Automated psychophysical personality data acquisition system for human-robot interaction

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Abstract This paper introduces an experimental method to collect various types of non-verbal cues for personality recognition that could be used for reliable human-robot interaction. The proposed system can record raw data of video, audio, and physiological signals through 9 different interaction scenarios. Each scenario is presented through a customized program, PsychoPy that is freely available for psychology study. Also, ROS is used to control a robot and sensing hardware such as camera and microphone. All the acquired data can be automatically organized for distinct modalities to find the possible correlation between different non-verbal cues and human personality scores from Big-5 personality model. So far, 10 different people have participated in the experiment and responses from more people will be added to the dataset. In the future, we are going to analyze the obtained dataset to find the correlation between non-verbal human behavior and human personalities.

Keywords Personality recognition, Human-robot interaction, Data acquisition

1 Introduction

Personality is one of the typical behavioral traits of human exhibited in various situation. Through the extensive studies from psychology, relationship between personality and human behavior has been established [1,2]. Also, adaptive behaviors of robots in response to diverse feedbacks from user play an important role for reliable human-robot interactions [3,4]. In this study, we propose a data acquisition system that automatically records non-verbal cues for personality recognition under specific human-robot interaction scenarios.

2 Method

2.1 System Architecture

Figure 1 shows the overall architecture of the proposed system. Program developed in PsychoPy plays each episode of scenarios and receives responses from the subject [5]. All the raw non-verbal data are automatically stored according to experiment situations. ROS (Robot Operating System) controls the robot and all the sensing devices installed in the lab [6].

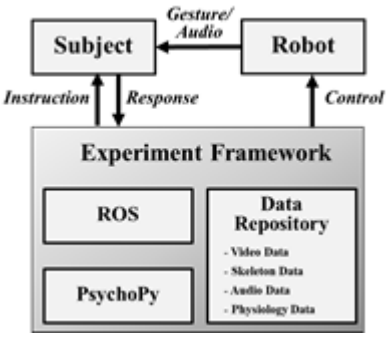

Fig. 1. Architecture of the proposed system

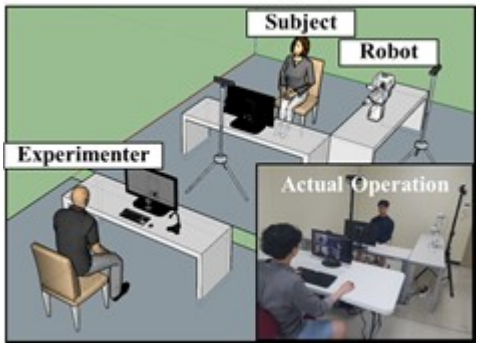

Fig. 2. Layout of the experiment space

Figure 2 illustrates the layout of the actual system that are used for experiment. Subject receives all the instructions and delivers his/her responses through the subjects' computer. Robot (NAO is used in this study) standing on the left side of the subject participates into the experiment for certain scenarios that is designed for human-robot interaction situation (Table 1) [7]. There are two different Kinect cameras that record body movement of the subject. Facial expression of the subject is also recorded by the commercial webcam installed in front of the subject. Speech signal can also be recorded through either microphone attached on the Kinect and commercial USB-typed audio amplifier. The subject wears wristband (Microsoft Band or Empatica E4 wristband) for gathering physiological signals such as heart rate, body temperature and so on.

2.2 Procedure of the experiment

The experiment consists of three different stages (instruction stage, test stage, and episode stage). During instruction stage, subject receives basic information on the entire experiments. Test stage is required to measure the trait of the subject's personality through standard Big-5 questionnaires (BFI-K-44) [8]. Personality traits in this stage are expressed in degrees from 1 to 5 for five different factors of personality: Extraversion, Openness, Conscientiousness, Agreeableness, and Emotional Stability. After subject finishes answering 44 different questions, episode stage begins. Episode stage consists of 9 different episodes that is designed to imitate the general interaction situation, conversation situation with the robot, and the specific situation that could put the subject under

Num.	Scenario	Duration (minute)
1	Introduce yourself	1.5
2	Introduce yourself to the robot after listening to self-introduction of the robot.	3
3	Tell the fun experience to the robot after listening to the story of the robot.	3
4	Describe the objects you saw in the waiting room.	5
5	Introduce the robot to the experimenter.	5
6	Speak the answer by solving any one of the three logical problems.	5 (limited)
7	Read and speak 12 newspaper headlines.	2
8	Describe any one of the three situations using pantomime.	5
9	Sing a song you chose	1.5

Table. 1. Scenarios of each episodes

psychological pressure (Table 1). Each scenario used in episode stage is created based on the previous human psychology study [9]. For example, episode 1 reflects the situation like the monologue with an audience or the interview with an interviewer. However, the behavior of the experimenter acting as an audience or interviewer is strictly limited because the active or subjective response of the experimenter can cause a change in the personality trait of the subject. In episode 2 and 3, subject should wait until robot finishes its speaking and robot shows the motion of consent while subject introduce him- or herself as well. In episode 7, 8, and 9, subject should perform the scenario while looking at the front camera or instructions presented on the screen.

3 Result

We have constructed the proposed system in the lab and started to gather data for further personality analysis. Figure 3 illustrates each view from monitors of subject's PC, experimenter's PC and the robot simulation mapped to the motion of the robot. The subject's screen shows the status of the experiment and instructions for each scenario. In the experimenter screen, gathered data from all the sensors are displayed in real time. We plan to continue gathering more responses from subjects with different personality scores, build the personality recognition model and test if the model is useful for better interaction between human and robot in the future.

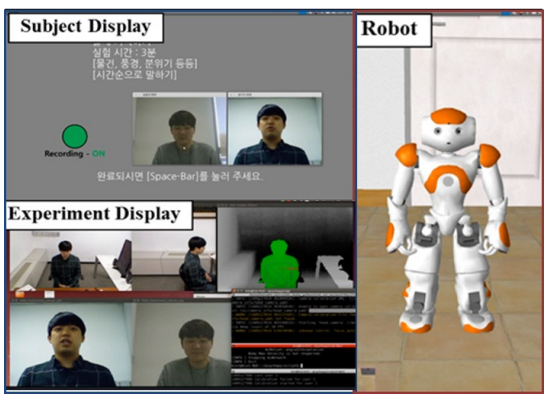

Fig. 3. Example view of the proposed system during experiment

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