



INDIAN INSTITUTE OF TECHNOLOGY GUWAHATI
SHORT ABSTRACT OF THESIS

Name of the Student : Nilakshi Yein

Roll Number : 146105008

Programme of Study : Ph.D.

Thesis Title: A Study on Developing an Interactive Stepping Exercise Tool to Improve Physical Balance of Elderly Population in India

Name of Thesis Supervisor(s) : Dr. Swati Pal

Thesis Submitted to the Department/ Center : Design

Date of completion of Thesis Viva-Voce Exam : 24/02/2021

Key words for description of Thesis Work : Elderly Fall problem, Exercise Intervention, Exergame, Indian context

SHORT ABSTRACT

Fall in the elderly population is a serious hazard to their livelihood. In India alone, aging people are increasing every year, and the elderly of our society deserve an independent and active life. In India, a fair sum of the elderly faced brain injury; and loss their independence due to falls. This makes the elderly fall into a significant worldwide health concern. Balance exercises have extensively assisted the aging population in avoiding falls. However, elderly people are unwilling to do traditional exercise due to negative self-worth, laziness, boredom, not motivated, negative physical worth, busyness in other works, etc. Exergames (gaming movements that required physical movements to finish the game task via an interface: computer/ screen/ mobile) are useful solutions to motivate the elderly to perform the exercise. As most of the research is based on the developed nations (e.g., Wii, Dance Dance Revolution (DDR), etc.), they are not appropriate for developing nations' context-specific conditions (language, real-life relevance, the relatability of the game- avatar, etc.). To our knowledge, no such extensive research has been done considering the Indian scenario. This research provides a new understanding into the field of elderly fall research in India by providing a more thorough insight into the use of exergames as a fall preventive measure for older adults, particularly concerning balance improvement. The research indicates that exergame influence the elderly's motivation towards exercising. In designing the exergame, choosing exercise's particular purposes, such as stepping abilities and balance, need to be selected and developed considering the context-specific issues. The design process precisely considered the preferences of the elderly in India, along with the stepping exercises' movements aimed to mimic the players' movements during gameplay. Exergaming has an excellent prospective to become an essential part of future tailored medical technology in elderly fall research. An exergame tailored is being introduced in this research for the elderly population of India. The investigation also addresses the perceptions and experiences of the elderly towards exergame. It also indicates the initial approach that included developing a stepping-exergame tailored for the elderly in India as a preventive measure to fall. The interface concept is developed using the Technology Acceptance Decision Tree (TADT). The design process includes Indian Anthropometric data for designing the prototype-mat with a computer interface. The designed exergame is specially tailored for the elderly in India, termed Therapeutic Stepping Exergame (TSE).

The design process has carefully considered the minute details found in the literature survey, the ethnographic study, personal interview, and TADT. In the elderly exergame experience, self-paced game speed, avatar, and game theme related to the elderly in the Indian context come out as a desirable game aspect along with the usefulness of the exergame. The investigations employed in the thesis are a mixed methodology approach utilizing quantitative and qualitative methods of data collection and analysis. Qualitative aspects of these design-based experimental investigations helped us capture user experiences and inductively derive relations between various complex subjective parameters experienced by the elderly in the field.

The thesis tested three hypothesis:

- H1. The use of TSE will improve balance in the elderly in India.
- H2. The use of TSE will improve balance confidence in the elderly in India.
- H3. The use of TSE will reduce the fear of falling in the elderly in India.

A paired t-test is used to test the hypothesis. The results indicate a statistically significant ($p \leq .05$) so, the null hypothesis is rejected. After the statistical analysis is done to test the validation of the research hypothesis, it is found that TSE has improved the balance and balance confidence in the Indian elderly. It has significantly reduced the fear of falling and has motivated the elderly to exercise. The descriptive statistics and subjective assessment indicate that the user has accepted the TSE, signifying the validation of the design heuristic proposed in the TSE design. The TSE acceptance and the essential constructs for its use by the elderly in India have been evaluated using UTAUT2 (Unified Theory of Acceptance and Use of Technology 2 exergame) and subjective assessment. In this thesis, based on the insight knowledge gathered from literature, field investigation, experimental investigation, and prototype development, design heuristics for the elderly are developed. This thesis recommends design heuristics for exergame, a game story, and game movements so that researchers can further study the exergame for the elderly while designing for Indian or similar contexts. However, to realize the full potential of exergames as a rehabilitation tool and fall preventive measures for the elderly, there is a need to introduce new exercise movements during gameplay further. It is necessary to gain knowledge and understand which technology to use for rehabilitation purposes or exercise. Establishing the results in achieving long-term adherence to the exergames is also indispensable. This thesis has presented numerous essential steps towards understanding the end-users' (elderly in India in this research) need for the exercise measure in an exergame. In the future research path, EXG with exoskeleton specific for elderly users as a rehabilitation paradigm might be a breakthrough in the elderly fall research.