

Instruction Manual

Robotic Clothing Recommendation System

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1 Software Dependencies

- Python version 2.7 Download Page.
- Ubuntu version 14.04 Download Page .
- Robot Operating System version Indigo with a catkin workspace, Installation Instructions.
- Naoqi Python SDK, Download Page.
Username: asblab.robots@gmail.com Password: uoftASBLab
- Choregraphe, Download Page.
- Python Weka Wrapper, Package Page.
- Java Virtual Machine (part of the Python Weka Wrapper installation procedure).
- MySQL for Ubuntu, Installation Instructions.
- mySQLdb, Package Page.
- Transitions, Package Page.
- Android Studio, Download Page.
- phpmyadmin Installation Instructions.
- Pybluez, Package Page.

2 Required Files and Directories

- Built catkin workspace for ROS Indigo, with an ROS project named prototype containing the following Python files: android_connector.py, clothingfsm.py, decoupled.py, debugger.py, and robotfsm.py.
- A speech directory in src/scripts directory in the catkin workspace containing the following .mp3 files: Athletic.mp3, Comfort.mp3, DressCode.mp3, Entire.mp3, FinishedOutfit.mp3, FinishedOutfit2.mp3, Generating.mp3, GladLike.mp3, InsideOutside.mp3, Introduction.mp3, NextButton.mp3, Okay.mp3, ReplacingEntire.mp3, ReplacingPieces.mp3, Satisfied.mp3, SoundsGood.mp3, Thanks.mp3, UserProfile.mp3, WholeOrPart.mp3.
- A srv directory in the src directory of the catkin workspace containing the following ROS service files: Features.srv, FeatureType.srv, Feedback.srv, Recommendations.srv, RecommendationsTwo.srv, SaySomething.srv, ScreenTransition.srv, UserName.srv, WaitAcceptance.srv, WaitAcceptanceTwo.srv, WaitNext.srv, WaitReplace.srv, WaitReplaceTwo.srv.
- Android studio projects ClothingRecommenderNoDelay and ClothingRecommenderV3, which are directory names, located in the home directory.
- A mysql database named userprofiles containing tables users and clothing. Users is a listing each of the users currently using the system, and the clothing table is a table which contains the clothing items for each user.
- In the Android device's external storage directory path, there should be a directory titled 'clothing', where pictures for each clothing item are located, and referenced to when running the application. Each picture item in this directory should be a .png format picture in order to

3 Initial Setup

3.1 Bluetooth Connectivity

The system will not be functioning correctly unless the server computer running the ROS files is connected with Bluetooth to the tablet. Setting up the Bluetooth device should be done through consulting Google, as it is different for different types of systems and Bluetooth devices. Once properly configured, the Bluetooth icon should be shown on the top right corner of the screen (see following figure). Clicking this will allow to pair to the tablet device. In the device, navigate to the Bluetooth settings screen, as this is required for the device to initially pair with the computer. Once the device is on the Bluetooth settings screen, click the Bluetooth icon on the computer, search for the device, and attempt to pair with it. On the device, a PIN number should be displayed on the screen, which should be inputted into the computer to complete the pairing.

As any problems are going to change based on bluetooth devices, Google search engine is recommended for troubleshooting.

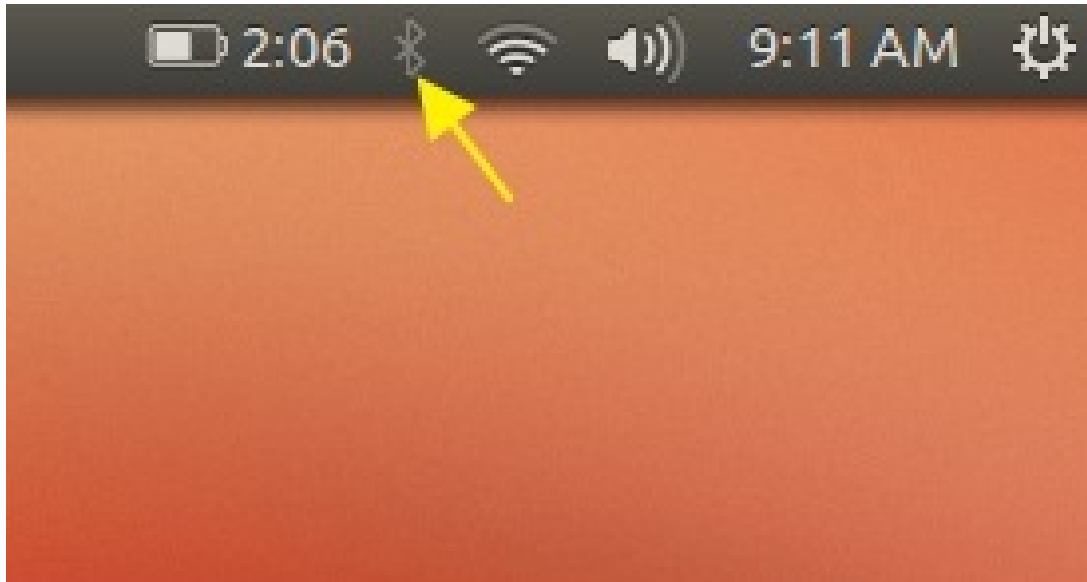


Figure 1: Bluetooth Icon in Ubuntu.

3.2 Nao Connectivity

This section is only required to be completed if the Nao robot is not configured to be run on the same network as the computer.

In order for the system to run correctly, the Nao must be connected to the same network as the computer. If the computer has wireless connectivity, simply ensure that the Nao and the computer are connected to the same wireless network. Setting up the Nao wirelessly can be done through the instructions located on Aldebaran's website.

If the computer does not have wireless connection capabilities, it can still be connected to the Nao robot by plugging it into the router or modem that the Naos connection is through. This means that the router/modem must be physically located in the same place as the computer, within distance to pair an ethernet cable between the two devices.

3.3 Touchscreen Connectivity

The touchscreen can be easily connected to the computer through any USB 2.0 or USB 3.0 to USB-C cable. The device used for this project, the Acer Iconia One, should show up as a device named B3-A20 if connected correctly and the device is charged.

4 Running the System

4.1 Turning on and Connecting to the Robot

Before this section should be followed, please refer to the earlier section Nao Connectivity, and ensure that the robot is connected to the same network as the computer.

1. The first step is to turn on the robot, which requires the robot to be charged ahead of time. Simply press the button on the Nao's torso once, and the lights on the robot should light up. This boot process typically takes around 2-3 minutes, and when finished, the robot will say 'Ognag Gnouk', unless its sound is on mute.
2. Once booted, the first thing that should be done is opening the Choregraphe software, and making sure that the robot is visible for connection. This can be done by clicking the icon on the top left of the Choregraphe GUI, shown in the figure below. This should open up the connection window, in which the robot should show up to be connected, and the IP address displayed.
3. Click on the correct Nao and click connect to connect to the robot in Choregraph. Once connected, the volume can be quickly changed to the desired level using the icon on the top right of the GUI (shown in the figure below). Also in that section of the GUI, are the Wake and Rest commands, which are the moon and sun icons respectively. The battery life is also shown in this section of the GUI. If the battery life is orange or red, plug the robot in to charge it to yellow before running the system.
4. Before the system can be run, the robot needs to be in the rest position, kneeling with its legs fully bent, and hands resting on its thighs. If the robot is not already in the position, pick the robot up, and press the Wake button. This will stiffen its joints, and should put the robot into the standing position. If the robot does not automatically go into the standing position, go to the pose library and double click Stand,
5. Once the robot is in standing position, simply put the robot into the surface where the robot is intended to be located during the interaction, and then press the rest

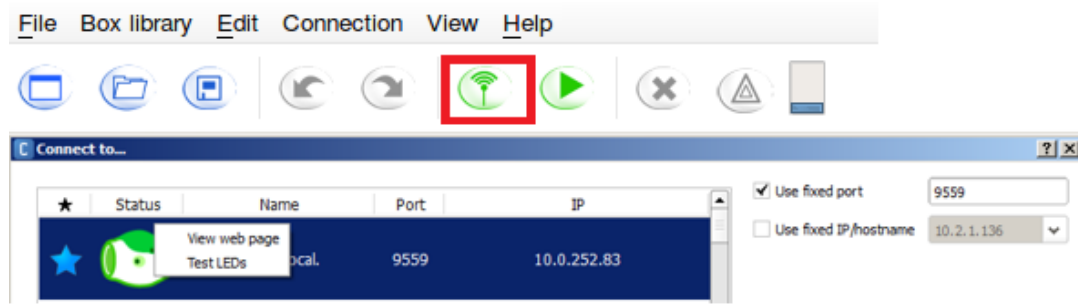


Figure 2: Connecting to Nao in Choregraphe.

button (Moon icon) once more. Now the robot is configured and ready to be used in the interaction.

4.2 Turning on and Connecting to the Android

Before this section should be followed, please refer to the earlier section Touchscreen Connectivity, and ensure that the touchscreen is connected to the computer, and is charged. For the Acer Iconia One, the device can be turned on by holding the button on the top left of the device for 3 seconds.

1. The first step is to run Android Studio on the computer. This can be done by either using a start-icon if that has been configured, or navigating to the directory where android studio is located in bash, going to the bin folder, and typing the following command to run Android Studio:

```
./studio.sh
```

2. Once Android Studio opens, click Open Project and navigate to the directory 'ClothingRecommenderV3', and click on it to open the project.
3. If this is the first time running the system, click the Build command in the toolbar and build the project.

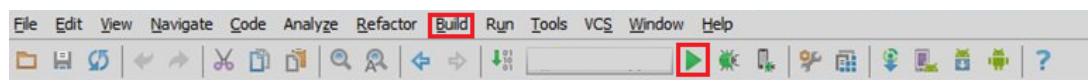


Figure 3: Android Studio Toolbar.

4. Click the green rightward facing arrow to run the app on the device. Select the appropriate device when prompted, and click O.K. to run the app on the device. If this is done correctly, the clothing recommendation app should show up on the device, with the following screen displayed.

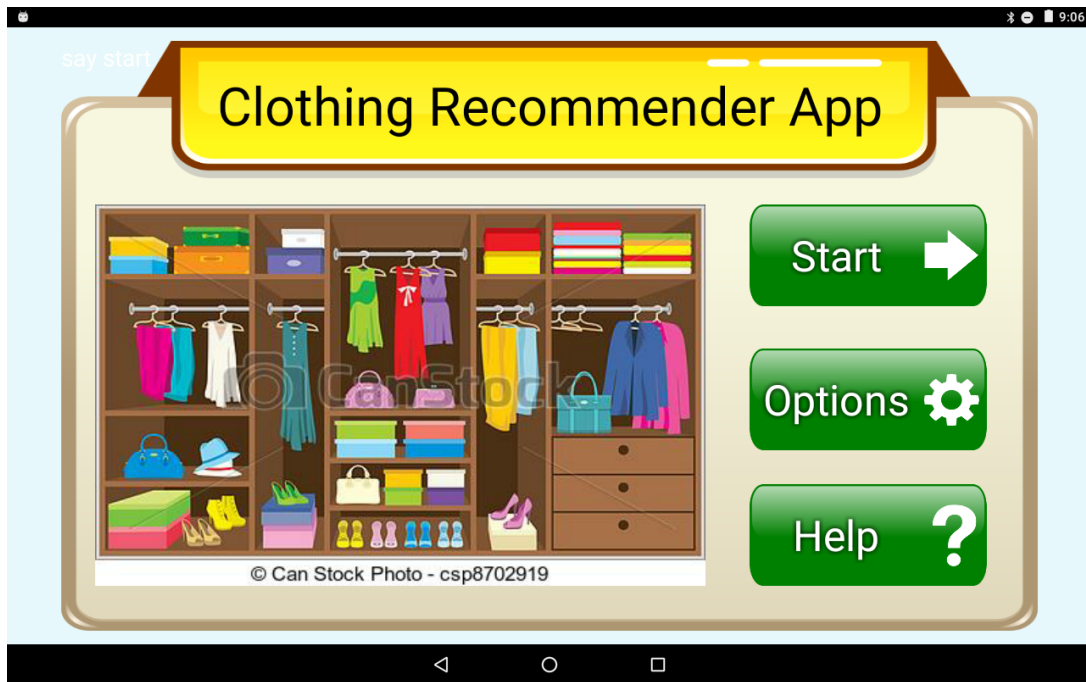


Figure 4: Welcome Screen of App.

4.3 Running the Full System

Before following the steps in this section, ensure that the robot is turned on, connected, and in the rest position before starting. Also, the android device must be running the clothing recommendation app, which should be displaying the aforementioned welcome screen on the main screen.

1. First, open four new terminal windows in Ubuntu (Ctrl + Alt + T).
2. In one of the four terminal applications enter the following command to start the ROS core:

```
roscore
```

3. In another, different terminal window, enter the following command:

```
roslaunch prototype android_connector.py
```

4. In another, different terminal window, enter the following command:

```
roslaunch prototype clothingfsm.py
```

5. In another, different terminal window, enter the following command:

```
roslaunch prototype robotfsm.py
```


6. Once these steps are completed ensure that each of the four processes is running in its own terminal window.
7. Now, the interaction is ready to begin. The android tablet can be disconnected physically from the computer, and should be placed to the right side of the robot to ensure that the robot's gestures are pointing to the tablet correctly.
8. Start the interaction by pressing the 'Start' button on the touchscreen.
9. Once the interaction is finished, in order to be run again, the three latter processes must be run again. This can be done quickly by going to each terminal window, pressing the up arrow key, and pressing enter.

4.4 Running the Tablet-Only System

The instructions for running the tablet-only version are the exact same as for the prior, except for a few small differences:

- The robot is not needed for this version, so all instructions involving turning the robot on and connecting to the robot are not required.
- Instead of running `robotfsm.py`, run the python script `decoupled.py` instead:

```
roslaunch prototype decoupled.py
```
- Instead of running the Android Studio project 'ClothingRecommenderV3', run the Android Studio project 'ClothingRecommenderNoDelay' instead.
- Ensure that loudspeakers are connected to the computer, so that the text-to-speech can be heard.

All other instructions and aspects of running the system are the same.

5 Updating Clothing in the Wardrobe

Adding to the clothing table for the default wardrobe must be done through phpmyadmin. This section will be rather brief, as plenty of phpadmin tutorials exist online.

1. Open up an internet browser and put the following address in the address bar:
`http://localhost/phpmyadmin/`
2. Open the clothing table in phpadmin.
3. Add a new clothing item, selecting the right clothing category, label type, and putting a string description.
4. Plug the android device into the PC, open up the local storage on the device, and go to the clothing folder.
5. Add a picture of the clothing item you added to the database, which will be displayed on the mannequin in the program.
6. Name that picture 'String.png', where String is the description of that clothing item you added to the clothing table in the database.

6 Troubleshooting and Known Solutions to Issues

6.1 System Stops Working While Running

If an error occurs while the system is running, the following steps should be taken:

1. If the `robotfsm.py` module was in the middle of running, and the system stops working, the robot needs to be restarted. Press and hold the button on Nao for 3-5 seconds until the robot says 'Gnuk Gnuk'. The robot will then take approximately a minute to shut down, and then needs to be turned on again.
2. Go into the `clothingfsm.py` and `robotfsm.py` terminal windows, press `Ctrl + Z`, and then run each of these again.
3. Go into the `android_connector.py` terminal window, press `Ctrl + C`, and then run this process again. **Important: Do not press CTRL + Z in the android_connector.py process terminal.**
4. If the android application is frozen on any screen, and is not on the welcome screen, close the app on the tablet, reconnect it to the computer, and run the application again.
5. Once these three processes are running again at their first stage, the robot is turned on and connected, and the android application is on the welcome screen, the interaction can start again by pressing start on the touchscreen.

6.2 ROS Package Not Found

If none of the three python files are running properly, due to an error of the package not being found, this means that the ROS environment is not setup correctly.

The following command needs to be run while in the `catkin_ws`:

```
source devel/setup.bash
```

And the following needs to be added to the `bashrc` file:

```
source path-to-catkin_ws/devel/setup.bash
```

After this is done, if there are still errors, it's possible that the catkin workspace hasn't been updated. Navigate to the `catkin_ws` directory and run the following:

```
catkin make
```

6.3 Issues Running robotfsm.py

There are a few common issues that might occur when running robotfsm.py.

6.3.1 Error with the statement from naoqi import ALModule on line 9

:

The only way that this error will occur is if the Naoqi Python SDK is not properly configured. Repeat all installation instructions if necessary, and test that the library is configured by starting the python interpreter by typing 'python' in any terminal window and pressing enter, and then typing import naoqi and pressing enter. If no error occurs, naoqi is installed correctly.

One of the most common issues is that the Naoqi SDK is not located on the PYTHON-PATH. The following two lines need to be added onto the bashrc file:

```
export PYTHONPATH=${PYTHONPATH}:/path/to/python-sdk/lib/python2.7/site-packages
export DYLD_LIBRARY_PATH=${DYLD_LIBRARY_PATH}:/path/to/python-sdk/lib
```

6.3.2 Cannot connect to Naoqi error:

If robotfsm.py is run, and an error message shows that the process is unable to connect to the Naom this could mean either one of the two following things:

1) The Nao is simply not connected properly.

In this case, ensure that you are able to connect to Nao in Choregraphe. If the robot is not showing up there, follow the directions on the Aldebaran website for configuring the wireless settings properly for the Nao.

2) The IP address for the Nao in the robotfsm.py program is not correct.

Occasionally, the IP address for the Nao can change, or if it's set up on a different router, it will definitely change, and thus the robotfsm.py script must be modified for the new IP.

To learn the new IP, either check the IP through the connection window in Choregraphe, or press the Nao's torso button once (don't hold it), and Nao will recite its IP address out loud. Then, open the robotfsm.py file in a text editor or Python IDE and navigate to line 710. Change the listed IP to the correct IP, and save the file before running the rosrn command again.

```
NAO_IP = "10.254.25.108"
```

6.4 Issue Running clothingfsm.py

There is one major issue that can occur when trying to run clothingfsm.py

6.4.1 Error Connecting to the mySQLdb Database

If there is any connection error to the mySQLdb Database, this means that something is not configured properly with the database. This error should not occur unless there was some form of tampering with the database or tables.

Firstly, open clothingfsm.py and navigate to line 537. Ensure that the *host* parameter is set to either 'localhost', or if it is already set to localhost and you are receiving an error, change the host parameter to '127.0.0.1'.

Also, ensure that the *user* and *passwd* parameters are correctly set for your database.

Lastly, ensure that the mysql folder located on your system contains the correct database, with a directory named userprofiles in it, containing the table files clothing.frm and users.frm.

6.5 Bluetooth Errors

If there are any bluetooth errors displayed on the app while running, even though the computer and tablet device are paired, simply stop all of the processes, physically remove and reconnect the bluetooth adapter, and run the program again.