UNIVERSITI TEKNOLOGI MARA

AN OPEN-ARCHITECTURE BIOLOID HUMANOID ROBOT CONTROLLER IN SUPPORT OF DEVELOPMENTAL DISABILITY (DD) REHABILITATION

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ABSTRACT

Robot-assisted therapy has facilitated developmental disability (DD) children in performing rehabilitation modules. However, most robot-assisted therapy controllers come with closed systems which hardly support the integration of third-party components. Therefore, there is a need for more open scheme for controller design. This thesis presented a proposed controller which is aimed to extend the features of the inexpensive commercial BIOLOID humanoid robot and is compared to the manufacturer's closed system controller named CM-530. The proposed controller was developed based on Raspberry Pi 3 model B with hardware attached on top (HAT). Given that the proposed controller is more open and provide greater flexibility to developers, a comparison in terms of average power consumption and timestamp performance of BIOLOID robot-assisted therapy using both controllers respectively are also made towards its ability to provide better support in terms of control perspectives for DD rehabilitation modules. The average power consumption for the proposed controller was 15.12% higher than CM-530 during idle mode. In dynamic mode, the proposed controller consumed 13.79% and 19.40% higher than CM-530 controller when tested for single and multiple servomotors. These is happened due to the controller's architecture which require a Linux operating system in order to operate while CM-530 controller does not run any operating system. All results were collected using Arduino IDE and graphed using MATLAB R2015a software. The timestamp performance for the proposed controller allowed BIOLOID robot-assisted therapy to perform all five required DD rehabilitation modules while CM-530 only performed two rehabilitation modules. In conclusion, the custom-designed controller provides better capabilities regarding to its open-architecture which gives an opportunity for other developers to delve further into the structure knowledge that helps in reducing its maintenance cost. The open characteristics of proposed controller consequently will enhance the controller potential/capabilities and can be utilized by other robot-assisted therapy in future.

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CHAPTER ONE
INTRODUCTION

1.1 Research Background

Over the recent decades, robotics is increasing rapidly in the field of science and engineering. Mobile robotics is a broad field of study which is different from general robotics which means it has the ability to move. Mobile robots include humanoid robots, unmanned rovers, entertainment dogs, drones, and others. Mobile robots are able to replace humans in various areas which includes medical care, surveillance, automation, transportation, patrolling, emergency rescue operations, construction, entertainment, museum guides, personal services and others [1]. Mobile robots differ significantly from other types of assistive technologies, including the applications on smartphones and tablets in terms of physical engagement. Normally, a person more willing to engage and influenced via an embodied physical agent than when interacting with smartphones and tablets and it has been proved that individuals are more satisfied when faced with human-like interfaces [2]. Therefore, this leads to less embarrassment to the individual when engaging with the robot. This is very important in the case of health-care problems.

For instance, humanoid robots can be used to can make the interaction more significant. Accordingly, previous researchers have exploited humanoids for socially assistive robotics (SAR) [3]. The scientific, technological, and industrial communities are paying close attention to SAR due to its high potential value in enhancing the quality of life for a large segment of the population [4]. Rather than providing physical assistance, SAR applications, focus on assisting humans through social interaction. From this perspective, the social robot may play a role in assisting people to improve their well-being by suggesting something to do by performing a specific activity such as exercising or influencing and motivating human behaviour [5]. Numerous initiatives have demonstrated robot inspiring capabilities, even when real people have difficulty motivating users for example when interaction with autism [6].

Humanoid robot has always been prominent research in mobile robot since it possesses a physical appearance similar to that of a human, including two arms, two legs, and a head. For example, NAO [7-10] as shown in Figure 1.1, ASIMO [11], i-