Web interface for operating and visualizing multi-pan-tilt-zoom videography
system

Background

NAPPLab, lead by Prof. Micah Corah, is developing a robotic videography system
for filming team sports and social behaviors.
This system consists of a network of pan-tilt-zoom cameras controlled by a
centralized computer.
Ultimately, we would like this system to be able to autonomously film groups of
moving people or athletes according to human inputs such as by selecting
aesthetically pleasing views of players passing a ball or obtaining multiple
views of a runner that could later be used to reconstruct their motion.

Project Description

For this field session the task will be to develop a web interface for our
camera system house in the Brown 293 Robotics Lab.
Our current system is able to track people and objects moving in our motion
capture space and control four PTZ cameras to follow them.
However, we have few tools that we can use to operate the system or for
visualizing camera feeds.

Because this field session project represents a component in a larger research
task, we expect the team to complete this project by building simple and
configurable modules based on existing tools for robotics research.
Specifically, the team should use ROS2 (Robot Operating System) to build modules
(nodes) that will interface with our broader system by sending and receiving
standardized messages.
The team will also have access to (and contribute to) tools maintained by
NAPPLab (and contributed to by prior Field Session teams) for detection,
tracking, camera control, and other purposes.

Tim Flynn (Mines, Assistant Athletic Director for Communications) is

also a
stakeholder for this project.
The team will be encouraged to meet with him early on to discuss plans and to
refine goals.

Project Goals

The web interface to the videography system should have the following features:
1. Visualize camera feeds from 4+ PTZ cameras together or individually
2. Visualize locations of cameras and objects being tracked (top down or 3D)
3. Interface with the tracking system and multi-camera controller
  * Provide text inputs to specify kinds of subjects to track and film
  (e.g. people, teddy bears, Blaster)
  * Select tracked objects to prioritize/deprioritize or enable/disable
  * Select between operation modes and change parameters for those modes
4. Allow operator takeover and teleoperation of any of the cameras
5. Interface with NAPPLab tools via ROS2 topics and services

Optionally, the team may consider the following additional tasks:
* Controlling ground robots in the motion capture area for the purpose of
  demonstrating the filming system
  (e.g. for purpose of filming a teddy bear sitting on a robot following a
  preplanned path; subject to availability of suitable robots)
* Hot potato demo: select priority subject for a filming task based on an object
  "hot potato" that can be passed around
* Automated linear broadcast: Cut between camera feeds based on knowledge of
  views and the scene (who is in the field of view, facing the camera, or other
  parameters)
* Integrate Optitrack motion capture system to provide inputs for tracking
  (the current system uses RGBD depth cameras and YOLO-World)

Skill Set

* Experience with Linux & Unix environments, especially Ubuntu
C/C++
Scripting language and scientific/mathematical programming
* Python with numpy
Robotics skills (preferred or to be developed during field session)
* ROS/ROS2 experience

* Experience with computer vision algorithms and/or coordinate frames and rigid
  body transforms

Preferred Team Size

3-4 students

Outcomes and Opportunities with NAPPLab

Please reach out to Prof. Micah Corah if you are interested in continuing to
work on robotics research with NAPPLab.
Opportunities may include: independent study, hourly RA-ship, Summer Undergraduate Research Fellowship (SURF), Mines Undergraduate Research Fellowship (MURF), or VIPER.

This project may contribute to future research publications in robotics
conferences or journals.
If so, student contributors will be acknowledged for their contributions.
If you wish to contribute as an author to publications stemming from this
project, you must reach out to Prof. Corah directly to discuss how to do so and
what kinds of contributions would merit authorship.

Intellectual Property

This project is a component of ongoing research in NAPPLab.
We suggest adoption of the BSD 3-Clause license to facilitate continued use of
products of this field session in our research program.

Location of Work:

Mines Campus

Client Liason

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