Dog-Inspired Social Behaviour in Robots with Different Embodiments

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Abstract for demonstration

Abstract **— This demo paper aims to demonstrate how dogs' behavior could help to design social behavior for robots. Adopting a so-called "hearing robot" scenario we show that the dog-inspired leading behavior implemented in robots can be effective in human-robot interactions independently of the robots' embodiment.**

I. Introduction

Social robots should be able to participate in different interactions with humans in an acceptable and believable way [1]. In order to fulfill this requirement a robot has to convey intentionality in a way that the human partner can attribute beliefs and intentions to the robot [2]. Hereby, roboticists aim to supply these artificial agents with adequate social skills.

Recently Miklósi and Gácsi [3] suggested that human-robot interaction could be regarded as an inter-specific interaction. Hence, using natural analogies, human–animal interaction can provide a useful biological model for designing social robots that are able to interact with humans. Dogs can provide an especially promising model since during the domestication process dogs were able to successfully adapt to the human social environment and to participate in complex social interactions with humans in various conditions [4].

We demonstrate that applying human-dog interaction as a model for designing robots' social behavior towards the users we can achieve believable and socially acceptable human-robot interactions in case of different robot embodiments.

II. Content of the Demo

In the present demonstration we utilize a scenario based on the interaction of deaf people and "hearing dogs". These dogs provide assistance to their deaf owners by leading them to the source of important sounds in the environment. We will demonstrate that the visual communicational behaviors displayed by dogs during such leading interactions could be successfully implemented in four robots with different embodiments, which results in effective interactions, in which the "hearing robots" can successfully communicate intentions and lead the human partners to predetermined places.

The behavior of the robots has been designed based on human-dog interactions and consists of (a) interaction initiation with the user, (b) leading behavior, (c) feed-back and (d) goal oriented attention-directing behavior. For further details on the behavioral design see the flow chart (Figure 1), which was created to standardize the robots' behavior during the interactions [5].

A. The robots in the demo

MogiRobi

MogiRobi (Figure 2a) was designed at the Department of Mechatronics, Optics, and Information Engineering at the Budapest University of Technology and Economics in collaboration with the Department of Ethology at Eötvös Loránd University. The structure has a holonomical base. With omni-directional drive the robot can move to the reference position, in every horizontal direction at a time. It can reach a 2 m/s top speed in any direction. It has two 'head-tufts' what can be rotated either upward or backward, and a rear antenna what can also be positioned upward or downward, and moved sideways (3 degree of freedom (DOF) head, 2 DOF neck, 1 DOF ear, 2 DOF tail).

Ethon

Ethon (Figure 2b) was designed at the Comparative Ethology Research Group, Hungarian Academy of Sciences - Eötvös

Loránd University. It has a holonomical base, with a motion control method and data processing that are more distributed than that of MogiRobi. Despite the 40kg total mass of the robot, it can reach the 2 m/s top speed in any horizontal direction. The "head" of the robot is a Kinect sensor controlled with DC servos around 2 DOF with interpolation. The robot also has a 1 DOF arm.

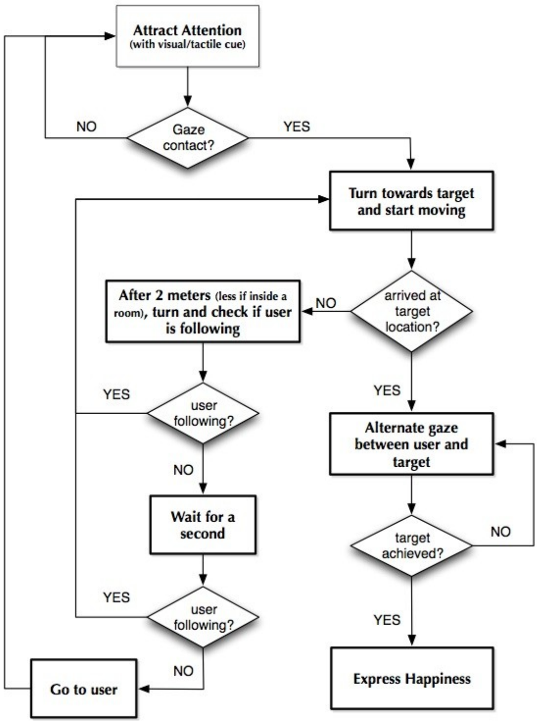

Fig. 1. Flowchart for the dog inspired behavioral design [5]

Sunflower

The University of Hertfordshire's Sunflower robot (Figure 2c) was specifically designed for research into robotic companions for the elderly in domestic smart home environments.

The Sunflower robot was designed with three main system modules. The top section consists of a simple head, with a neutral non-animated face, attached to a 4 DOF neck for gaze direction. The middle section consists of a diffuse colour LED light display panel, a speaker capable of playing sounds and simple tunes and a touch screen user interface which is attached to a retractable carrying tray. The bottom section consists of a commercially available Pioneer P3-DX mobile base.

FLASH - Flexible LIREC Autonomous Social Helper

FLASH (Figure 2d) was designed at Wroclaw University of Technology, Poland. It is a balancing social robot equipped with the expressive head EMYS (EMotive headY System) and two dexterous hands WANDA (Wrut hAND for gesticulAtion). The robot's head and hands serve to express emotions through facial expressions and gesticulation. The FLASH motion and navigation system allows the robot to move on flat surfaces. The head is an 11 DOF construction composed of 3 discs, with movable neck, eyes and eyelids. The hands consist of a pair of human-like arms endowed with hands. Each arm is built using the modular IGUS Robolink system and has 7 DOF, 3 in the shoulder, 2 in the elbow, and 2 in the wrist. Each hand has 4 fingers with 3 DOF each - one finger is playing the role of a thumb.

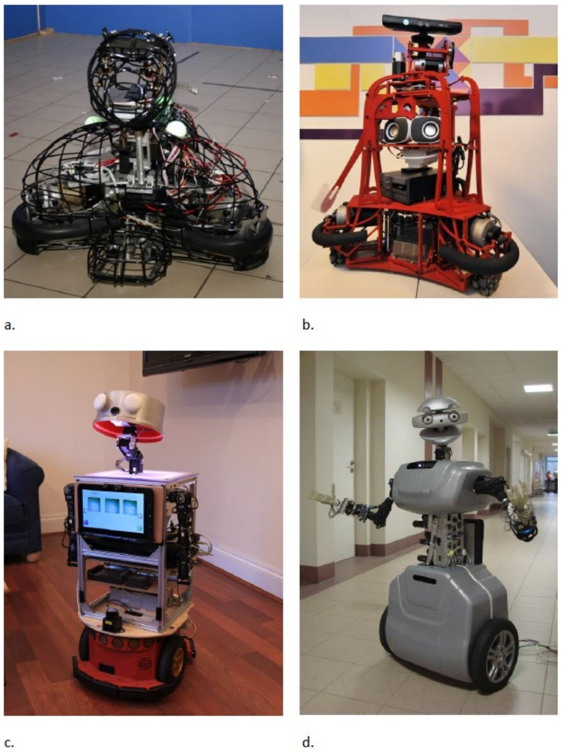

Fig. 2. Robots used in the demonstration (a. MogiRobi, b. Ethon, c. Sunflower, d. FLASH)

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