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Interactive Scenario Development of Robot-Assisted Therapy for Cerebral Palsy: A Face Validation Survey

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Abstract

Humanoids have potential in the augmentation of rehabilitation programme for children with cerebral palsy. To make the humanoid programme applicable and clinically compliant, correct interactive scenarios had to be developed. Development of Human Robot Interaction (HRI) scenario is the main focus of this study. Through discussions with clinicians and therapists, four interactive scenarios have been formulated. The researchers have designed and developed the interactive scenarios concerning the suitability of measuring items in the Gross Motor Function Measure (GMFM) that is suitable to be applied by humanoid robot NAO. Choregraphe software, a programming tool that allows programmer to create and compile the behavior of the robot was used in this study. Choregraphe Suite is a multi-platform desktop application, to create animations, behaviors and dialogs. The developed interactive scenario had undergone a face validity process. This method of validation is used to confirm through peer reviews that the content of the interactive scenario is suitable to be used for children with cerebral palsy. Thirty peer reviewers, made up by a group of physiotherapists and occupational therapists validated the suitability of the interactive scenario. The result of the validation will be explained in this paper.

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1. Introduction

Cerebral palsy (CP) is an umbrella term that encompasses a group of non-progressive and non-contagious motor conditions that causes physical disability, chiefly in the various areas of body movement [1]. There are four types of CP which are spastic, ataxic, dyskinetic and mixed [2]. It is noted that the awareness on CP had started since the 1860s. Early studies by William John Little (1810-1894) related CP to perinatal anoxia, injury to the head and neck at birth and difficulty in deliveries [3] which findings were agreed by Sigmund Freud. The biggest challenges faced by children with CP are limitations in the fundamental areas of humanity: mobility, communication, manipulation, orientation and cognition [2]. Since CP has no cure, management for CP focuses on how best to help individual maximize his or her potential to improve their quality of life [4].

Humanoid robot NAO is a 58-cm tall humanoid robot which is made with the aim of robotic applications for education and research purpose. At present, NAO is widely used as a social companion, a learning tool in the classroom [5] and autism rehabilitation purposes[6]. This biped robot comes with 25 degrees of freedom (DOF), an array of sensors, giving it good motion and artificial intelligence.

Human-robot interaction (HRI) has widened their wing to help people with disabilities to improve their quality of life. In fact, robotic therapy hold promise for managing children with CP to learn motor skills [7,8]. Some previous studies have used social robot in their study in rehabilitation for children with CP such as Cosmobot [9], Kinetron [10], and Ursus[11]. Since children with CP

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react positively towards robots [12], humanoid robot with HRI architecture has great potential to facilitate motor development and to enhance motor skills by repetitive exercising [13].

This study proposes the use of NAO as an adjunct tool in physical therapy sessions for children with CP. NAO has good potentials to be used as a therapeutic tool due to its human-like figure. The robot acts as a therapy aid to promote human to human interaction between the child and the therapist. However, it is important to know that the robot is not to replace the function of the therapist. The effectiveness of management for children with CP is expected to be improved by initiating joint attention between child, therapist and the robot. The robot is aimed to maintain the child's motivation and engagement during therapy.

The developed interactive scenario has undergone a face validation process. This method of peer review is essential to confirm the interactive scenario suitability to be used for children with CP. The content of the interactive scenarios have been peer reviewed and face validated by a group of physiotherapists and occupational therapists (n=30 people).

2. Interactive scenarios

After discussions with clinicians and therapists, four interactive scenarios had been formulated. The researcher have designed and developed the interactive scenarios concerning the suitability of measuring items in the Gross MFM that is suitable to be applied by NAO. GMFM looks at the ability of the child to roll, crawl, kneel, sit, stand, walk, run and jump. Choregraphe software, a programming tool that allows programmer to create and compile the behavior of the robot was used in this study. This section will briefly explain all the formulated scenario covers the aim, the protocol, and the programming.

2.1. Interactive Scenario 1: Introductory rapport

Interactive scenario 1 involves a two-way communication that requires interaction between the NAO and the participant. It consists of several simple questions to the child and duration of scenario 1 is two minutes. The aims are to observe the child's reaction to the presence of a robot and to create rapport between the child and the robot.

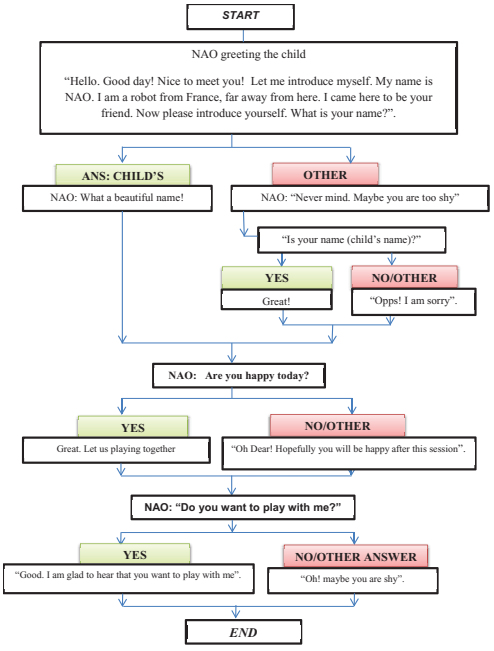

Fig. 1. Flowchart of Interactive Scenario 1

Figure 1 shows the scenario flowchart. Initially, the robot is in a sitting position and will be placed on the table facing towards the child. Then the robot greets the child, introduces itself and continues to the next question.

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