Bachelor project

Title Vision based odometry, localization and obstacle avoidance for a small mobile robot with limited wheel encoders

Supervisor Alexander Förster, Gilles Caprari

student already assigned

Keywords Robot localization, computer vision,

Prerequisites A smart phone with a front camera (Android or iOS)

Abstract

For a mobile robot to act in a dynamic environment it needs to be able to perceive and avoid obstacles in its surroundings. The usual solution for small robots is to use infra-red proximity sensors to detect objects. These sensors require a very small amount of computational resources. Unfortunately, the ranges of these sensors is limited to a few centimeters.

In the age of smart-phones computing powers is not anymore a limiting factor and a camera is a standard sensor nowadays. These resources can piggy-bagged on the robot and used as optical sensor to detect objects in the robots path.

The student would implement a robotic system, able to detect obstacles, plan a trajectory around them and execute this trajectory with only a limited feedback available from the wheel encoders. Additionally, the objects are tracked during the movement to compensate the path integration error.

For more information, contact the advisors directly.

Links http://www.wheelphone.com
http://en.wikipedia.org/wiki/Dead_reckoning

Master project

Title Vision based simultaneously localization and mapping for a small mobile robot

Supervisor Alexander Förster, Gilles Caprari

Keywords Wheel-phone, semi-global matching, SLAM, V-SLAM

Prerequisites A smart phone with a front camera (Android or iOS)

Abstract

For a mobile robot to navigate in a previously unseen, dynamic environments it needs to be able to build a map of its surroundings and at the same time localize itself within that map. The wide-spread availability of optical sensors and cameras made visual SLAM an interesting research topic in robotics. Robotics middleware and third party libraries supports this kinds of localization and mapping algorithms, but they have to be integrated and adapted to the selected robot. The limitation of the smart-phone based robot is, that its computational power is not adequate for a real time application. A client server architecture has to me implemented to outsource the cost-intensive tasks, but allows in the other side to navigate autonomously in the environment.
For more information, contact the advisors directly.

Links http://www.wheelphone.com
http://en.wikipedia.org/wiki/Simultaneous_localization_and_mapping
http://wiki.ros.org/vslam

Bachelor/Master project

Title Control a humanoid robot with a 3D mouse, a leap motion sensor and a control pad and compare the user experience

Supervisor Alexander Förster, Juxi Leitner

Keywords humanoid robots, human robot interaction, input methods

Prerequisites Programming in C/C++ or Python, experience with robots and user interfaces can be helpful

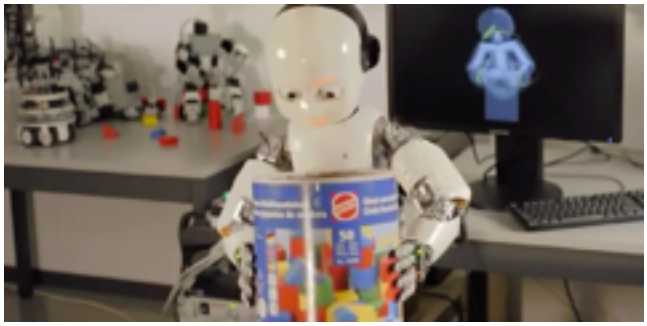
Abstract

The iCub is a complex human-like robot. To generate its motion a large number of motors need to be controlled in close cooperation. Currently no simple methods to chose the robot's behavior or control the robot remotely are available, yet at our lab various interesting and novel input devices are available (including a LEAP motion sensor, a tablet, a control pad and a 3D mouse).

The student would develop the code to use these interfaces together with our robot control framework(s). The goal is to investigate which of these interaction methods allow the users to feel most comfortable while controlling the robot. Tasks of interest include reaching, grasping and tele-robotic operations.

This project can be shapes for a bachelor and master thesis by changing the complexity of the project goal.

For more information, contact the advisors directly.



Links http://www.icub.org
http://robotics.idsia.ch
https://www.leapmotion.com
http://www.3dconnexion.com/products/spacenavigator.html

Bachelor/Master project

Title Control an unmanned air vehicle with the 3D mouse, leap motion, control pad and compare the user experience

student already assigned

Supervisor Alexander Förster, Juxi Leitner

Keywords flying robots, user interface, human robot interaction, input methods

Prerequisites Programming in C/C++ or Python, experience with robots and user interfaces can be helpful

Abstract

In recent years more and more robotic platforms have crossed from the research labs into the homes of users. One example are aerial vehicles, such as the depicted Parrot AR Drone. While flying these quad-rotors is simpler than other micro-aerial vehicles there is still room for improvement. Currently most of the flying is controlled by using a tablet or smart phone.
The student would develop the code to control the drone with other available user inputs and then investigate how confident the users feel about them controlling the robot. At our lab various different input methods are available, including a LEAP motion sensor, a control pad and a 3D mouse.
This project can be shapes for a bachelor and master thesis by changing the complexity of the project goal.
For more information, contact the advisors directly.

Links http://ardrone2.parrot.com
https://www.leapmotion.com
http://www.3dconnexion.com/products/spacenavigator.html

Master project

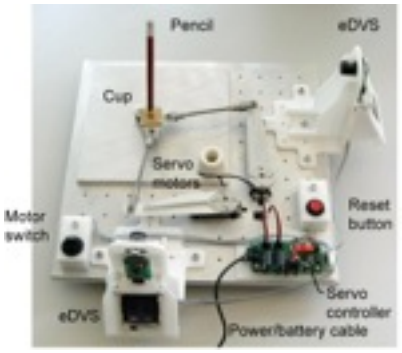
Title Learn to balance a pencil based on the data of two dynamic vision sensors

Supervisor Alexander Förster

Keywords Dynamic vision sensor, pole balancing, reinforcement learning

Prerequisites Master course Intelligent systems and Robotics, experience with embedded systems or robot can be helpful

Abstract Robotic pole balancing with large objects is a well known exercise in current robotics research and also one of the most famous examples of reinforcement learning. However, balancing arbitrary small poles (such as a pencil, which is too small for a human to balance) is challenging, because to the limitations in vision processing. A dynamic vision sensor is inspired by the animal's retina. It responds to temporal contrast in an event based manner and does not grab images as frames. This method drastically reduces the amount of data processing required to react to environment changes.
The current implementation of the pole balancing robot is based on a simple engineered algorithm for a specific pencil. The goal of this project is to implement an adaptive and robust control system based on machine learning methods.
For more information, contact the advisors directly.



Links http://www.ini.uzh.ch/~conradt/research/PencilBalancer/
https://wiki.lsr.ei.tum.de/nst/programming/edvsgettingstarted
http://webdocs.cs.ualberta.ca/~sutton/book/the-book.html

Bachelor project

Title Human interaction with a swarm of mobile robots via a touch sensitive tablet

Supervisor Alexander Förster, Juxi Leitner

Keywords human robot interaction, swarm robots, tablet programming (android/ios)

Prerequisites Programming in C, experience with embedded systems or robot can be helpful

Abstract Swarm robotics and swarm intelligence is inspired by the emergent behavior observed in social insects. Swarm robots are in general simple physical systems with a elementary individual behaviors influenced by local communication between the members of the group. The instinctive interaction between the individuals generates self-organization which sometimes seams to be intelligent.
Unlike distributed robotics systems, swarm robotics focuses on a much large number of robots, and promotes scalability.
The key question is how a single user can control a swarm of robots with a simple control interface to fulfill a task which cannot be solved without a massive number of individuals. Within this project various control strategies should be applied to mobile robot systems in simulation and in the real world.
For more information, contact the advisors directly.

Links http://www.idsia.ch/~alexander/robotlab.html
http://www.swarmcontrol.net
http://robohub.org/researchers-use-single-joystick-to-control-swarm-of-rc-robots/
http://en.wikipedia.org/wiki/Boids
http://www.idsia.ch/~nagi/research.html (for inspiration)
http://www.youtube.com/watch?v=HSOziHgQedA (for inspiration)

Master project

Title Camera grid for tacking miscellaneous objects with similar forms of appearance

Supervisor Alexander Förster

Keywords computer vision, photogrammetry, multi camera system

Prerequisites Programming in C/C++, knowing Matlab

Abstract The aim of the project is to extend an existing real time color based object tracking program. The current version of the software is tracking objects in the image space of one camera. The system has to be extended in some ways: A post-processing step to convert the image coordinates to world coordinates has to be integrated into the real time process. Secondly, the software has to be extended to handle multiple cameras and information about the object positions have to exchanged between the camera tasks. Thirdly, feedback information from the objects has to be integrated into the system for a very robust tracker.

The current tracking system is programmed with the Qt framework and the DC1394 library to handle FireWire cameras in a operating system independent way.

For more information, contact the advisor directly.

Links http://www.idsia.ch/~alexander/robotlab.html
http://qt-project.org/
http://damien.douxchamps.net/ieee1394/libdc1394/
http://www.vision.caltech.edu/bouguetj/calib_doc/

Bachelor project

Title Using cheap robots for a mobile wireless sensor network testbed

Supervisor Alexander Förster, Anna Förster

Keywords mobile robots, embedded systems

Prerequisites Programming in C, knowing C++, experience with embedded systems or robot can be helpful

Abstract The aim of the project is to extend an existing software system to a new robot. The current version of the software is controlling a special kind of robots via Bluetooth. The system has to be extended in some ways: A host control module has to communicate with an infrared transmitter and broadcasts packets to mobile robots equipped with a infrared receiver. Secondly, the software on the mobile robots has to be extended to handle incoming packets and to control the robot accordingly.
The host software system is programmed with the Qt framework in C++, the software on the robot is written in C.
For more information, contact the advisors directly.

Links http://www.idsia.ch/~alexander/robotlab.html
http://www.idsia.ch/~foerster/2012/3/main_abstract.pdf
http://www.irtrans.de/en/shop/usb.php
https://aseba.wikidot.com/en:thymio