Chapter 4

Hand Exercising Exoskeleton: An Aging Assistive Device for Rehabilitation

Soumya Kanti Manna
College of Engineering & Management, India

Prasanna Kumar Lenka
National Institute for the Orthopaedically Handicapped, India

Subhasis Bhaumik
Indian Institute of Engineering Science & Technology, India

ABSTRACT

Aging is a common stage of human life where people often face different problems related to physical and mental weakness which in turn make them feeble to do their daily activity. Despite of all the challenges, most aged people prefer to do their daily routine at their own. Assistive technology is used to support those people to get back into their normal life and enhance the independent living. Exoskeleton or wearable robots are people-oriented robots designed to be worn. These robots are designed around the function and shape of the human body and the human will be able to control the robotic limbs. This control can assist in walking, running, jumping higher or even lifting objects one would not normally be able to lift. A hand exercise device called “Exorn” which is user friendly, simple to use and easy to control is being focused in this chapter.

INTRODUCTION

Assistive technology is an engineering and science endeavour which involves supporting the elderly or disabled to do the activities of daily living. It is a branch of rehabilitation engineering focused on mobility, communication, visual, hearing and cognitive functioning of elderly and disabled. Hand exercise exoskeleton is one of the therapeutic assistive devices targeted to disabled and elderly in rehabilitation process.

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Human body generally faces two types of impairment: one is sensory impairment like sight, sound, smell, taste, touch and sensitivity and other one is motor impairment such as speech, balance, gait, coordination, grip and arm function. Sensory impairment can be replaced through different implants and surgery. Hearing problem can be solved by using hearing aid, cochlear implant and signing. Reading machine, refreshable braille and glasses can assist the people who have a sight problem due to ageing or aftereffects of any neural diseases. But the problems related to nerve motor function cannot be solved by any replacement because those are being controlled by brain signal. Aged people generally suffering from several problems related to physical, cognitive or sensory impairment. As a result, they are unable to fit into this society and will not be able to do their daily activities. Those kinds of disability are originated from several chronic diseases or come with heredity. Several times it has been found that those people have more than one of these three impairments. As an example, spinal cord injury can damage both physical and sensation power. Those problems will also increase as they approach towards sixty’s according to Ross (2001). If a blind person has diabetes, he or she might loss the sensation ability at the older age.

The overall elderly and disabled assistive device market is segmented into medical mobility aids and ambulatory devices, medical furniture and bathroom safety products, vision and reading aids and hearing aids. There are nearly 800,000 stroke incidents reported in each year in the United States in a statistics provided by Stroke Static (2009). Heart Disease and Stroke Statistics (2009) say that there are nearly 80% of stroke survivors suffer hemiparesis of the upper arm and impaired hand function is found in published report by Duncan, Bode, Min and Perera (2003) as the most disabling motor deficit. Even after extensive therapeutic interventions in acute rehabilitation, the chance of regaining normal use of the impaired hand is reported to be low viewed by Kwakkel, Kollen, Grond, and Prevo (2003). Adequate hand function is essential for daily living. People should consider and take care of the mechanisms underlying hand motor function impairment and optimizing hand therapy techniques that elicit greater gains in motor function. The hand exoskeleton plays an important role in rehabilitation of upper extremity impairment in both elderly and disabled. Here the mechanical design of the system has been described and simulations of an exoskeleton as well as the kinematics are also discussed.

BACKGROUND

Today it is very difficult to provide 24 hours human assistance to an aged person in a home. In developed countries like USA and UK, government is very much concerned about the health issues of the aged person. It is true that in the third world countries people have to struggle hard to fulfill their daily needs (Goffi, Terpenny, Vernon, Green, & Vorster, 2005). Investment for the development of assistive devices is a matter of aristocracy. Though government is now taking care of those people by providing rehabilitation services to the aged people, giving them a safe environment and livelihood after being neglected by their own relatives.

The use of assistive technology can reduce all those hurdles which in turn may improve quality of life as discussed by Simpson and Hedman (2002) as well as Ryan, Tewey, Newman, Turner, and Jaeger (2004). Already a lot of researches have been carried out regarding uses of assistive technologies. But the success of these technologies lies in understanding barriers to use of current technology, finding the loopholes and how to overcome it.
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