Intelligent Interactive Systems – Projects

1. Computer Vision Project – Instruct an Exercise session

Background: For elderly people, people with chronicle illnesses or people recovering from an accident it is crucial to exercise on a regular basis. However, providing enough medical staff to instruct the exercise is often a problem. In addition, some of the patients are embarrassed to practice, because they might be slow in understanding and executing the tasks. Luckily, robots can help with both problems. It has been shown that robots are indeed capable of instructing successful exercises and are often even more motivating for people to perform the exercises than their human counterparts.

Task: Your virtual NAO robot shall instruct an exercise session and correct the user if he or she does not perform the exercise correctly. Select six different exercises (either body postures or movements) that both a human and the NAO robot can perform in a similar manner. Implement those exercises in the simulated robot. The interaction with your system may look like this: First, the robot introduces the general task (please note that the virtual robot doesn't have speakers, so you may simulate the speech output by writing it to the command line). It then displays the first exercise people have to imitate. The user then tries to imitate the same posture or movements. The robot uses a camera (either a Kinect or regular RGB camera) to analyze the human exercise and gives feedback on their performance. A first step for giving feedback is to just give a binary "right" or "wrong" output. In a second step, you can implement more precise feedback, for example: "Please put the left arm a little higher". Once the exercise is correctly imitated, the robot moves on to the next one.
Ask some of your fellow students to perform an exercise session with your system and evaluate the system performance afterwards.
In addition to reporting the results, your project report shall also contain an elaboration about potential ethical concerns you identified with this system.

2. Machine Learning Project – Face Recognition

Background: Social robots often have repeated interactions with human users. During each interaction, the robot learns something about the preferences of the user that are useful to know in future interactions. Mapping these preferences to a certain user can be done in multiple ways, for example using some unique ID number or RFID chip card. However, more intuitive and human-like and therefore preferred in social interactions is face recognition.

Task: Your virtual NAO robot shall be able to recognize at least six different users using face recognition and greet them with a personalized gesture and sentence. Select at least six

different greeting-gestures the robot can perform and the humans can choose from. Implement those movements in the simulated robot.

The interaction with your system may look like this: When the robot meets a new user for the first time, it asks that person for his or her name and to choose one of the personalized gestures. The robot then learns the persons face and saves it together with the name and the gesture the user chose. The next time the user meets the robot, the robot performs the personalized gesture and greets the user by name. Please note that the virtual robot doesn't have speakers, so you may simulate the speech output by writing it to the command line.

You have to use an ordinary RGB webcams as an input for your system. For processing the camera data and for performing the machine learning task, you may use computer vision and generic machine learning libraries. However, you are not allowed to use pre-implemented libraries for face recognition.

Ask some of your fellow students to introduce themselves to the robot and then meet if for the second time. Evaluate the system performance afterwards.

In addition to reporting the results, your project report shall also contain an elaboration about potential ethical concerns you identified with this system.

3. Embodiment Project – Expressing emotions

Background: Engaging in a social conversation does not only require robots to correctly interpret emotional states of a human. One way of showing a social behavior for robots is to display emotions themselves. Humans show emotions mainly by using facial expressions. The NAO robot, however, has no facial expressions. Therefore, you have to fall back to using sound, body posture and LEDs. Many research has shown that there is in fact an influence on the embodiment type between 2D (virtual) and 3D (physical) embodiment. But is that true for recognizing emotions as well?

Task: Use the virtual 2D version and the physical NAO robot to express six different emotions: Happiness, Sadness, Disgust, Fear, Anger and Surprise. You can use the speech output as well as the LEDs and the body posture, but the robot is not allowed to name the emotion it is acting directly. In order to evaluate your ability to show emotions, make a small user study with some of your fellow students and see how well they can recognize which emotion the robot is expressing. Can they recognize the emotions equally well in both embodiments? Investigate as well if the intensity and naturalness is the same in both embodiments for each emotion.

In addition to reporting the results, your project report shall also contain an elaboration about potential ethical concerns you identified with this system.