5 Nao Robot

Module Goal

The purpose of this module is to introduce the student to the NAO robot and Choregraphe software. Using the Choregraphe software the learner will write a program to control the NAO robot's operations.

INTRODUCTION

Learner will be able to:

- Provide an overview of the NAO robot
- Identify Choregraph Software
- Expand upon creating programs using Choregraphe software
- Given specific tasks, create programs to control the NAO robot with Choregraphe software

INTRODUCTION TO THE NAO ROBOT

The NAO Robot

The NAO robot is a revolutionary teaching tool from which to introduce robotics starting with very basic logic programming up to more advanced programming languages such as c++ or python.

Degrees of Freedom

The NAO robot is comprised of 25 **degrees of freedom.**

Degrees of freedom are the x,y, and z axis with which a robotic arm may move across for each joint. This means the up and down, left and right, and forward and reverse movements. A robotic arm typically consists of 6 degrees of freedom.

NAO Sensors

The NAO robot has two cameras located at its forehead and mouth. Two speakers for ears and four microphones around its head. There are a total of 7 tactile sensors located on its body, 3 on the head, 1 on each hand, and 1 on each foot.

List the key terms that are required for the students to understand this topic and provide a definition.

Available Resources:

OPEN SOURCE MATERIALS, include thumbnails for placement of each photo in MBL INTERACTION section above:

Name of Resource	Author/s	Source Location	License

INTRODUCE CHOREGRAPHE SOFTWARE

Choregraphe

The software which accompanies the NAO robot, **Choregraphe**, comes with a 3D virtual version of the robot which can be programmed as if it were the real thing**.**

Choregraphe allows students an easy to understand pictorial form of programming instead of the conventional text based programming languages.

Under the "pictures" they represent, is the actual coding which can be edited or whole new codes can be add through choregraphe.

This program is extensive and includes a number of functions which requires being connected to the actual NAO robot in order to function. For this reason this section will discuss only those that will be used to control the virtual robot.

Choregraphe User Interface

Click on the markers to learn more about the Choregraphe User Interface.

- Robotic View – 3D virtual NAO
  This display allows for selecting each part of the robots body that the programmer wants to move. Each degree of freedom is shown and can be moved by changing the degree at which the servo is at. Recording of the changes made can be done by having a timeline open in the background. It is important to note that you should select what time segment you would like the changes to take effect at, otherwise the previous motor positions may be overwritten. A virtual NAO is grey in the robotic view window, a real NAO is colored.
- Connect To
  o Connect To Window
    Connect To opens a window that scans for the current NAOs, virtual and real, currently running on the network which the computer the choregraphe program is open on. Note: The virtual NAOs are shown in blue and the real NAO is shown in green.
- Disconnect
  This button disconnects from the current NAOqi that the program is connected to.
- Stiffen All Motors On/Off
  When the NAO is running the servos are activated so that it will hold the position or be able to move.
  o Wake
    When selecting "Wake", the NAO's motors stiffen and he stands up.
  o Sleep
    Selecting "Sleep" makes the nao move into a resting position and removes the stiffness from the motors. The resting position is taken so that once the stiffness of the motors is removed, the robot will not fall over.
- Flow Diagram Area Input/Output
  The NAO works based on start/begin and end/finish logic. This means that once an applications is started a signal is sent from the 'flow diagram area input' into the first box. Once that box is finished it will send out information, usually a single signal which will start the next box or end the application by going to the 'flow diagram area output'.
- Box Library
  The Box library contains all of the preprogrammed codes and animations that will be used to control the robot.
- Box Description Area
  By hovering over a box, a description of what it does will be shown under the box library.

- Automated Life Mode
  The Automated life mode allows the NAO 2.1 to act more human by tracking movements and sounds, locking onto faces, and rotating to the person whom is speaking. This mode is not useful to have active while programming since the NAO will constantly move its legs, arms, and head to appear to be human.

List the key terms that are required for the students to understand this topic and provide a definition.

Available Resources:

OPEN SOURCE MATERIALS, include thumbnails for placement of each photo in MBL INTERACTION section above:

Name of Resource	Author/s	Source Location	License

CREATE PROGRAMS WITH CHOREGRAPHE SOFTWARE

Choregraphe Programming

Choregraphe is a modular programming software application that can be used to program the NAO robot to perform simple to very complex behaviors. Choregraphe may be used with or without an internet connection, but must to be connected to the same IP address as the real or simulated robot in order to operate.

Choregraphe Modularity

Choregraphe is modular because it uses boxes. Users click and drag boxes from the Box Libraries onto the Flow Diagram Panel. When the appropriate inputs and outputs are connected, the program associated with the boxes shown in the flow diagram panel will load and run on a NAO that is linked with Choregraphe by clicking the Play icon on the toolbar.

Choregraphe Demonstration

List the key terms that are required for the students to understand this topic and provide a definition.

Available Resources:

OPEN SOURCE MATERIALS, include thumbnails for placement of each photo in MBL INTERACTION section above:

Name of Resource	Author/s	Source Location	License

TRANSFER PROGRAM TO THE NAO HUMANOID ROBOT WITH CHOREGRAPHE SOFTWARE

Program Transfer to NAO

The Choregraphe program must be transferred to the NAO robot in order for it to operate. This can be done wirelessly with a Wi-Fi hub that has been set to connect automatically with the NAO robot.

Position the NAO

The NAO can be manually placed into a neutral crouch position when it is powered down without causing damage to any joints because they are relaxed in the powered down mode.

Power Up the NAO

Power on the NAO by pressing the button on his chest.

The software will boot and flash several lights. This process may take several minutes. The NAO will say "Oneg nuke" when he is fully booted, indcating that the NAO is set up to connect automatically with the wi-fi network hub. Instructions can now be sent to the robot using Choregraphe over the wireless LAN.

Launch Choregraphe

Launch Choregraphe and establish a connection to the NAO by clicking the green "Connect To" icon which will open a window and allow you to select your robot. Select your robot and click the Connect To button at the bottom of the window.

Robot View

The Robot View should now accurately represent the robots stance in the crouching position and you are ready to build a program to make the robot say "I'm tired" and wipe its forehead.

Select and Connect Commands

Select and drag the Say and Wipe Forehead boxes from the Box Libraries into the programming panel.   Click the OnStart black arrow at the upper left corner of the programming panel and connect the line to the Say black input arrow in order to connect the Say box. Then click on the red output arrow of the Say box and connect to the black input arrow on the Wipe Forehead box.

Click the Play program icon on the toolbar to send the program to the NAO. This will execute the program and the robot will say "I'm tired" and then wipe his forehead. The command will be performed in the Choregraphe Robot View and at the actual Robot. Click the Play program icon on the screen to view a video demonstration.

Shut Down

Actual NAO standing:

Shut the NAO off by pressing the chest button for about 3 seconds until he says, "Nuke, nuke". Move your hand so that NAO can slowly crouch down on his own and turn off. All of his lights will turn off when the robot is powered down and the Choregraphe application can be closed.

List the key terms that are required for the students to understand this topic and provide a definition.

Available Resources:

OPEN SOURCE MATERIALS, include thumbnails for placement of each photo in MBL INTERACTION section above:

Name of Resource	Author/s	Source Location	License
File:Linksys WRT54G V1.jpg **NO ATTRIBUTION**	Tharkhold	http://commons.wikimedia.org/wiki/File:Linksys_WRT54G_V1.jpg	Public Domain

SUMMARY

The NAO robot is a monumental advancement in robotic engineering. The software package which accompanies the NAO robot, Choregraphe, is a modular programming software application that can be used to send commands wirelessly to the NAO robot. Robot commands can range from the very simple to the highly complex.

LABS

Provide an overview of labs that are required. Include any links to labs that are available for review.

See NAO – Humanoid Robotics Manual 1 Level 1:

Lesson 6 – Introduction to Choregraphe

Lesson 7 – Basic Interactions

*Extra Lesson 8 – Basic Interactions 2 (This can only be done one group at a time since it requires the NAO robot.

QUIZ

.

FURTHER STUDY

Provide brief information here about where students can get more information on this topic (leading organizations, libraries focused on this topic, etc…). Be sure that the information is nonproprietary, reliable, and fairly static (something we won't have to change often).

STATEMENTS

Form

Form