CLOUD-BASED USER MODELING FOR SOCIAL ROBOTS: A FIRST ATTEMPT

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USER MODEL FOR SOCIAL ROBOTS

A **social robot** is an autonomous robot that interact with people by engaging in social-emotive behaviors, skills, capacities, and rules (Breaz et al, 2014).
Thus, it is crucial the ability to interpret and react to human behavior, and a key mechanism is **user modeling (Fong, 2003)**.

User models are used by robots for:

- helping the robot to understand an individual's behavior and dialogue.
- for adapting the behavior of the robot to the different abilities, experiences and knowledge of user.
- for determining the control form and feedback given to the user (e.g, stimulating the interaction).

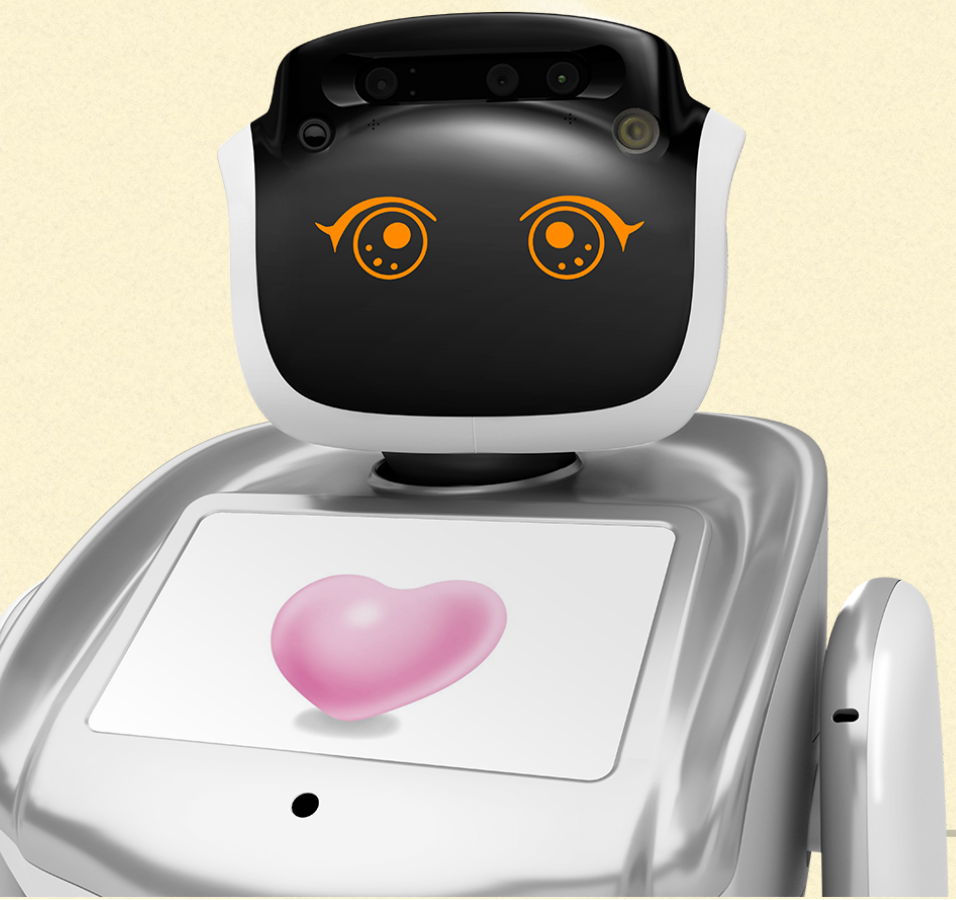
GOAL OF THE PAPER

This paper presents the our attempt to integrate user modeling features in social and affective robots.

We propose a cloud-based architecture for modeling the user-robot interaction in order to re-use the approach with different kind of social robots.

In particular, we describe the iROBOT application and its components

THE IROBOT APPLICATION



- The aim of our project is to develop a general purpose cloud-based application, called iRobot, offering cloud components for managing social, affective and adaptive services for social robots.
- This first version of the application has been developed and tested for the Sanbot Elf (henceforth simply Sanbot) robot acting as client, thus this client-side application has been called iSanbot.
- Thanks to the cloud-based service, the robot is able to handle a basic conversation with users, to recognized them and follow a set of social relationship rules, to detect the user's emotions and modify its behavior according to them. This last task is focused on real-time emotion detection and on how these could change human robot interaction.

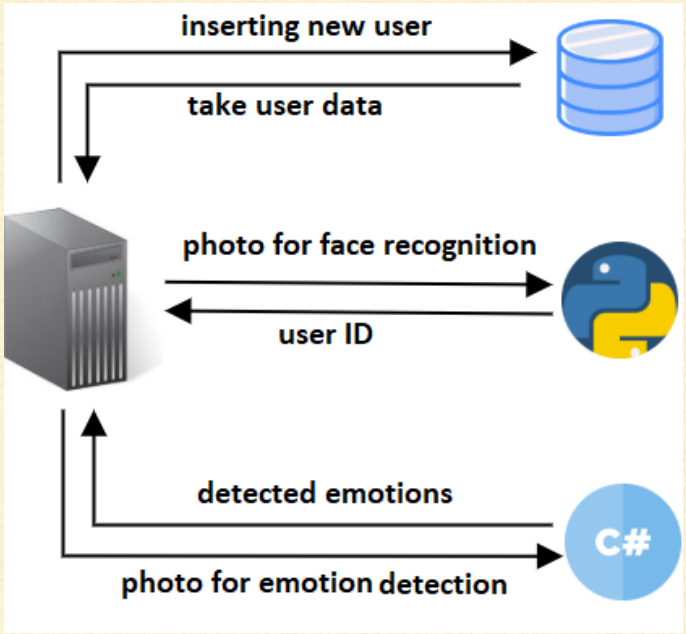
SCENARIO

- As case study, the Sanbot robot welcomes people who enter the hall of the Computer Science Department of the University of Turin.
- The robot must be able to recognize the people it has already interacted with and remember past interactions (mainly with the employees of the department), introduce itself and be able to welcome new people who arrive and give them information about the offices.
- In the future, it must also be able to accompany people to offices and back to the entrance. As far as the offices information are concerned, we have developed a Sanbot application able to deliver this information to the user during a basic welcome conversation. This application will be no more detailed here, since this is out of the scope of the paper.

SANBOT DESCRIPTION

- Sanbot is a humanoid-shaped robot with a total size of 92 x 30 x 40 cm and a weight of 19 kg. The body structure is mostly made of plastic with a motor based on wheels that allows the robot to rotate over 360 degrees.
- Sanbot has a 3 cameras, 2 in the head and 1 in the chest belonging to the tablet incorporated in the robot. They can be used for taking pictures, recording videos and audio and camera's live streaming. In the Sanbot's head there is also a microphone.
- The body of Sanbot is equipped with a tablet incorporated on the chest, which can be used to show and use all the applications installed on it.
- Sanbot is equipped with sensors throughout all its body like infrared sensors, touch sensors and PIR, WIFI, Bluetooth and ZigBee wireless connections.

SANBOT ARCHITECTURE



There are two main components:

- a client, written in Java for Android, with the goal to interact with the user and to acquire data aimed at customizing the user-robot interaction,
- a server, written in Java, and located on a dedicated machine, which represents the robot's "brain" in the cloud. It acts as a glue between the components:
    - the emotion recognition,
    - the face recognition,
    - the user modeling
    - the speech-to-text service.

The application starts with a natural language conversation with the goal of knowing the user (e.g., face, name, sex, age, interests, mood, etc.) and then recovering all the acquired and elaborated information from the user modeling component for adapting its behavior.

FACE RECOGNITION SERVICE

The face recognition has been developed in Python and implements the librarY "FaceRecognition.py"

Sanbot welcomes and takes a picture of the user, and sends it to the Java server, which delegates the Python component to the user's recognition.

- If the user has not been recognized, it asks the user her name, and, before taking her a picture, it asks the permission to, then it asks her profession, favorite color and sport. The detected predominant emotions will be inferred and stored, as well as other biometric data.
- If the face recognition component recognizes the user, all her stored information are recovered and the user is welcomed (e.g.,Hello Cristina! Do you feel better today?) as well the next question to read.

EMOTION RECOGNITION SERVICE

- Sanbot is able to recognize: sadness, anger, disgust, joy, fear, surprise and contempt (Ekman's universal emotions).
- The emotion recognition service implements the libraries of Affectiva. It realized through a continuous streaming of frames directed to the C\# component, which extracts the predominant emotions. Then, the server sends a response via a JSON object to the client, which can adapt its behavior.
- In our application, Sanbot changes its facial expression with the expression associated with user's mood

USER MODELING

iSanbot implements a simple **user model** organized as a set of feature-value pairs:

- user name
- age range
- gender
- favourite sport
- favorite color
- profession

asked

- number of interaction
- predominant emotions

inferred

ADAPTIVE BEHAVIOR

User model based:

Sanbot changes its facial expression with the expression associated with user's mood

Altro??

Stereotype-based: the robot performs a more informal conversation with young people and a more formal one with older people, it is more playful with young people and more serious with older people. As for emotions, if it sees a sad face he says a joke or plays a song, while he smiles and congratulates the smiling people.

CONCLUSION

We are now working with the Pepper robot to replicate the same scenario implemented in Sanbot.

We are working on integrating into the user modeling component in order to enrich the information available to the robot for its conversations with users:

- information stored in the Computer Science department web site, about users activities (the number of office, office hours of the professor, class schedule, etc,)
- inferred features such as kind of personality (Big Five), stereotypical user classification based on socio-demographic information (sex, age and profession).

In the future we would like to replace Affectiva with a similar service we are developing, extend the user model with more sophisticated rules of inferences and adaptation, improve the component of natural language processing.

Thanks for the attention

For questions:

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