Kung Fu Nao

Human-Robot Interaction (MKI50)

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1 Introduction

Introducing the reader to the topic of learning from robots.

The topic learning from demonstration is a topic that has seen a huge growth in the last few years. This topic always consists of teaching a robot how to perform a task via demonstration by a human. A new topic is that of learning a human how to perform a task from demonstration by a robot.

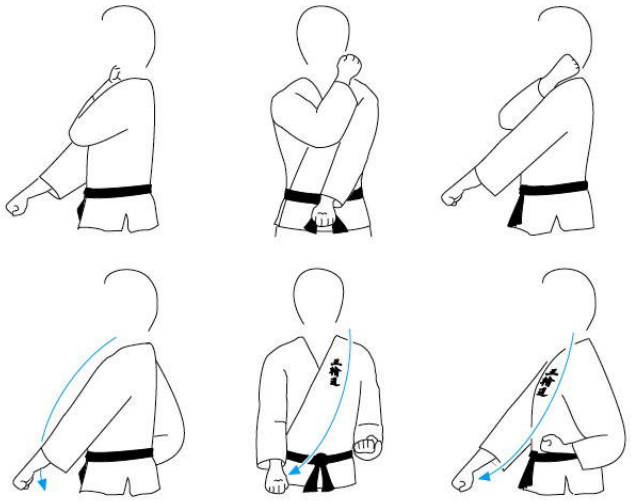
In this report an overview will be given of a robot capable of learning a human how to perform certain "karate" movements from demonstration by a robot. In this system a robot is able to perform a motion, teach the human how to perform this motion, assess the performance of the human and give extra information on the motions that are performed the worst by the user.

During our program the user is able to learn three motions:

1. Left hand punch
2. Defensive block
3. Right hand punch

The left hand punch and the right hand punch both are simple forward motions of the respective arm. The defensive block is a slightly modified version of the "Gedan barai" motion used in Karate. How this motion should be performed is visible in figure 1.

Figure 1: An instruction on how to perform the Gedan barai



2 Hardware and Software

2.1 Hardware

In order to build this system the following components were used:

- Laptop
- Nao robot
- Microsoft Kinect
- Wireless router

The Microsoft Kinect is connected to the laptop using an USB cable and is used to capture the body model of the user. The Nao robot is controlled with a wireless connection using the wireless router.

2.2 Software

In order to program this system the following software has been used:

- Microsoft visual studio 2012
- Microsoft Kinect SDK
- Choregraph

3 System

Discuss the system from an AI point of view.

3.1 Perception

A way to detect the user and the body model. Do not mention the Kinect.

3.2 Communication

Gestures + speech...

3.3 World Model

4 Individual Components

4.1 Perception

Skeleton tracking + dynamic time warping

4.2 Communication

Note here that we both use speech and gestures. Note that we use both beat gestures(gestures without semantic content) as well as metaphoric gestures (gestures indication thinking as well as gestures indication).

The metaphoric gestures are:

- Thinking
- Flexing of the muscles
- Bowing

Keyword	Possible words
YES	yes, sure, ETC.
NO	no, nope, ETC.
LEFT	left, left hand, ETC.
RIGHT	right, right hand, ETC.

For speech a word-spotting algorithm is used. This word-spotting algorithm uses a many-to-one mapping which maps several possible word onto one word that is returned to the system. This way the user can use several possible words to confirm a question of the robot. The mappings consist of:

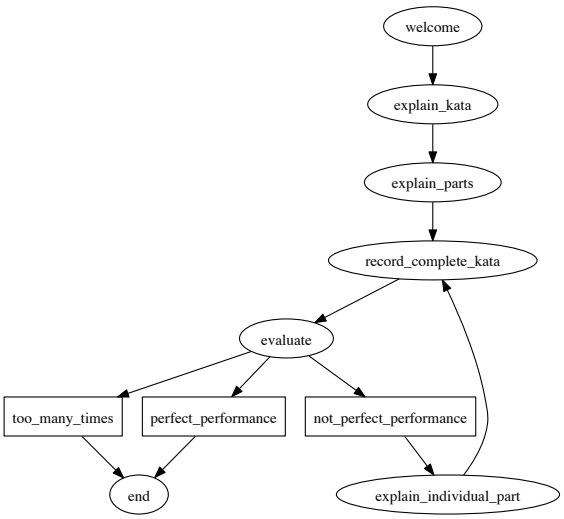
During the program Naomi will ask the user for input several times. Some of the questions are used to keep the user active during the program and are just meant to give the user extra interaction with the robot. An example of this question is: “Have you practiced Robot Karate before?” after which the robot either will say that it will be an easy lesson or asks the user to give extra attention to the gestures. Other questions are used by the robot to give specific feedback. An example of this question is asked during the performance of the defensive block: “Are you having more trouble with your left or with your right arm”, after based on the input of the user the robot will explain only one arm of the defensive block.

4.3 World Model

4.4 Graphical User Interface

5 Interaction Patterns

Figure 2: State diagram showing in what order the behaviours of the robot are performed



6 Conclusion