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Promoting Healthy Aging Using a Robot Support System and Emotion Recognition

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Abstract. The aging population poses challenges such as loneliness, decreased mobility, and medical conditions. To tackle these issues, a proposed robot platform offers personalized well-being behavior change suggestions. Developed through a user-centered process involving surveys and focus groups, and tested with a first prototype, the system is ideal for individuals with "special social needs". Technical results indicate that emotion recognition is valuable, with attention and valence being key metrics, but user acceptance and quality of facial/speech analysis for elderly users remain challenges.

Keywords. Socially Assistive Robots, Internet-Based Intervention, Behavior Change Techniques, Facial Emotion Recognition

1. Introduction

By 2025, 22% of the world's population will be 60 or older [1], facing challenges like loneliness, pain, and illness [2]. Lifestyle interventions can mitigate these effects but may be difficult to follow [3]. A robot platform that offers personalized and adaptable behavior change recommendations can help older adults in their home environments [4]. This project incorporates facial analysis to better understand user emotions for more effective interaction [5]. However, social robots are not yet widely adopted, except for basic companion robots [6].

2. Methods

The design of the system involves four phases with end-user engagement: (1) online survey for general user requirements, (2) focus groups for specific user requirements, (3) pilot 1 for basic interactions, and (4) pilot 2 for scenarios and autonomous interactions.

178 healthy seniors from three different age groups (55-64, 64-74, and 75+) participated in a survey to evaluate their technology use, attitudes toward robots, and design preferences. Additionally, three focus groups (n=19) were conducted in the Netherlands, Austria, and Belgium to gather user scenario information.

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A prototype was developed using a user-centered iterative design process. The prototype utilized the social robot Q.bo One [7] and customized software for user interaction, emotion recognition, and intervention delivery. The prototype was tested in supervised (n=18) and unsupervised (n=17) pilot sessions in the same countries, with the supervised sessions taking place in a simulated setup for two hours and the unsupervised sessions in the users' homes for a full day.

3. Results

Qualitative research shows that users recommend the robot solution for individuals with "special social needs," such as the elderly, those living alone, and those with mild physical or cognitive impairments. Customization, independence, and support during installation and usage were emphasized. Two usage scenarios were developed, with the robot as a motivator and communication partner.

On a technical level, pre-trained models for emotion recognition were found to be valuable, with attention and valence being the most useful metrics. The least enjoyable tasks had the highest variation in attention and individually attuned peaks of negative valence, indicating potential for customization and increased user engagement.

4. Discussion

The project's current robot system shows promising results but has technical limitations and complex actions could require five years of R&D and market preparation. User acceptance among older adults is a challenge, but is expected to improve as the robot market grows. Improving facial and speech analysis for the elderly population is also challenging and requires specific data collection, longer calibration, and better expectation matching. More information can be found on the project homepage² [8].

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² AID2BeWell is funded by the European funding programme AAL (Active and Assisted Living) and the national funding organizations ZonMW, Austrian Research Promotion Agency (FFG), and Agentschap Innoveren & Ondernemen