Designing CALLY, a Cell-phone Robot

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Abstract
This proposal describes the early phase of our design process developing a robot cell-phone named CALLY, with which we are exploring the roles of facial and gestural expressions of robotic products in human computer interaction. We introduce non-verbal anthropomorphic affect features as media for building emotional intimacy between a user and a product. Also, two social robot application ideas generated from brainstorming and initial participatory design workshop are presented with their usage scenarios and implementations. We learned from the pilot test that the prototyping and bodystorming ideation technique enabled participants to more actively take part in generating new ideas when designing robotic products.

Keywords
Robotic product, mobile phone, facial and gestural expressions, affect features, bodystorming

ACM Classification Keywords
D.5.2 [Information interfaces and presentation (e.g., HCI)]: User Interface

Introduction
What if an alarm clock not only rings but also moves around and hides from the owner? What if a car navigation system leads its owner to the destination by pointing directions with its gestures when he/she is

Figure 1. An idea sketch of a cell-phone with robotic body

driving? What if a telephone enriches conversation by physically mimicking the remote user's expressions?

Besides verbal language, people use many kinds of interaction media such as tone of voice, facial expressions and gestures. In human-machine interaction, however, there is more limited means of communication. Researchers have suggested a variety of physical computing devices providing more intuitive modalities to enrich HCI, and it is now common for real world product designers to consider new sensors and haptic components when they design convergent information artifacts. But, in terms of output media, not many products support dynamic feedback beyond 2D displays, speakers and vibrating motors. This lack of modality may not cause usability problems directly; instead, it brings dry conversations between a user and his/her possessions, and it is hard to establish an emotional sympathy from that kind of boring relationship. For example, while lots of on-screen/hardware skins and toy applications have been designed to be customized in mobile devices, most of them do not seem so successful at building long-term intimacy since they only stay inside or on the thin surface of existing products.

To address this issue, we focused on non-verbal and anthropomorphic affect features like facial expressions and physical behaviors that a social robotic product could employ. Our approach is based on interaction design methods which are accomplished with a broad range of interdisciplinary studies relating human perception, artificial behaviors, emotional communication, participatory ideation techniques, prototyping and so forth. In this report, however, we describe a couple of robot application scenarios from our brainstorming sessions based on the cell-phone usage context, implementations of the robot prototype named CALLY, and initial findings from a pilot participatory design workshop to generate further design ideas.

Related Work

The Softbank Mobile Corp. and Toshiba recently launched an interesting mobile phone having legs and arms [1]. It looks very similar to an application of our project, but of which limbs are just static decorations. A car accessory, the Thanks Tail, showed a way in which an everyday product can convey emotional expression, but lacks autonomous response [2]. Examples of more sophisticated robotic applications can be seen in pet robots such as AIBO and Paro. It now seems the development strategy is shifting in the market; recent robotic products such as Rolly [3], Miuro [4] and Nabaztag [5] are focused on music, entertainment and networked multi-user environments. This new generation of products has simple perception abilities and abstract- or non-mobility. And, more importantly, they are based on the existing products rather than created as a whole new robot agent.

Designing CALLY

One of the target platforms we considered in our brainstorming sessions among developers is mobile phones. As a cell-phone has more computing power and supports more complex tasks, it has become more familiar device in our life. A conventional cell-phone user may use his/her device mainly to make telephone calls as well as to check information like time, date, missed calls and battery status. Cell-phones are also commonly used to wake the user with an alarm sound,

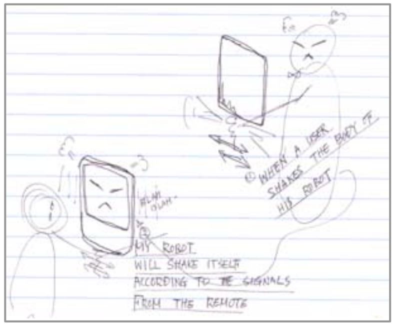

Figure 2. Conveying physical motions over the phone in a multi-user situation

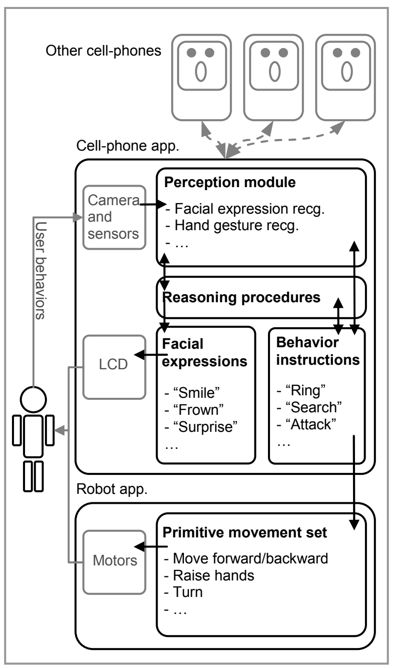

Figure 3. Implementation architecture of the proposed cell-phone robot

exchange text messages, take pictures and listen to music.

We set about the design process as developing several cell-phone usage scenarios in which robot behaviors can enrich user-product interactions. The first target context we picked was an alarm ringing situation, because it has a balanced complexity in perceptional abilities, intrinsic gestural instructions, a motor system and intelligent responses. The second scenario was based on a multi-user situation. We imagine a teleconference or mobile-network where two or more people are connected via cell-phone robots. Each participant can send an instant emotion cue to control the facial expressions and gestures of others' agents [figure 2].

Prototyping CALLY

The proposed cell-phone robot consist of two parts; hardware and software application [Figure 3]. They can create a network and communicate each other via a wireless network.

The robot body was designed based on the minimum requirements of mobility and gesture variations in the given alarm scenarios. It was implemented by using a robot toolkit, Bioloid Expert Kit [6]. It has four wheels, two arms, a cell-phone dock and a battery/controller pack [Figure 4]. The cell-phone dock is located in the upper body right in front of the battery pack, so the cell-phone acts like a robot head and displays facial expressions on its LCD.

Software written in C++ and Java manages the robot's behaviors, perception, reasoning and networking abilities. The behavior instructions include primitive movements (e.g. 'turn right/left') and task sets (e.g. 'search for the owner'). The perception module captures video inputs, recognizes human features and triggers robot behaviors. Those behaviors and perception capabilities can be supplemented computationally by a server PC. There are three different wireless connections employed in the prototype; Bluetooth for communicating between cell-phone and the robot, the Wi-fi for multiple cell-phones, and a customized wireless protocol for PC-robot communication. The Wi-fi networking has a typical server-client structure that enables us to simulate the multi-user conferencing scenario.

Figure 4. The first prototype of CALLY

Participatory design workshop

Four participants joined in a pilot workshop. They were asked to generate further application ideas of the cell-phone robot after seeing a demonstration of the first CALLY prototype. A pair of cell-phone masks were given to help the participants share their ideas with bodystorming [figure 5].

Figure 5. Participatory design workshop; two participants are acting cell-phone robots in a tele-conferencing situation

We observed that participants readily understood the CALLY prototype and its contexts of use. As it was demonstrated, the participants could easily set about imagining suitable situations for this new product. Participants also received as many friendly impressions from its gestures as they got from its robotic shape.

The paper masks, even though they were very rough, not only made the workshop more enjoyable but also helped people more actively perform the workshop. The participants explained possible robot behaviors by mimicking its gestures and, from that, could figure out hidden advantages and limitations of the product by themselves. While the design session lasted twice as long as its schedule, all participants kept on interested in the workshop.

Conclusion

We introduced the early results of our on-going project exploring affect features of social robotic products. We learned from the pilot participatory design workshop that CALLY has emotionally affective gestures and enables the participants to easily understand the product and its environment. The bodystorming technique was also useful for generating new ideas. While a set of very rough paper prototypes was used, it helped discussions by providing people with new and enjoyable experiences.

Acknowledgements

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