15-400 Project First Milestone
15-300, Fall 2016

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1 Major Changes

The largest change in my project is that I will be modelling user intent solely off of gaze rather than a combination of gaze and direct control of the arm. By considering gaze and direct input independently, I can make direct use of previous work operating robots off of a combination of direct input and goal distribution [3]. In Javdani's work, he generates this goal distribution based off of the user's selection history. Instead of user history, we will use gaze to model the user's goals. This allows us to use hindsight optimization to approximate the POMDP (Partially Observable Markov Decision Process), which would otherwise be computationally infeasible.

2 Progress

I have gained deeper familiarity with the papers I read for the proposal [1] [3] and additionally read papers relating to the lab [4], externally related progress [2], and hindsight optimization [5]. Note, due to my project pivot, I decided to learn more about current hindsight optimization techniques rather than focus on POMDPs.

Since I changed to modeling the direct input and the gaze independently and there is already a framework for combining predicted goal distribution and input, my work towards understanding the Ada/joystick software (using the Github repository) will likely become irrelevant to the project.

3 Relation to 1st Milestone

My goal was to understand the joystick and gaze detection software further and deepen my understanding by reading various Machine Learning related papers. I have surpassed my literary targets. However, my change in approach will likely make most of the understanding I developed of the Ada software irrelevant. As the software mapping gaze to an object is not yet complete, I have not made any progress in that realm.

4 Surprises/Future Milestone Revisions

Other than the strategy change there have been any major setbacks or surprises. Future milestones remain mostly intact as the steps, data pipeline and model iteration, remain necessary for project completion. In light of the pivot, I will also need to present my goal distribution in a manner usable by the existing hindsight optimization framework.

5 Resources Needed

The resources I need are largely the same as mentioned in my project proposal. I am dependent on another project mapping the headset's gaze detection to the object of the user's gaze. Their work is ongoing and on track to be available in the spring. Additionally, I will need the software developed in [3] to determine Ada's movement dependent on gaze based goal prediction and the joystick input.

References

[1] Henny Admoni and Siddhartha Srinivasa. Predicting user intent through eye gaze for shared autonomy. In *Proceeding of the Shared Autonomy in Research and Practice*, November 2016.

[2] Eric Demeester and Alexander Huntemann. Detecting user interaction changes using the kullback-leibler distance. In *Proceeding of the Shared Autonomy in Research and Practice*, November 2016.

[3] Shervin Javdani, Siddhartha Srinivasa, and J. Andrew (Drew) Bagnell. Shared autonomy via hindsight optimization. In *Proceedings of Robotics: Science and Systems*, July 2015.

[4] Stefania Pellegrinelli, Henny Admoni , Shervin Javdani, and Siddhartha Srinivasa. Human-robot shared workspace collaboration via hindsight optimization. In *IEEE/RSJ International Conference on Intelligent Robots and Systems*, October 2016.

[5] Robert Givan Sung Wook Yoon, Alan Fern and Subbarao Kambhampati. Probabilistic planning via determinization in hindsight. In *AAAI Conference on Artificial Intelligence*, July 2008.