Title:

Remote Control and Navigation of Robotic Arm based on ROS (Robotic Operating System) supported by Computer Vision Tracking

Scope:

In recent years, the application of automated tasks for robotics is getting a dominant role in a series of applications in the fields of manufacturing, agriculture, civil inspection, assistance, health and other. Often such tasks require precise robotic control and navigation in undefined environments, moving systems and not-fixed tracks/trajectories. The trajectory estimation and movement of the robotic systems and arms highly depends on many environmental and application parameters such as obstacle-avoidance, required accuracy, movement of the mounted components, payload, movement degrees-of-freedom (DOF) etc. In this thesis, we target to the implementation of algorithms for a robotic arm movement for high precision tasks supported by existing computer vision algorithms for tracking objects. The robotic algorithms will be developed in the ROS (Robotic Operating System) and the computer vision algorithms will be based on OpenCV and/or Matlab. The thesis will be performed in the steps that follow:

- Selection of the appropriate robotic arm system (if not already purchased) with the following characteristics: affordable price, programming support and compatibility with the ROS operating system, at least 4-DOF operation, weight that its tip can carry. Examples include: uArm Swift Standard Kit, Poppy Ergo JR.
- Adaptation and mounting of a stereo-imaging camera set at the tip of the robotic unit.
- Development of control algorithms for movement and integrated control of the robotic arm for certain tasks. The developments will be performed in ROS (Robotic Operating System).
- Adaptation of existing computer vision algorithms (Open Source Computer Vision Library (OpenCV)) for obstacles detection and obstacle tracking/matching (eg FlannBasedMatcher or other). The developments will be done in OpenCV (C++) and/or Python.
- The ultimate purpose of the thesis will be the development of the suitable control and navigation algorithms (in ROS) for object tracking and followance supported by machine vision algorithms (in OpenCV) while the cameras are installed on the robotic arm (moving together with the robotic arm).

The aparatus to be used includes the following:

- Robotic arm with 4-6 DOF.
- Machine Vision Cameras, 9.1 MP Color Grasshopper3 cameras, USB 3.0, 9fps, 1 CCD, C-Mount (Fujinon lense 12,5mm, aperture1.4, Space Com Fixed lense 25mm, 1:0.95) (to be used in stereo mode)
- Access to ROS and OpenCV source introductory source codes and tutorials.

Prerequisite Knowledge:

- Theoretical background or robotic algorithms for movement and control.
- Some experience with programming languages (Python, C++).

Knowledge to be acquired from the thesis:

- Familiarization with standard operating systems used in robotics (ROS).
- Hands-on experience with robotic control and navigation.
- Experience with modern machine vision equipment and algorithms.

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