Humanoid Robot Assisted Interactive Sign Language Tutoring Game

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Abstract—There is an on-going study which aims to assist in teaching Sign Language to hearing impaired children by means of non-verbal communication and imitation based interaction games between a humanoid robot and the child. In this study, the robot will be able to express a word in Sign Language among a set of chosen words using hand movements, body and face gestures and having comprehended the word, the child will give relevant feedback to the robot.

This study proposes an interactive game between a NAO H25 humanoid robot and preschool children based on Sign Language. Currently the demo is in Turkish Sign Language (TSL) but it will be extended to ASL, too. Since the children do not know how to read and write, and are not familiar with sign language, we prepared a short story including special words where the robot realized the specially selected word with sign language as well as pronouncing the word verbally. After realizing every special word with sign language the robot waited for response from children, where the children were asked to show colour flashcards with the illustration of the word. If the flashcard and the word match the robot pronounces the word verbally and continues to tell the story. At the end of the story the robot realizes the words one by one with sign language in a random order and asks the children to put the sticker of the relevant flashcard on their play cards which include the story with illustrations of the flashcards. We also carried the game to internet and tablet pc environments. The aim is to evaluate the children’s sign language learning ability from a robot, in different embodiments and make the system available to children disregarding the cost of the robot, transportation and knowhow issues.

Keywords— Humanoid Robots, Interaction games, Non-verbal communication, Sign Language

Description: In this novel study we propose an interaction game [1,2] based on sign language, between children and a humanoid robot (currently Nao H25 with fingers). The aim of this game is to assist sign language tutoring especially for preschool children [3,4,5]. During the game the robot tells a simple and short child story (Figure 1) and within the story uses some special words in sign language (currently 5 words, car, father, table, friend and three). The game is based on interaction, sign language interpretation (gesture implementation and recognition) and turn-taking. When the robot realizes a word in sign language, the children are expected to show the robot related coloured flash card (i.e. card representing “dad”). As the card is recognized (vision recognition through robot’s camera) and matched with the current word, the robot pronounces the word verbally and continues the story (Figure 2). If the word is not recognized or do not match, robot gives a warning with different colored eyes. Robot does every special word twice in the story. At the end of the story, robot implements these words with sign language in random order without telling their names verbally and asks children to guess the words and put relevant stickers of the flash cards to their playcards (required for evaluation and feedback of the experiment) (Figure 3).

![Figure 1](image1.png)

Figure 1. Screen shots from the game (a) Robot performing a sign (b) Child shows the colored card of the word “dad” to robot (c) Child completes the playcard using stickers of the colored cards

We use a Nao H25 and Turkish sign language for the current demo, but working on the translation of the game to ASL. We used Choregraphe software and vision recognition module within the software to control the robot and recognize the flash cards. Although Choregraphe had text-to-speech module in different languages, we used a real child’s voice since we could not find a suitable Turkish text-to-speech program. We used Phyton and C++ to control the system. The series of joint values to realize signs in Robot are currently produced manually but we are still working on detecting and learning them through Motion Capture systems. To the best of our knowledge, this is the only study to teach children sign language within an interaction game using robots.

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**Figure 2. Flowchart of the game [4]**

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**Nao’s Tale**

(3) close (friends) decided to go to picnic to the forest. (Dad) drove them to picnic with his red (car). When they arrived they put their food on the (table).

Please put relevant stickers to the boxes

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1 2 3 4 5
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**Figure 3. Play card containing part of the story and the test (translated to English). The flashcards and stickers contain the same pictures but bigger in size. [4]**

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**REFERENCES**


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