Encouraging HRI with a minimalistic and expressive robotic head

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I. INTRODUCTION

One of the main goals of social robotics is to design lifelike social robots which share everyday life with people and support them in daily activities [2]. Therefore social robots need to intuitively interact with naive users. We do not design social robots for trained expert users, but for everyone. In other words we need to design communicative functionalities, which are natural and easy to interpret. Different approaches for the design of heads for social robots can be identified, which can roughly be divided into “cartoon-like” (e.g. EDDIE [3], Flobi [5]) heads as well as very human-like anthropomorphic heads (e.g. Furhat [4], light-head robotic face [7]).

Our design goal is to develop a social robot head which follows a minimalist design approach, intentionally focussing on facial expressions supported by head movements. In the design of the facial expressions we similarly to others rely on animation principles ([6]). Furthermore, we aim at implementing an affordable robotic head that can be modularly used on different robot platforms.

II. DESIGN

The robot head is designed to show facial expressions (normal, happy, excited, tired, wondering, confused, upset, thinking, curious, surprised, angry, sleeping) with its eyes. Displays behind a transparent plastic shield act as eyes. Elevations of the shield around the eyes help to visually increase the sizes of the eyes. Facial expressions come with additional movements of the head on its three degree of freedom neck joint to support the expressiveness of the eyes and make the robot head appear more lively. Expressions come in three emotional intensities, which control the amount of head movement and simultaneously the exaggeration or reduction of the visual expressiveness.

We rely on speech, touch and gestures for interaction. On top of the robot, a multi-touch tablet is included for giving basic commands. Touch is also used as a feedback device for the robot, enabling interactions including pushing the robot away and rewarding the robot by patting it on its touch-sensitive skin. The skin consists of pads of foam cores covered with an airtight layer [1], where compression of a pad leads to a detectable increase in air pressure within the pad. The skin can detect light taps with a finger but is also robust enough to sustain blows, where the soft pads provide collision protection for the head and also the user. This skin also gives the robot head a soft look and feel.

In addition, the various off-the-shelf sensors and electronic devices in the head make it an ideal tool to use it for tasks such as contact-less measurement of temperatures, reading text, pointing with a laser, use it as a torch light, track objects and people or controlling the TV and radio or other Z-Wave home automation devices. The Android based tablet allows access to thousands of apps including speech recognition and synthesis and the control board based on a Raspberry Pi allows control of all the components over a single USB cable at an affordable price.

Fig. 1. Lean design of the robotic head with three representative expressions, happy, excited and wondering.

III. CONCLUSION

In this paper we presented the design of a minimalistic and expressive robotic head for social HRI. The first key aspect was the animation-based development of facial expressions in combination with head movements. The second key aspect is the affordability and modularity of the head. Based on first trials with an early prototype on around 50 elderly users we expect the design of the robotic head to provide high user-friendliness and achieve good acceptance based on its minimalistic, but still human-like design. Further and more in depth studies with the presented design will follow.

REFERENCES