Tekkotsu : A Platform for Robot Vision Education

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Introduction

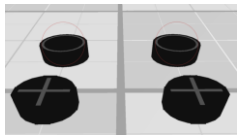
Tekkotsu is a vision-based software for education of college students and high school students. It has good user interface with elegant “dual-coding” vision system, which Introduces opportunity to effective computer vision teaching.

In moving from Calliope2SP to Calliope3 platform, we need to address a variety of issues, including object detection, kinematics, localization and path planning, etc. Besides, a demo for tic-tac-toe game playing in the real world is required to demonstrate how human and robot interact and how vision system works. This project has several focuses and solutions come out after many experiments no matter in real world or in simulation environment.

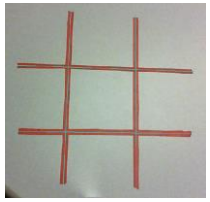
Object Detection

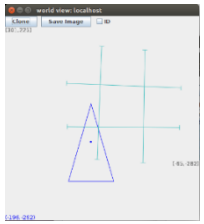
Tekkotsu takes a "dual coding" approach to representation. Paivio argued that people use both kinds of representations, when necessary, convert between one and the other. In Tekkotsu, sketches exist in a "sketch space" and shapes in an associated "shape space". Extraction operators can extract shapes (such as lines or ellipses) from sketches, while rendering operators produce a sketch from a shape. There are three spaces: camera, local and world. They can be utilized in different scenarios.

Naught extraction after optimization in Mirage:



Line extraction using Hough transformation and optimization:

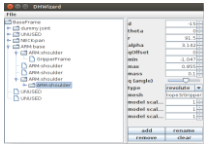


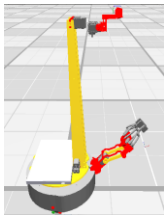


CamShS WorldShS

Kinematics

Tekkotsu includes kinematic descriptions that uses Denavit-Hartenberg parameters to describe reference frames associated with joints and interest points.



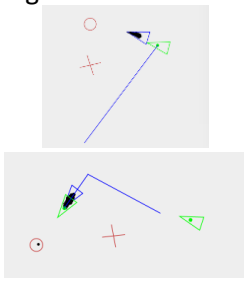


Part of upgrade from Calliope2SP to Calliope3 involves changing kinematic descriptions. It requires us to develop a new kinematic description.

Manipulation and Planning

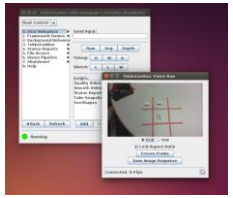
We Improved gripper manipulation by using vision information and modified strategy of RRT based path planning.

Precise gripper manipulation using vision information

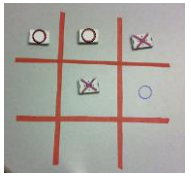


A path planning with an obstacle

CameraBot tic-tac-toe Demo

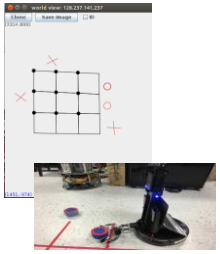


A good user interface ControllerGUI with a Raw Camera Image



Computer plays tic-tac-toe against people on the real board.

Real World tic-tac-toe Preparation



Future Work

Future focus should lie in improvements on navigation in order to fully implement real word game playing.

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