Socially Interactive Robot Sign Language Tutors

Type of Project

Finished research project

Summary

This study presents a socially interactive humanoid robot-assisted system for sign language (SL) tutoring for children with communication impairments by means of imitation-based interaction games. In this study, a five-fingered robot platform Robovie R3 is used to express a set of chosen words in Turkish sign language (TSL) using hand and body movements combined with facial expressions. The robot is able to recognize signs through a RGB-D camera and give vocal, visual and motional (as signs) feedback. The proposed game consists of an introductory phase where participants are introduced to the robot and the signs; an imitation-based learning phase where participants are motivated to imitate the signs demonstrated by the robot, and a test phase where the signs taught in the previous phases are tested within a guessing game. The current research presents the results from the studies with three different test groups. The presented humanoid robot is used as an assistive social companion in the game context using sign language and visual clues to interact with the children. The robot is evaluated according to the participant's sign recognition ability within different setups. The results indicate that the robot has a significant effect on the sign learning performance of participants.

Low-tech, high-tech products, services and contexts for play

The humanoid robot used in the study is a specially modified version of the Robovie R3 robot. The standard R3 platform is 1.08 m tall and weighs 35 kg and has 17 DOF (2*arms*4, neck*3, 2*eyes*2, wheels*2) but the modified version of R3 robot has additional DOF in wrists, and fingers, 29 DOFs in total; and also a LED mouth to imitate and/or express some basic emotions (such as a happy, sad or neutral facial expressions). The robot has five-fingered hands with independent fingers and longer limbs providing the opportunity to implement signs more accurately. The robot has also a small platform on the chest with an ASUS RGB-D camera which is used for gesture recognition. This platform provides also some flexibility on the interaction level and with respect to game scenario e.g. the depth camera attached to it can be easily replaced by a touch pad tablet according to game requirements in future studies.

The context of use

The presented platform can provide assistance to deaf or hard of hearing children in reinforcing their knowledge on Turkish Sign Language (TSL) by playing different games with the robot. Therefore, the robot may be used in different environments such as homes or classrooms.

Type of play in this play system

Cognitive

Practice
Rule play (including videogames)

Social

Solitary

Cooperative

Objectives related to play according to ICF-CY

Play for the sake of play: Major life areas - d880 enagement in play

d8800 solitary play
d8803 shared cooperative play

Play-like activities: Therapeutic and educational objectives

d1 Learning and applying knowledge (learning through symbolic play, learning through pretend play)
d3 Communication
d7 Interpersonal interactions and relationships

Number of participants

>20

Chronological Age

6-12 years
12-18 years

Development Age

6-12 years
12-18 years

LUDI Categories of disabilities

Hearing impairments:
Partially hearing impaired
Deaf

Explanation on the use of low-tech, high-tech devices, services or contexts

Explanation

Verbal instruction, language and communication fitting to chronological age
Visual instruction with pictures or drawings
Hand over hand: therapist/researcher leads the actions of the participant
Guided discovery: therapist/researcher coaches the participant so s/he discovers how to use the assistive technology

Involvement

Adult: therapist/educator/researcher

Role

Providing instruction
After the instruction, providing supervision during play

Evaluation of objectives and outcome measures

Description of outcome measure(s)

Observation by professional/researcher providing the play experience

Video analysis
Feedback from client/parents/professionals
(validated and reliable) outcome measures like tests, self-reports of client/system, questionnaires

Information about availability of outcome measure: publisher, website, contact person

Participants' teachers and TSL instructors were interviewed before and after the studies. The children participants have been handed a questionnaire with pictures to evaluate the designed system. A content analysis of the interviews was conducted and the study was evaluated in terms of the signs recognized by the children.

Summary of achieved effects

The results of paper-based test and verbal surveys show that the participants do not have any difficulty in learning and recognizing the signs from the Robovie R3 robot. The participants reported that it was easy to understand R3's signs, since it had five fingers and longer limbs its gestures were comprehensible. Participants also remarked that the Robovie R3 could produce smooth and natural-looking gestures.
Overall, the results with the different test groups were encouraging in terms of the humanoid robot's contribution to the sign language learning process of individuals with different profiles. The results emphasized that the presented interaction game could be played with children suffering from different degrees of hearing impairment and the humanoid robots might be presented as an effective teaching material in the context of improving the interaction ability of children.

References to the intervention or research project

Assoc.Prof.Dr. Hatice Kose, hatice.kose@itu.edu.tr

Contact Person

Assoc.Prof.Dr. Hatice Kose, hatice.kose@itu.edu.tr

Website

http://humanoid.itu.edu.tr

Publication

Uluer, Pinar; Akalin, Neziha; Kose, Hatice; A New Robotic Platform for Sign Language Tutoring, International Journal of Social Robotics, 7(5), p.571-585, 2015, Springer Netherlands

Keywords

Humanoid robots, Interaction games, Non-verbal communication, Sign language tutoring