Emotional Interactions between Artificial Companion Agents and the Elderly

(Doctoral Consortium)

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ABSTRACT

As the global population ages and the occurrence of single and "empty nest" elderly household increases, artificial companion agents will play a more important part in seniors' daily life to bridge some of the gaps left by the shortage of caregiving manpower. This research focuses on improving the emotional interaction strategies of artificial companion agents and advising designers on how to produce agents that fulfil missing social roles around seniors to enhance the believability of these agents.

Categories and Subject Descriptors

I.2.11 [**Artificial Intelligence**]: Distributed Artificial Intelligence—*Intelligent agents, Multiagent systems*

Keywords

Emotion; companionship; social roles; senior citizens; agent

1. INTRODUCTION

The rapidly aging population in many countries is putting increasing strains on the current institution centric elderly care system. In the U.S., every day until 2020, an average of 10,000 baby boomers will turn 65 [1]. Currently, with fewer than 20% of seniors housed in nursing homes and assisted living communities [2], our elderly care institutions can barely cope. Technology could play an important role in supporting senior citizens age in comfort, security and dignity. A major societal question is: "how to design appropriate technologies to fulfill missing social roles around an elder person?".

Artificial companion agents are hardware or software entities designed to provide companionship to a person [9, 11]. They have been demonstrated to be useful in therapy, offering emotional companionship, building trust, and facilitating socialization [4, 6, 10, 12, 13, 14]. The elderly population have a special demand for companionship. However, there is lack of empirical studies on what roles artificial agents

should perform around elderly users and how they can communicate with them through emotional interactions.

To address these problems, we attempt to establish a model to guide artificial companion designers to meet the emotional needs of the elderly through fulfilling absent roles in their social interactions. We call this model the *Role Fulfilling Model*. This model aims to use role as a key concept to analyse the socio-emotional demands from the elderly for functionalities in artificial companion agents. To evaluate the effectiveness of this model, we proposed a serious game based platform with unobtrusive sensing capabilities to enable detailed analysis of players' behaviour trajectory around various companion agents. This game will help us to involve senior users at scale through crowdsourcing to test the proposed model and related hypotheses.

To improve the emotional communication between artificial companion agents and users, this research addresses an important but largely overlooked issue in affective computing: "how to enable companion agents to express mixed emotions through facial expressions?" And furthermore, for different users, does individual heterogeneity affect the perception of the same facial expressions? Preliminary results reflecting significant gender differences have been found in our current studies. A mapping between mixed emotions and facial expressions has also been established which can advise future agent emotion expression designs. The perception of facial expressions between different age groups or cultural backgrounds will be investigated in future studies. This research is expected to establish a model to guide artificial companion agents to adapt their emotion expression strategies based on individual differences.

2. PROGRESS TO DATE

Artificial companion agents have been shown to provide beneficial effects to users. These benefits are achieved through the interactions between artificial agents and people. Since emotion is an important human trait, being able to display proper emotions constitutes an important aspect of artificial companion agents. Facial expression of the agents is one of the most important channels of emotional interactions. To improve this interaction, our current work studies how to enable companion agents to express mixed emotions with facial expressions.

In order to fill in this gap to enable artificial agents to display mixed emotions and facial expressions, we designed and conducted a large-scale user study to construct a mapping

Figure 1: The interactive tool for self-reporting mixed emotions.

from mixed emotions to simple of 36 2-dimensional (2D) facial expressions. We developed an interactive tool as shown in Figure 1 to allow a user to express his/her current feeling in the form of mixture of the Ekman's Six Basic Emotions (i.e., Happiness, Sadness, Excitement, Boredom, Anger, and Surprise) [5], and select how his/her facial expression would look like in the form of 2D smiley faces. This tool is inserted into a serious game [15] as part of the game play. At the end of a game session, we embed the proposed mixed emotion self-report tool to enable the player to express his/her feeling after the game.

The players cab indicate their emotion by selecting any one, or a mixture, of the six basic emotions by clicking on the stars shown in Figure 1. In the background, the value is captured as an 11-point Likert scale. After this, the tool asks the player which of the smiley faces best fits how he/she feels at the moment. The *AffectButton* [3] contains 36 images of different facial expressions. The player can choose the best one that can represent his/her emotion by dragging the mouse on the Smiley until the right face shows up.

Using this platform, we conducted user studies following the principles of human computation [8] with over 400 university students from China and Singapore. They produced over 2,200 valid responses. To study the influence of individual heterogeneity in understanding facial expressions, we have also studied the associations between facial expressions and mixed emotions between male and female respondents. The results have shown a significant difference between male and female perceptions on the facial expressions of happiness and boredom. Furthermore, women are found to be more sensitive in reading mixed emotions from one facial expression than men.

3. FUTURE WORK

The gender difference study is the first step of this research. We will involve participants from different age groups and areas to look for the individual differences in multiple demographical aspects. We have designed a further study to understand how the facial expressions of the artificial agents can affect the users. For example, when an elderly user needs professional medical advice, what kind of facial expressions are more suitable for the artificial agent who delivers the information? To find the answer of such questions, we plan to design another interactive tool to compare the possible facial expressions of the agents. The new experiments will also use serious games as a platform and involve large scale of participation through crowdsourcing. Beside this quantitative study, a Phenomenology [7] based the qualitative study will also be conducted for understanding the reasons behind people's choices.

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