Pocketable-Bones: A Portable Robot Sharing Interests with User in the Breast Pocket

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ABSTRACT

We propose a portable robot, named "Pocketable-Bones", that fits into a user's breast pocket and communicates with the user "side-by-side", which involves coordinating the direction in which the user is looking and the object of interest. In this paper, we discuss the development of a platform for the robot and the hardware configuration needed to establish the human-robot "side-by-side" communication. In our presentation, we will demonstrate the side-by-side communication with the robot and the participants can experience it.

CCS CONCEPTS

• **Human-centered computing** → **Interaction design theory, concepts and paradigms**; *Interface design prototyping*; *Mobile devices*; • **Computer systems organization** → **Robotic components**.

KEYWORDS

portable robot, side-by-side communication, gazing

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1 INTRODUCTION

Although it is fun to walk alone in a city voluntarily, it is also fun to walk there with someone. Through such interaction, we can be encouraged consequently. Could such a sense of "walking in the city with someone" be realized using a portable robot that can fit in our pocket?
With the miniaturization of hardware, portable robots have been proposed such as Teroos[4]. Teroos rides on the shoulder of the user as an avatar robot, and moves its eyes and body by teleoperation. Another example is RoBoHoN[2] a portable robot sold by Sharp Corporation is used for sightseeing guidance, education and so on. However, these robots cannot observe the user's gaze target and don't have a function to determine the direction of the eyes.
In this paper, we considered the "side-by-side communication" in which a triadic interaction is established between human and robot by observing an object of common interest. We designed a portable robot "Pocketable-Bones" shown in figure1, which gazes in our pocket, and describe its implementation and basic operation, including the background of the research, the basic concept of "Pocketable-Bones", implementation contents, and future work.

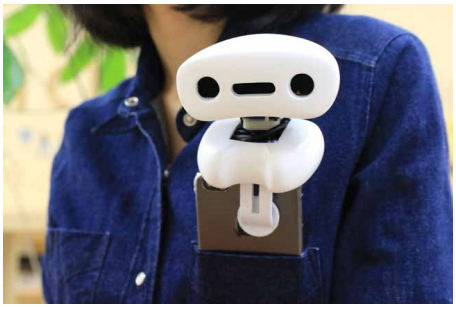

Figure 1: A portable robot "Pocketable-Bones" elicits a triadic interaction with the user by observing an object of common interest.

2 SIDE-BY-SIDE COMMUNICATION

Community of Human-Robot Interaction (HRI) study have focused on and mostly discussed "face-to-face" communication strategy. In face-to-face communication, for example, the user and the robot are divided as speaker or listener, and confront each other like a smart speaker and a person. However, the conversation between people is not only "face-to-face" communication. For example, in a conversation such as "It is beautiful scenery." "Yeah, exactly." it seems that speakers are speaking from the same position (side-by-side) interested in the same subject and have a mutual understanding. As described above, we have conducted research on "side-by-side communication" where a user and the robot share the experience and their emotions[5].

3 COMMUNICATION USING A SMARTPHONE

Recently, a chat tool has been proposed which can enjoy natural conversations like talk with humans. In the AI engine of the smartphone "Rinna"[1], texts were generated by recognizing an object

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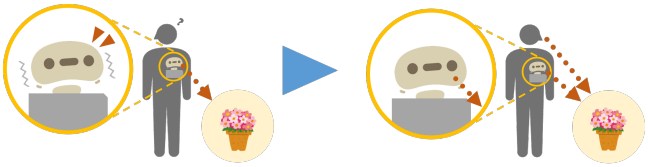

Figure 2: The user can feel robot's interest from its change in focus and share the emotion of the beautiful flowers with the robot.(Interaction Mode 2)

through the camera of the smartphone. The texts were about what object the "eye" of Rinna viewed and the user could enjoy a conversation with the smartphone. It is expected that chat tools using visual information such as "Rinna" will spread, but the AI agent is only displayed on smartphones, and it doesn't have any physical indicator. It makes difficult for users to recognize what object the AI is looking at.

4 POCKETABLE-BONES

4.1 Interaction Design

"Pocketable-Bones" is a portable robot which is attached to a smartphone. The aim of this study is to enable human and robot walk around together adjusting their vision to focus on the same object, so that the relationship becomes close and a social bond is created. "Pocketable-bones" adjusts the gazing direction by switching between the user's gaze and robot's. In "face-to-face communication", joint attention has been studied in which a robot follows the gaze direction of a person. In this paper, we extend joint attention to include the action of adjusting to each other's interest.

4.2 Mobility

Software in smartphone that use the phone's camera will spread in near future. However, attention of the software cannot be shown only with a smartphone. To avoid this, we implemented the robotic gadget so that the smartphone (robot) could display it gaze changes in real world.

4.3 System

The system configuration of the robot is shown in figure 2.
It consists of three components: JINS-MEME[3], android smartphone, and Pocketable-Bones. JINS-MEME measures the gaze direction of a person using a 6-axis sensor, and detects the object of interest of the person.
Android smartphones are used to determine the behavior of the entire system. Object detection is performed using the TensorFlow SSD from the image data taken by the camera of the smartphone, and the interest of the robot is determined. In addition, the robot's posture information is detected using a 6-axis sensor.
Upper part of system displays the robot's interest. The smartphone is connected with a USB cable and executes serial communication. Using the internal servomotor, the face direction can be changed using two vertical and horizontal axes motors.
CAD design of "Pocketable-Bones" body is shown in figure3.
"Pocketable-Bones" can be attached to the smartphone by the lower

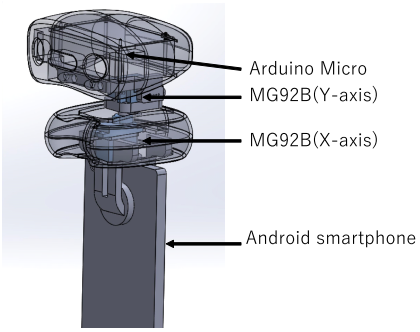

Figure 3: The robot can be attached to the top of the smartphone to displays its interest in the objects from the user's breast pocket.

clip part. The X-axis servomotor (MG92B) is attached to the clip, and the Y-axis servomotor is attached to it, enabling two-axis operation. The control board is stored on the head, and a Micro USB cable for connecting to Android and a cable for supplying power to the servomotor is attached.

4.4 Interaction

Operation is possible in the following two modes.

4.4.1 Mode1: Following the human gaze. In Mode 1, "Pocketable-Bones" follows the direction of the person's gaze completely. This function enables the robot to follow the human's interest and follow-up motion.

4.4.2 Mode2: Following an object. In Mode 2, an object is detected using the smartphone's camera and TensorFlow, and an operation is performed to follow the center coordinates of one object. With this function, the robot can determine the sight of interest, and it is possible to social display the robot's interest to the environment.

5 CONCLUSION AND FUTURE WORK

In this paper, we proposed a device for communication through gazing between robot and user in "side-by-side communication". We created a portable robot , named "Pocketable-Bones". In future research we would like to examine how the impressions given to people differ depending on each mode. In the presentation, we will demonstrate "side-by-side communication" with this robot and the participants can experience it.

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