ECHORD call1 experiment

GRASPY

Stereovision for Grasping by Humanoid Robot

6th of April 2011

EURON/EUROP Workshop

Vasteras, Sweden

European Clearing House
for Open Robotics Development
www.echord.info

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Experiment GRASPY

- Man and Robot will live together
  - ❖ At work
  - ❖ At home
- Specific features of the robot
  - ❖ It is mobile in its environment
  - ❖ It can manipulate objects
  - ❖ It communicates with humans
- Strong need in
  - ❖ Perception of the environment
  - ❖ Interaction with objects and humans

Experiment GRASPY

- Developments
  - ❖ Stereovision head for Nao
  - ❖ Localization of objects for grasping
  - ❖ Exchange of objects between the human and Nao

- Timing
  - ❖ Object Grasping : T0+8
  - ❖ Stereovision head : T0+9
  - ❖ Stereovision software : T0+12
  - ❖ Object Releasing : T0+12
  - ❖ Complete scenario : T0+14
  - ❖ Results of evaluation : T0+18

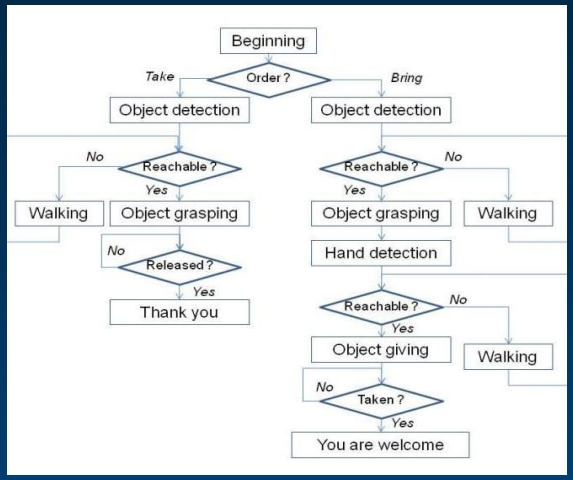
Experiment GRASPY

- Aldebaran Robotics
  - ❖ French SME
  - ❖ Humanoid Robot manufacturer
  - ❖ Development
    - ✓ Stereovision head
    - ✓ Releasing function

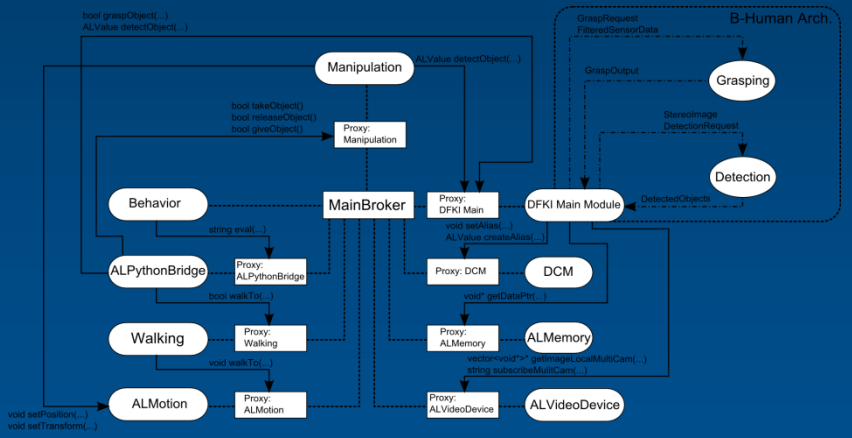
- DFKI
  - ❖ German research institute
  - ❖ Expert in Artificial Intelligence
  - ❖ Expert user of Nao
  - ❖ Development
    - ✓ Stereovision software
    - ✓ Grasping function

Experiment GRASPY : Specifications

- Scenario (deliverable 1.1)
  - ❖ Manipulation of cylinder-like objects
  - ❖ Graspable objects (vertical position)
  - ❖ The robot grasps the object
  - ❖ The robot gives the object



- Interfaces (deliverable 1.2)
  - ❖ Software architecture
  - ❖ API of functions



Experiment GRASPY : Stereo Vision Head

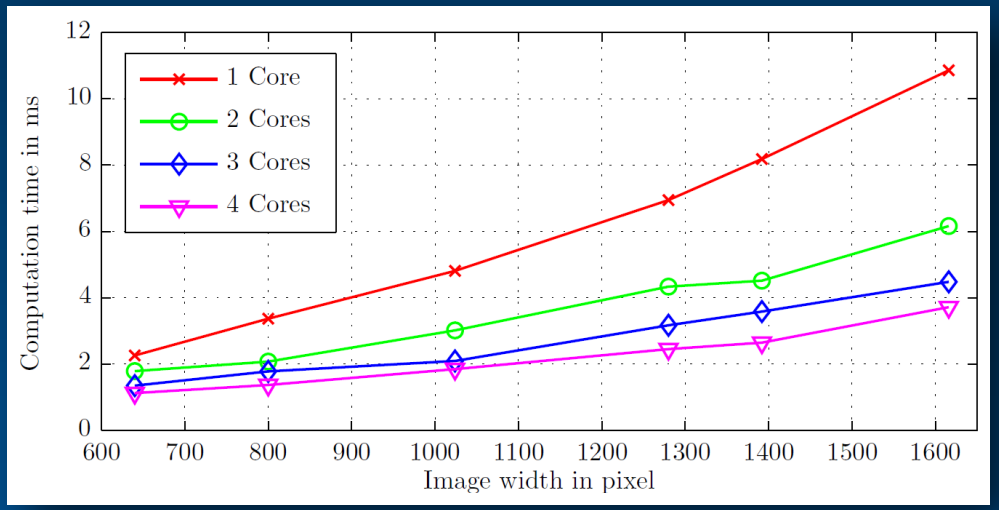
- New camera
  - Aptina MT9M114
  - 7 times more sensitive than the current camera in VGA resolution
  - Better low light images
  - lower motion blur
  - Up to 2.5 higher frame rate
- New lens 72.6⌖DFOV (instead of current 58⌖)
- New CPU
  - Intel Atom Z510@1.1GHz and Z530@1.6GHz
  - MMX, SSE, SSE2, SSE3 and SSSE3 SIMD instructions
- New architecture
  - FPGA for interfacing CPU and synchronized cameras
    - ✓ Software under development
  - Mechanical integration under development

Experiment GRASPY : Stereovision Software

- Contrast-Normalized Gradient Criterion

- Highly optimized implementation
  - ❖ SSE-intrinsics for computation core
  - ❖ Look-up table encoding shape to be searched for
  - ❖ multi-scale search scheme
  - ❖ multi-core support
  - ❖ so far evaluated on Intel Xeon W3520@2.67GHz

- Progress
  - ❖ Currently circle detection
  - ❖ Generalization to generic shapes under way
    - ✓ e.g. object, hand



Experiment GRASPY : Grasping

- Capability Map
  - ❖ Workspace is covered by a cube divided into equally sized sub cubes
  - ❖ Each sub cube represents a reachable area
  - ❖ Reachable areas are calculated by forward kinematics
- Grasp Planner
  - ❖ Using the Capability Map to decide whether an object is reachable
  - ❖ Plans full body movement