A Study on Smart Wheelchair Systems

[1]Mohammed Hayyan Al Sibai and [2]Sulastri Abdul Manap

[1,2]*Faculty of Engineering Technology,*
University Malaysia Pahang,
Lebuhraya Tun Razak, 26300, Kuantan, Pahang, Malaysia
[1]*mhdhayyan@gmail.com,* [2]*sulastri@ump.edu.my*

Abstract—Many people are suffering of temporary or permanent disabilities due to illnesses or accidents. For cases of difficult or impossible walking, the use of a wheelchair is becoming essential. Manual or electrical wheelchairs are satisfying for most of the low and medium level disability case where patients can use the wheelchair independently. However, in severe cases, it is difficult or impossible to use wheelchairs independently. In such cases wheelchair users often lack independent mobility and rely on somebody else handle the wheelchair. Researchers involved in wheelchair are aiming at designing smart wheelchairs to solve such problems. This paper is to review the recent studies on smart wheelchair systems. It aims to evaluate the current available technologies and to discuss new future directions for our ongoing research project.

Index Terms—Smart wheelchair; artificial intelligence; robotics; Embedded systems; smartphones

I. INTRODUCTION

Asia-Pacific Development Center on Disability (APCD) estimated population of persons with disabilities in Malaysia by 197,519 cases in 2007. Overseas, the Centers for Disease Control and Prevention (CDC) estimated that about 53 million people in America have a disability of some kind. Around two million people of them depend on wheelchairs for day-to-day tasks and mobility. Manual or electrical wheelchairs are satisfying for most cases. However, in severe cases, it is difficult or impossible to use wheelchairs independently [1]. These cases include people with vision problems, Tetraplegia, spinal cord injuries (SCI), Parkinson's or cognitive deficits. Consequently, wheelchair users rely on relatives, nurses or caregivers to help them with the wheelchair. To reduce suffering and the dependency of such users, some companies produce different types of what so called "smart wheelchairs". A smart wheelchair can be defined as a uniquely modified powered wheelchair which is equipped by a control system and variant sensors. It is also can be defined as a mobile robot base to which a seat has been attached [1]. Smart wheelchairs are designed to provide assistance to users in different ways. Its purpose is to reduce or eliminate the user's full responsibility on moving the wheelchair. They arealso designed for a variety of user types according to their situations and disabilities. One drawback of the Smart wheelchairs is the higher price of them comparing with the manual or the simple electrical powered wheelchairs. This paper reviewsrecent smart wheelchair systems.Commercialization issues and price estimation arediscussed.Clinicians and users' attitude toward the smart wheelchair is considered. Finally, new future directions for our ongoing research project are discussed.

II. LITERATURE REVIEW

According to the review paper published by Simpson in 2005 [1], there are many forms for designing a smart wheelchair. Early smart wheelchairs were mobile robots to which seats were added [2, 3]. Currently, most of developed smart wheelchairs are built on by modifying commercially available power wheelchairs[1]. Few smart wheelchairs are designed as "add-on" units that can be attached to and removed from the underlying power wheelchair. All these designs are sharing the same objectives which are: Easing the way the chairs are used, avoiding collisions as much as possible, increasing travel distance and decreasing travel time.