

SAG Additional Documentation – Final Report Interactive Robotics Laboratory Project

The Interactive Robotics Laboratory (IRL) has been officially renamed to Human Interactive Robotics lab (HIRo) this semester to avoid confusion on acronyms. This semester, we had a group of 9 students working on projects and researches in the social robotics space. We have two interactive projects with the robot arms. One of them programmed the robot arm to play chess with a human player. The chess board is captured and analyzed with an Intel Realsense camera mounted on the top of the UR5 robot arm. The move that the human player makes will be captured by calculating the difference between two chess boards. The computer vision algorithm that the team developed will convert the photo into a 2-D representation of the chess board. This chess board format is later passed to an open source library that uses the minimum spanning tree algorithm to determine the optimal move in a short amount of time. After the algorithm has reached a decision, it is then forwarded to the control module to move the chess piece. The other project is on using the robot arm to draw celebrity portraits. The celebrity's name is first shown to the camera on the arm. After the name is recognized, the program makes an automatic search on Google for an appropriate photo, and converts the photo to a dot style paint that is easier for the arm to draw. The image information will be forwarded to the control module and the arm will perform the drawing on the canvas. Both of the projects will be demoing on EXPO and demonstrate the learning process of the new members of HIRo.

There are also other research projects at the same time with these projects. These research projects are mostly individual projects from junior and senior members of the team. The research topics this semester includes exploring two arm collaboration with a deep-Q reinforcement learning technique and robot gesture recognition through convolutional neural networks. These projects are scheduled to be year-long projects and have gone through background knowledge research and are starting to build first-pass prototypes. The Human Interactive Robotics lab will continue to support these projects as well as other potential ones next semester.

Our robotic arm has also gone through a significant upgrade. We have installed the Robotiq 2F-140 adaptive gripper for fine object manipulation. The gripper was discovered in the robotlab from previous projects, and Professor Barrett brought us the coupling and wires for the gripper. This gripper can handle objects with varying shapes and weights, and can be controlled and integrated with the ROS protocols that we are familiar with. The addition of this gripper to our tool box will greatly boost existing projects and expand the range of projects that we can work on in the future. Through this semester, we have also created a website for our lab with previous projects and documentations. The website link is <https://olinrobotics.github.io/irl/>. We hope that the creation of this website can help future students better understand the

projects in the past and serve as the passage way to advertise our lab to a wider audience beyond Olin.

Overall, the Human Interactive Robotics Lab has gone through a successful semester, with accomplishments in both its engineering projects and organizational planning. We thank the support of the Student Activity Grant and Olin Robolab for making what we are doing possible and look forward to future semesters with more in depth explorations in the field of social robotics.