POLITECNICO
MILANO 1863

COGNITIVE ROBOTICS PROJECT

NAO-KINECT

DOCUMENTATION

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INTRODUCTION

The NAO-Kinect project is about the imitation of the upper body movements by a robot.

The tools we used are: a Kinect sensor (for Xbox 360) and a NAO robot.

Generally speaking, the system works as follows: the user moves in front of the Kinect, the sensor records the movements and sends them to the NAO, then the robot imitates them.

KINECT

The Kinect sensor, once activated, starts recording the movements of the user.

It identifies all the joints of the user and builds a skeleton. The skeleton is then streamed to every listener. The fixed frame rate is 30 frames per second.

It is suited for vocal commands recognition, though it was not included in the final application. The basic commands are Start/Stop the recording, the skeleton streaming, the speech recognition and the imitation.

The libraries needed to run the project are:

- Kinect for Windows SDK v1.8
- Microsoft Speech Platform SDK
- (eventually) en-US and/or it-IT Speech Recognition Language packs

NAO

NAO is a humanoid robot, created by Aldebaran Robotics, it is widely used, for academic purpose, it has been also used in teaching and since 2007 became the robot is used in the RoboCup competitions

The robot works in this way: a main software runs on the robot, which is NAOqi. NAOqi offers the main instruments needed in robotics.

When the robot boot NAOqi start all the modules and keep track of them in a tree structure, modules are classes and every one has a particular purpose, NAOqi act also as a broker, receive request from the network and activate the corresponding module, it can receive request from other broker or proxy.A proxy is an abject that behave as the module it represent

For our project ALMotion is the main module, since offer control for the stiffness and for the joint. The motion proxy is connected to the broker that is the NAOqi running on the NAO itself. We used also the ALRobotPosture to make the robot go to the stand position

Library used : naoqi-dotnet4-sdk-1.14.5

A more complete explanation: http://doc.aldebaran.com/1-14/dev/naoqi/index.html

ALMotion overview: http://doc.aldebaran.com/1-14/naoqi/motion/index.html#almotion

ALRobotPosture overview: http://doc.aldebaran.com/1-14/naoqi/motion/alrobotposture.html#alrobotposture.

FROM KINECT TO NAO

The goal is to compute the joint angle starting from the joint position : from cartesian space to joint space. In order to get the angles we compute vectors between those point, for example :

-UpperArm = Shoulder - Elbow

-LowerArm = Wrist - Elbow

To obtain the angle between two vectors we used the following formula:

theta = atan2(|Vect1xVect2| , Vect1.Vect2) [the result is in radians]

|Vect1xVect2| is the magnitude of the vector product between the 2 vector that is equal to sin(theta)|Vect1||Vect2|

Vect1.Vect2 is the scalar product between the 2 vector that is equal to cos(theta)|Vect1||Vect2|

We used atan2 instead of the simple atan function, because it is more stable and suitable for our purpose. A simple example could be the computation of the elbow roll, which involve ,the already mentioned, upper and lower arm. Once we have the position of the shoulder, of the elbow and of the wrist, we can compute the two vector. Next step is to compute the angle applying atan2, where Vect1 and Vect2 are replaced by UpperArm and LowerArm. Once the angle is found is adjusted with an offset, in our case for the elbow roll the offset was pi/4

SOFTWARE SETUP AND USE

In order to use the software is possible to download the whole code from the repository at https://github.com/TheVerga/NAOKinect.

Once downloaded the project open it with Visual Studio, compile and run it.

Be sure to have connected the Kinect sensor to your PC and then click on “Connect KINECT”. If the connection is fine the tracked skeleton will appear in the window.

Type in the specific textboxes the Nao’s IP and the Port number and click on “Connect NAO”. If you don’t know the IP you can press the button on the chest of the robot and he will tell you.

From now on Nao will follow the movement of the arms and the neck of who stands in front of the Kinect sensor. Be sure that the image of the skeleton is completely inside the window, in particular the arms and the head and that only one skeleton in represented in the window.

To stop the program close the window

CONTACTS

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