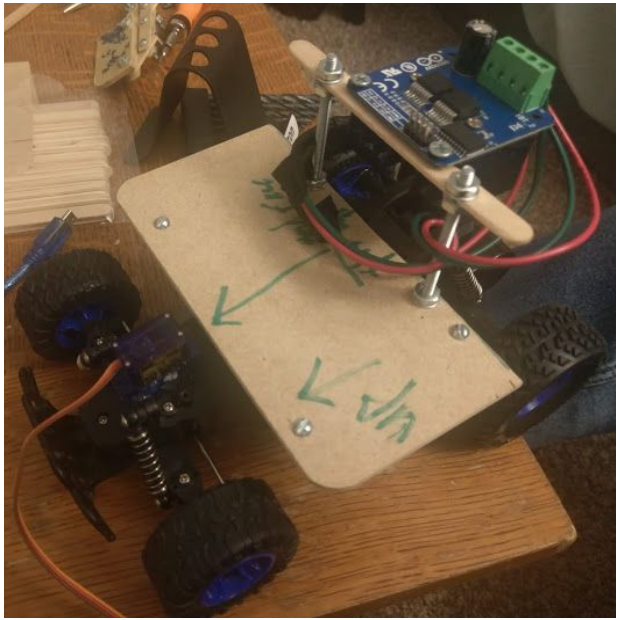
- Haji, A., Shah, P., & Bijoor, S. (2019). Self Driving RC Car using Behavioral Cloning. *arXiv preprint arXiv:1910.06734*.
- MIT race car
- Srinivasa, S. S., Lancaster, P., Michalove, J., Schmittle, M., Rockett, C. S. M., Smith, J. R., ... & Sadeghi, F. (2019). Mushr: A low-cost, open-source robotic racecar for education and research. *arXiv preprint arXiv:1908.08031*.
- Tobin, J., Fong, R., Ray, A., Schneider, J., Zaremba, W., & Abbeel, P. (2017, September). Domain randomization for transferring deep neural networks from simulation to the real world. In *2017 IEEE/RSJ International Conference on Intelligent Robots and Systems (IROS)* (pp. 23-30). IEEE.
- W. Farag and Z. Saleh, "Behavior Cloning for Autonomous Driving using Convolutional Neural Networks," *2018 International Conference on Innovation and Intelligence for Informatics, Computing, and Technologies (3ICT)*, Sakhier, Bahrain, 2018, pp. 1-7, doi: 10.1109/3ICT.2018.8855753.

My Work - Building blocks

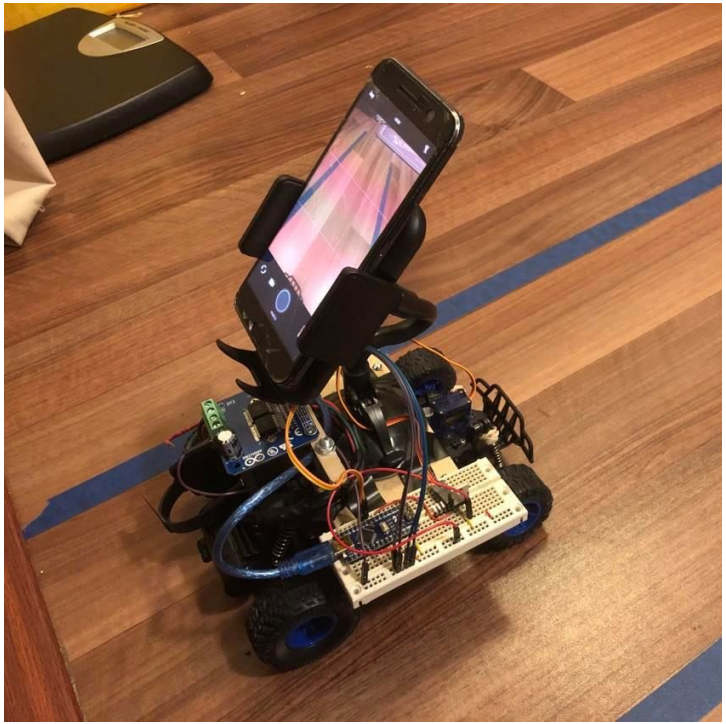
1. RC car - the hardware where the AI agent will run on
2. The simulated environment - where simulated data is generated and AI agent is tested
3. Computer vision and machine learning framework - create a bridge between real world and simulated world, and train AI agents

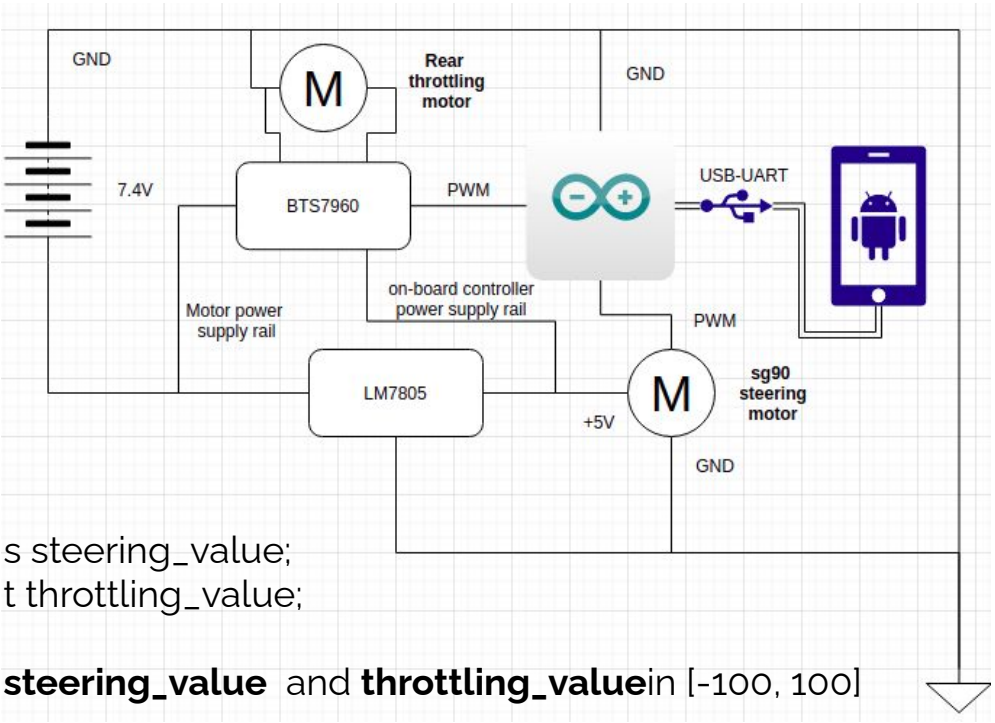
RC car - mechanics modifications





RC car - Circuitry and controller

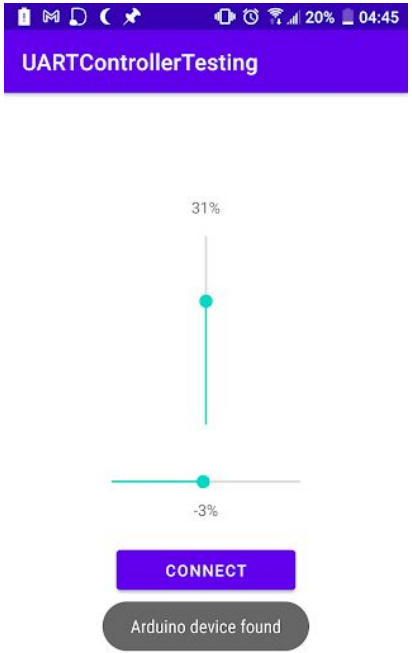


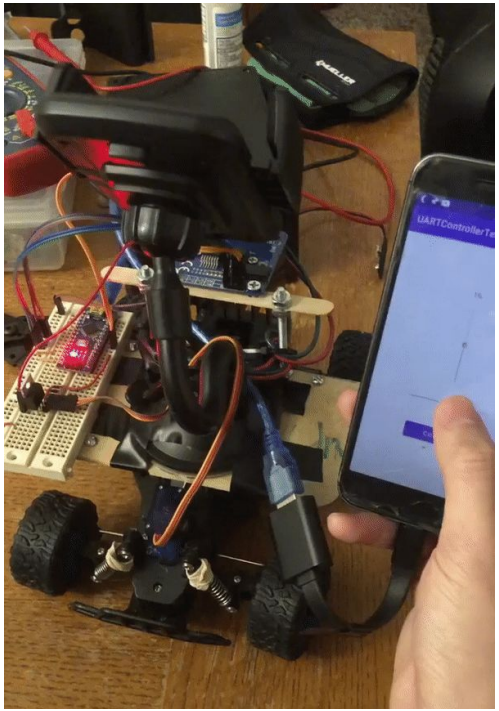


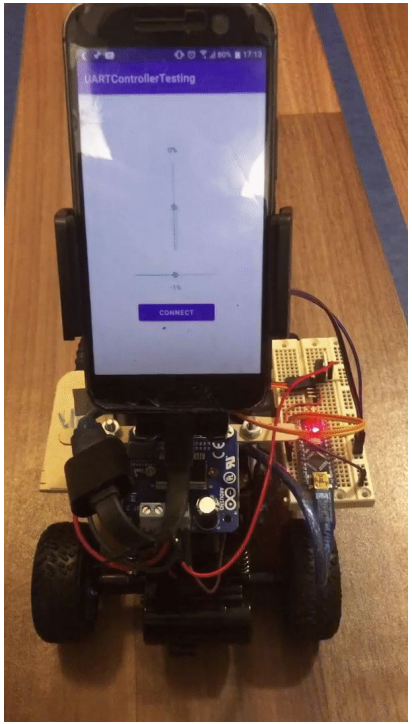
s steering_value;
t throttling_value;

steering_value and **throttling_value**in [-100, 100]

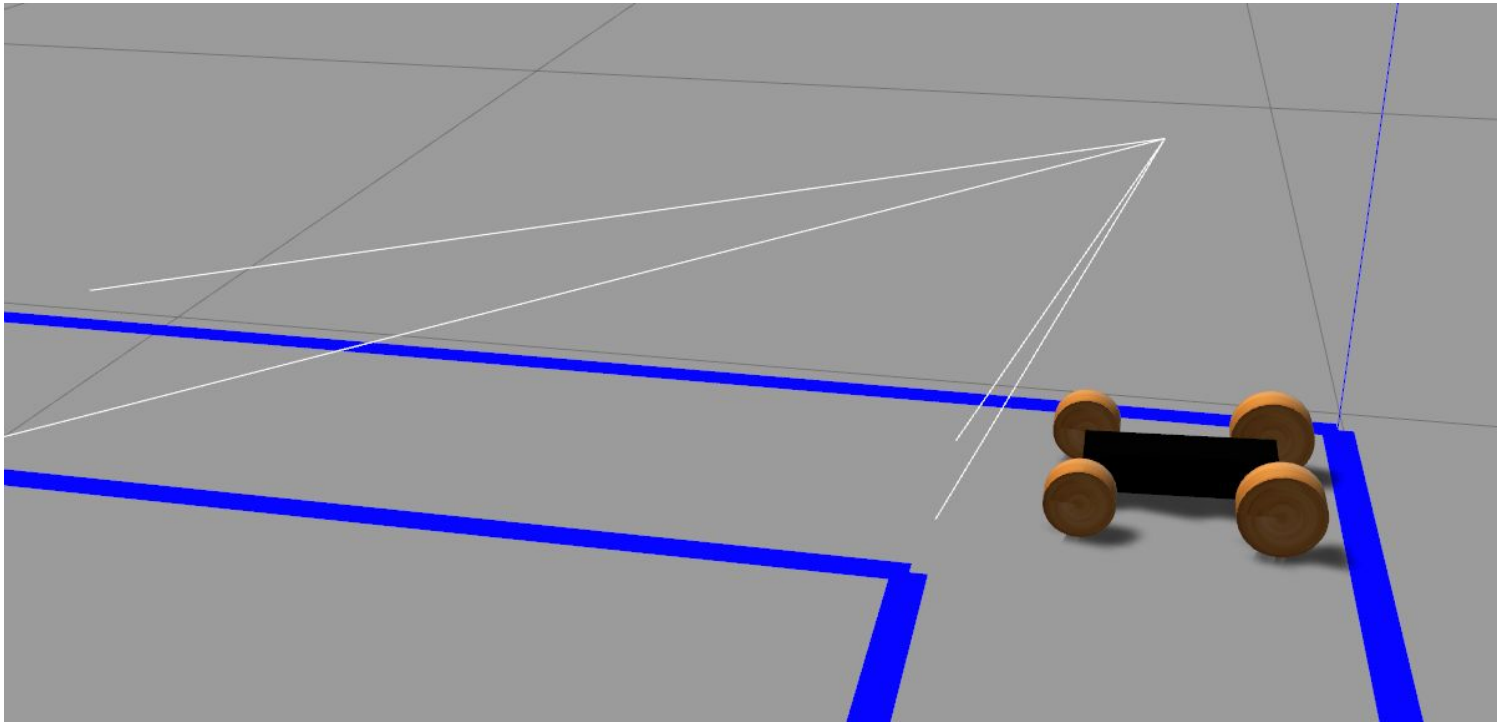
RC car - Controller android app demo



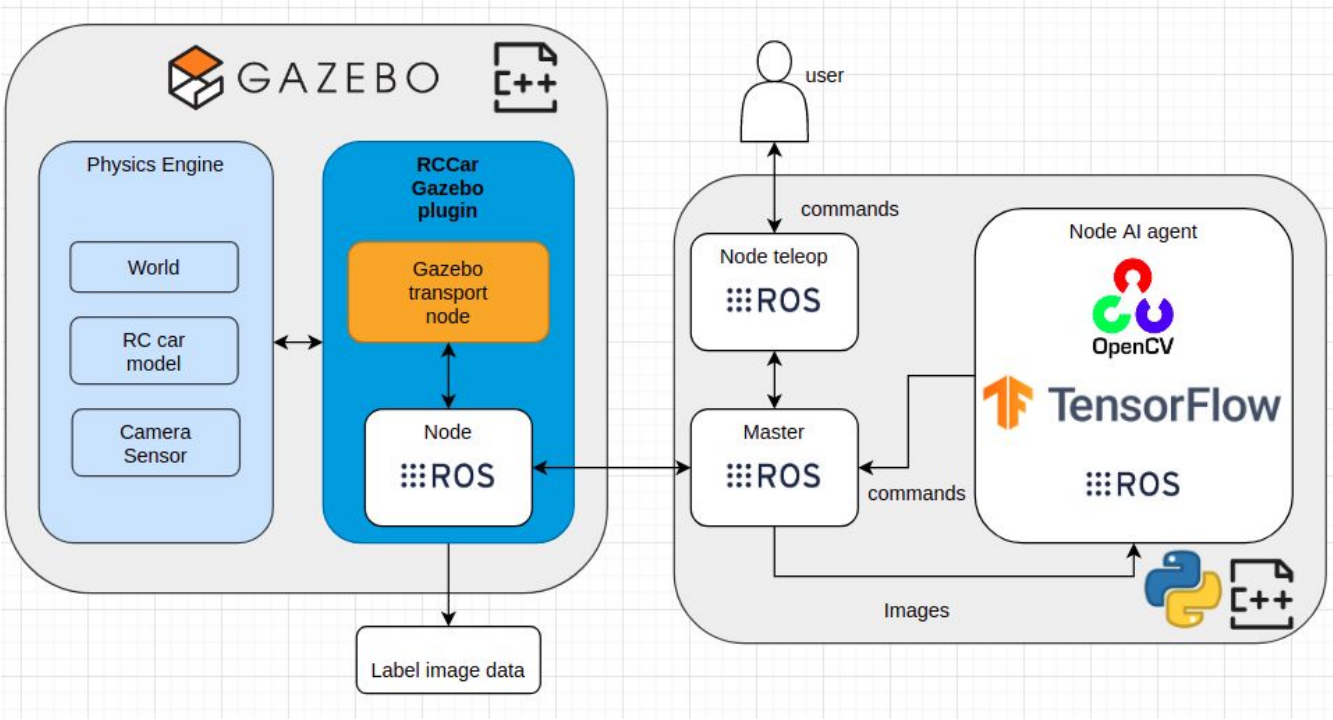




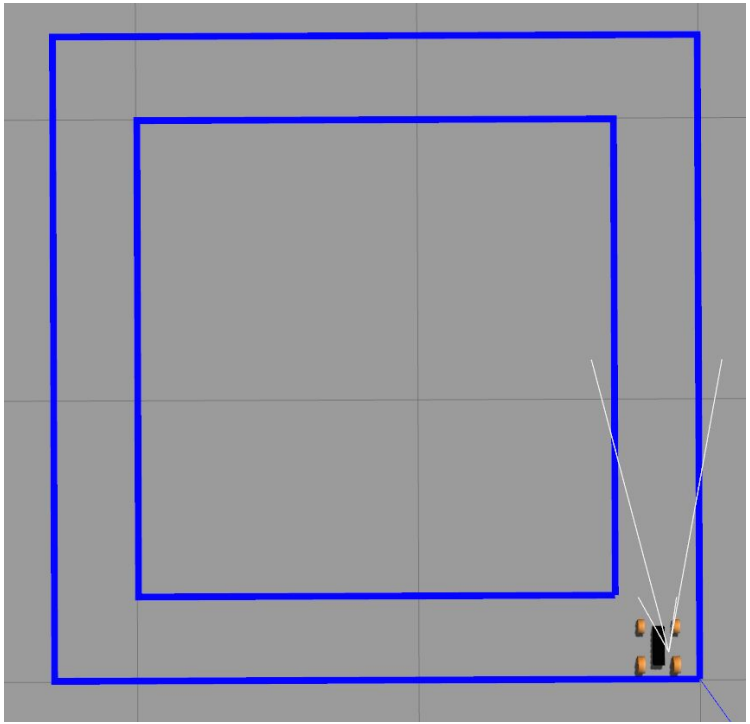
Simulated environment - 3D model of the RC car

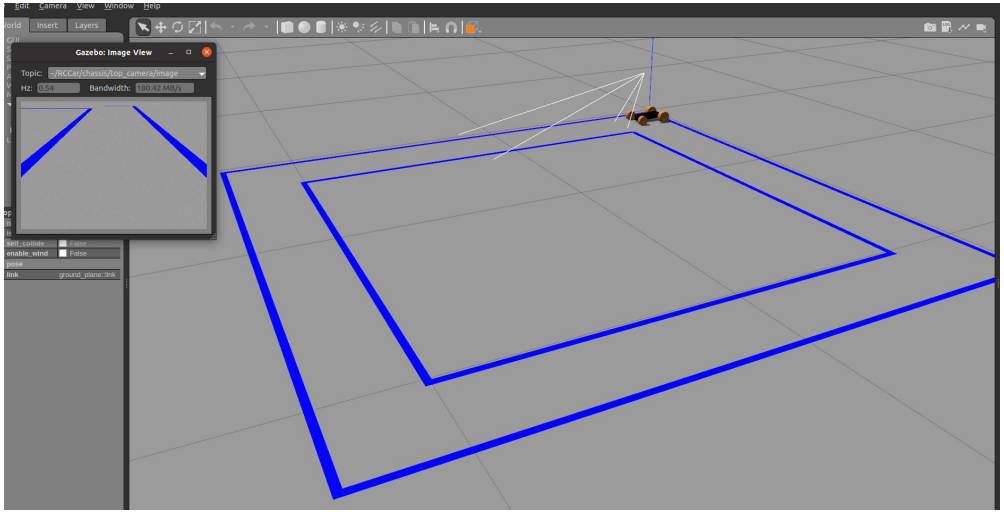


Simulated environment - background mechanics

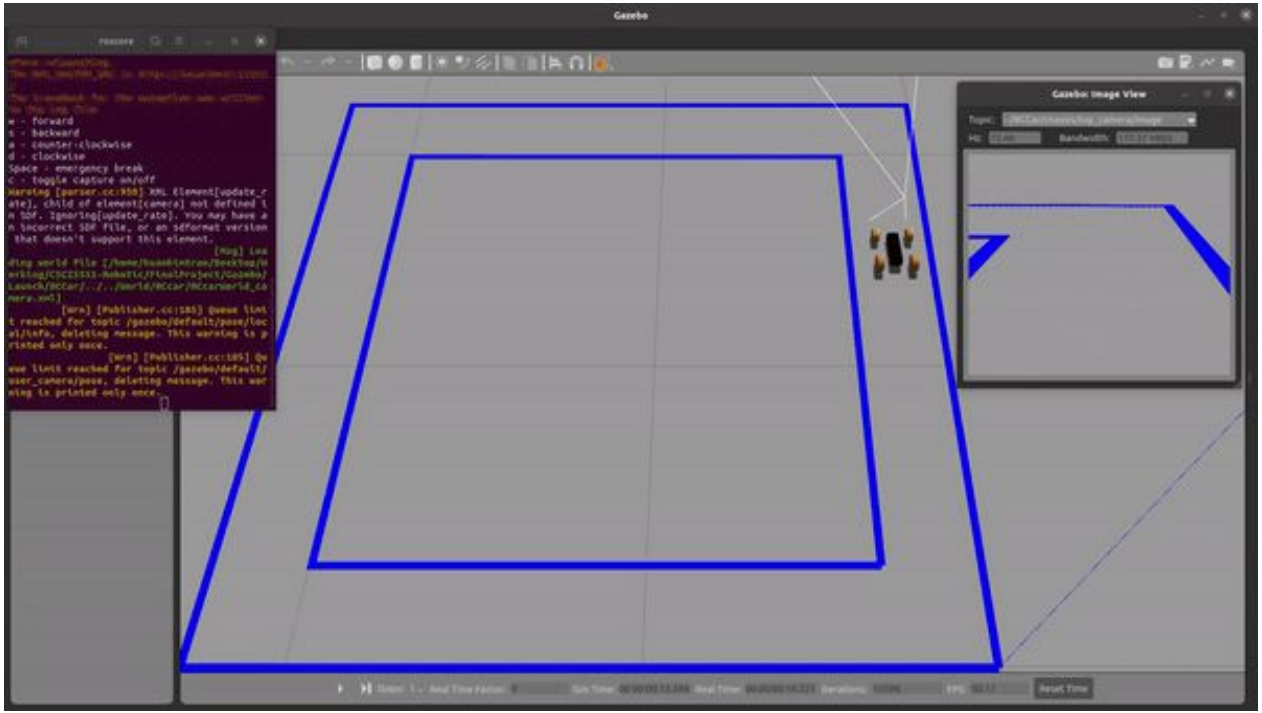


Simulated environment - the world

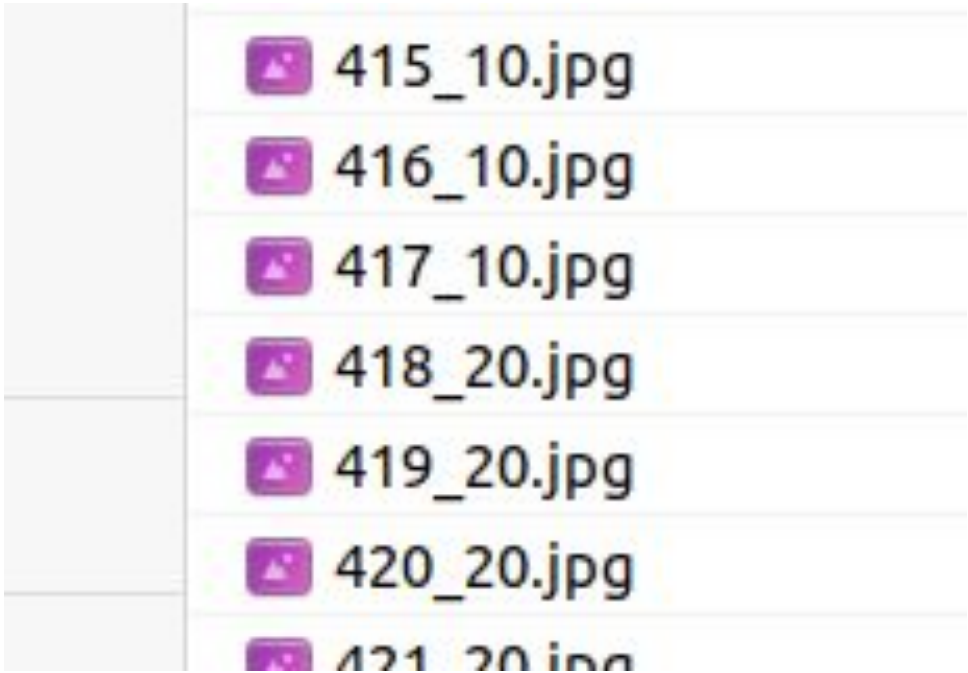




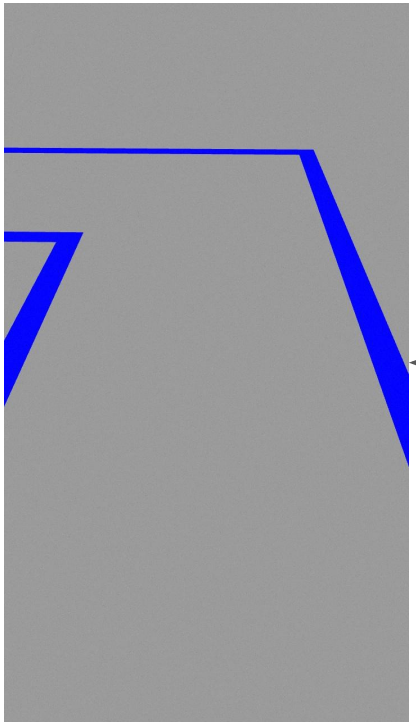
Simulated environment - in action



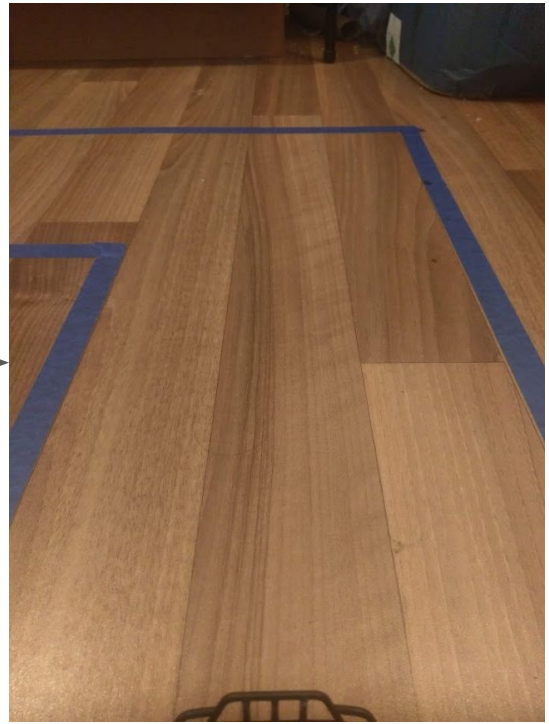
Simulated environment - generated labeled data



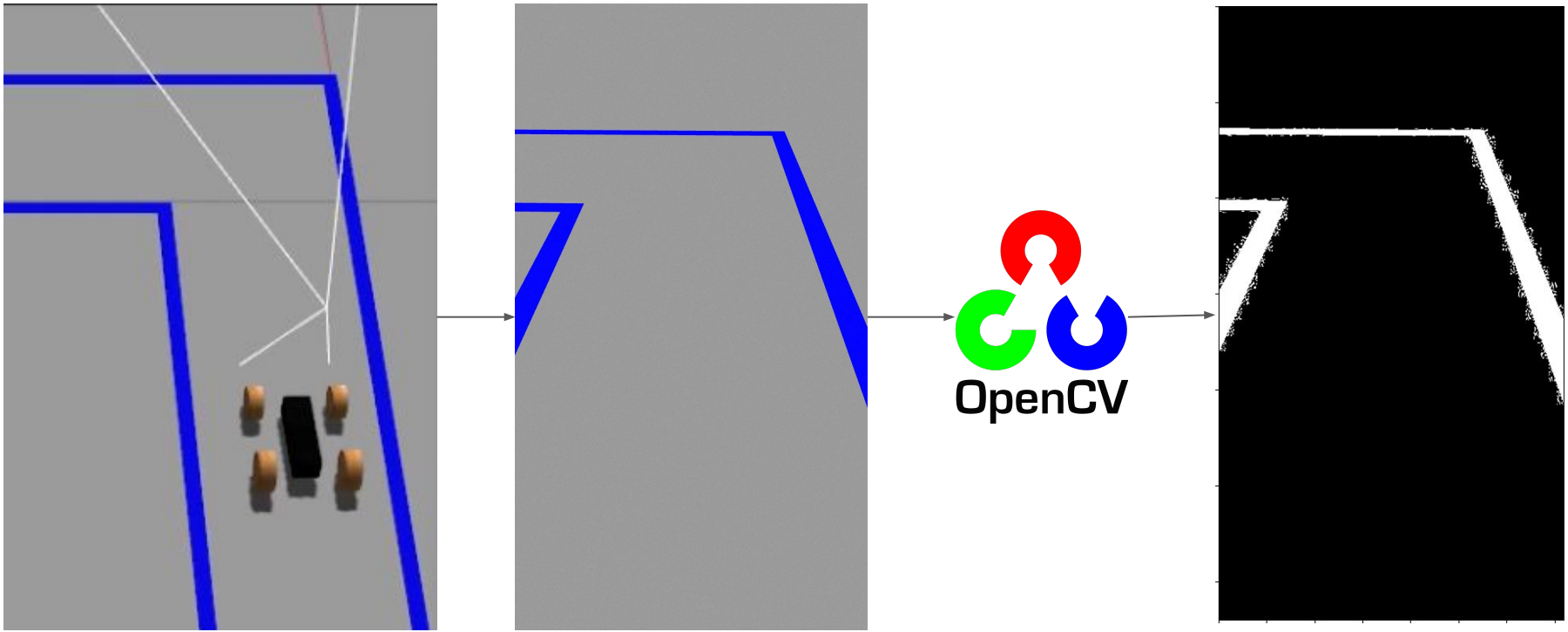
CV & ML - Simulation and real world bridge



How?



CV & ML - Simulation and real world bridge



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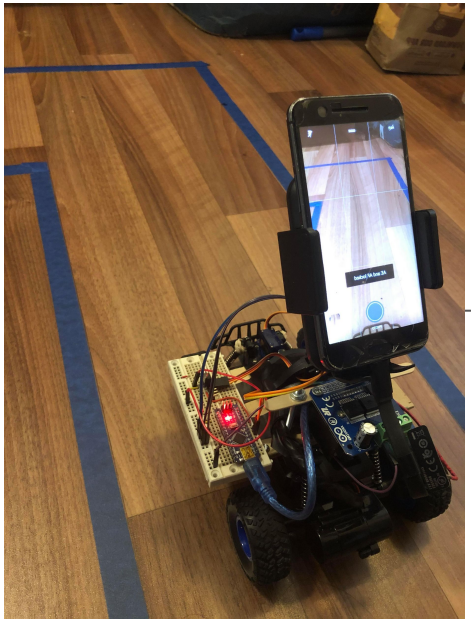
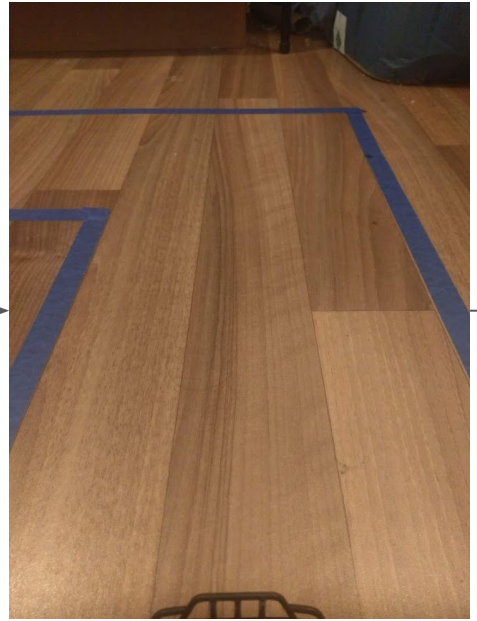
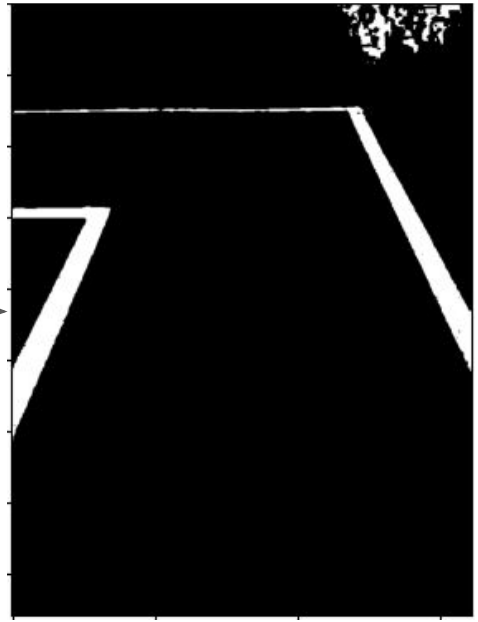
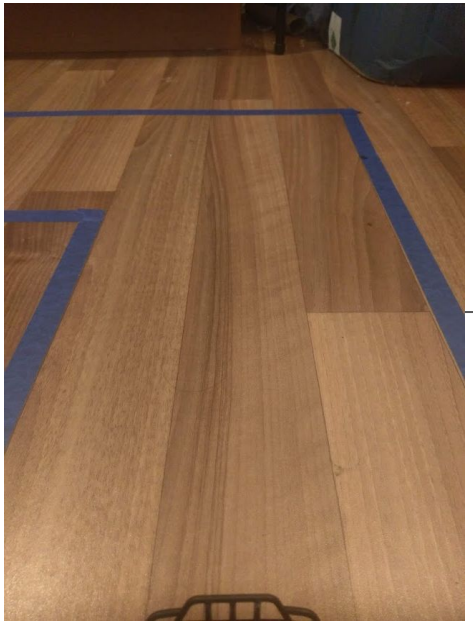


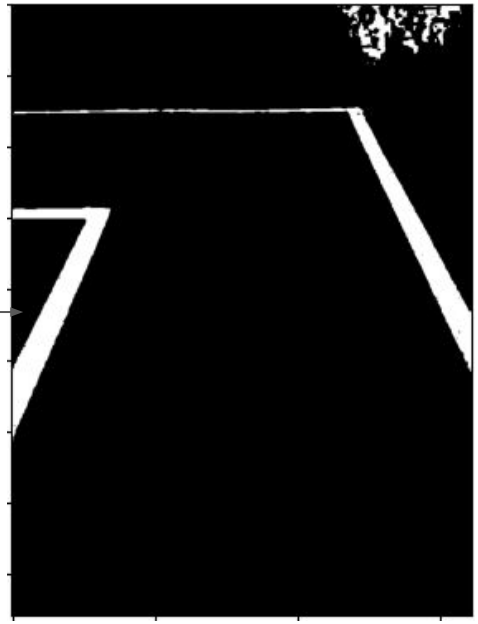


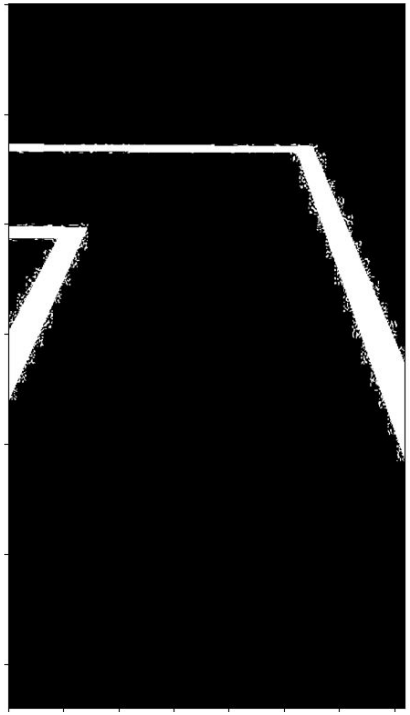
OpenCV

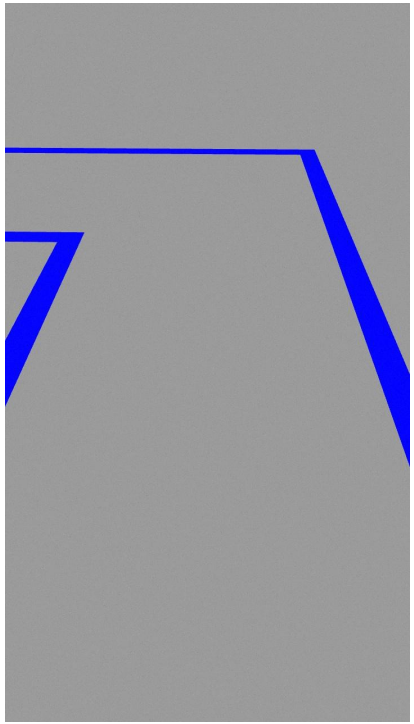


CV & ML - Simulation and real world bridge









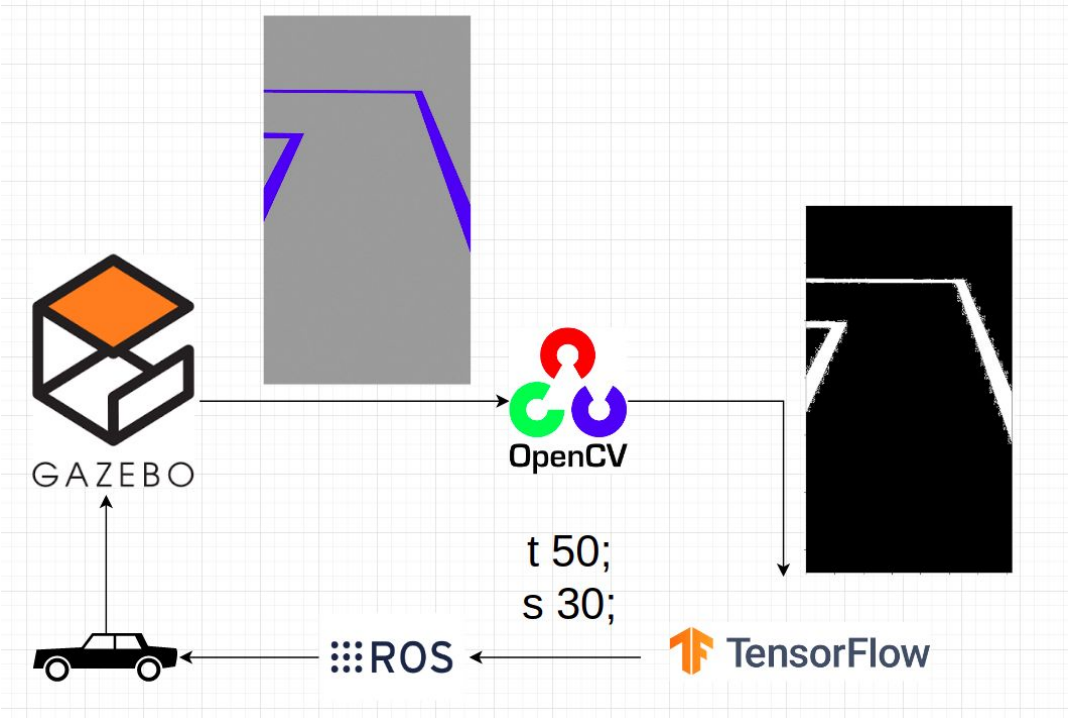
Conclusion

- Although the framework has not been complete, the similarity in the collected data to the real world data shows that it is very likely that AI agents could be trained entirely in the simulated environment and would still be able to operate properly in the real environment
- Moreover, with the current cost, this project could be a good open source project for beginner who attempts to start their journey to the self-driving car realm.

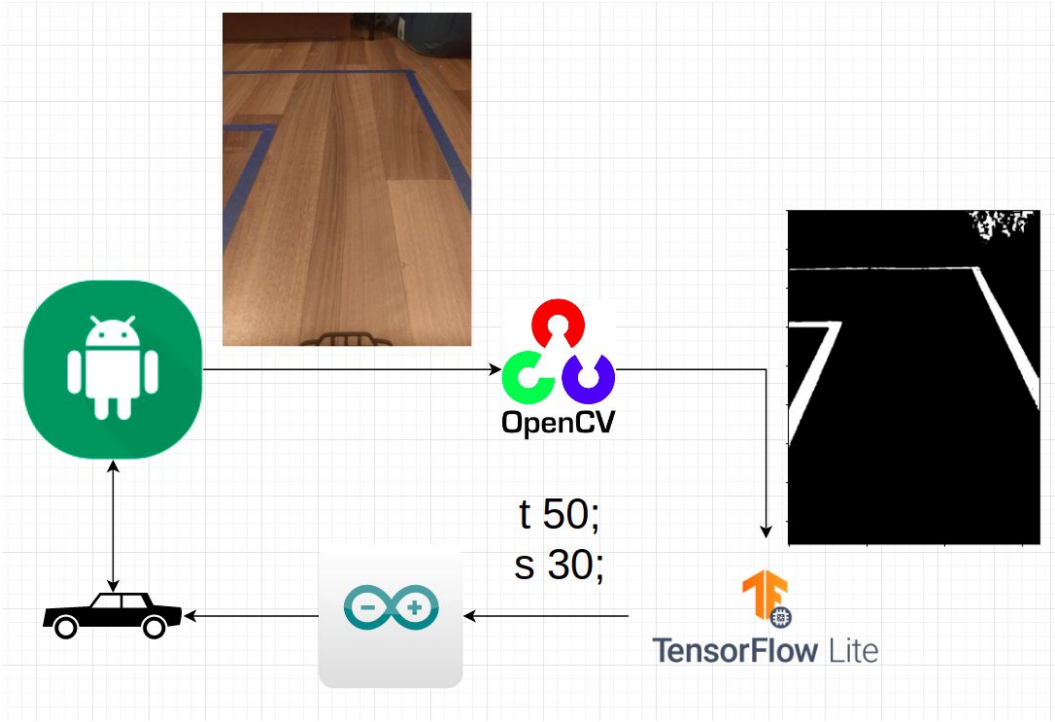
Questions and Answers

Thank you for listening

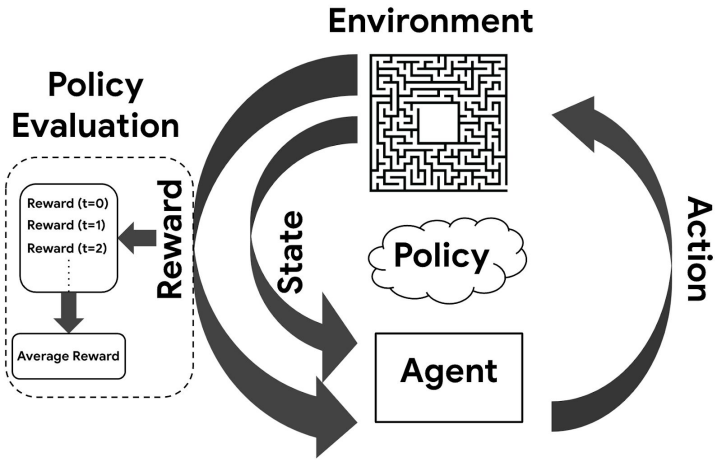
Conclusion - future work on simulated world



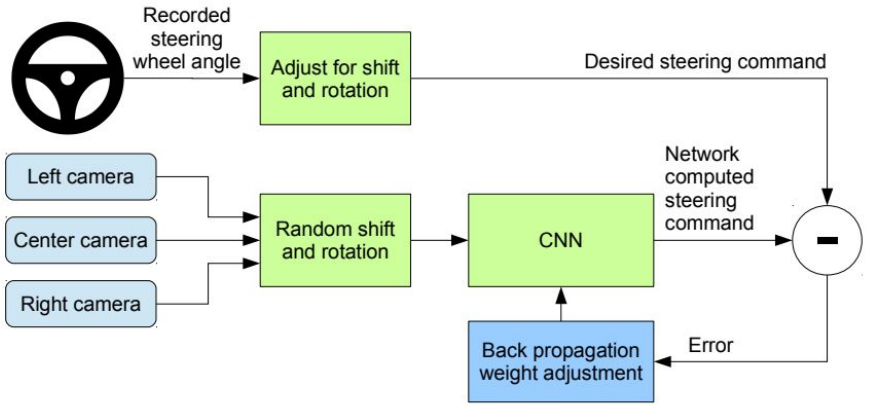
Conclusion - future work on RC car



Conclusion - future work on CV & ML



Reinforcement learning



Behavior cloning