Hybrid Assistive Limb

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Hybrid Assistive Limbs or HAL for short are a technology that has been thought about since the 1950's. The book 'I-Robot' by Isaac Asimov, inspired the invention of the modern day HAL suit. Designed by Dr. Yoshiyuki Sankai, HAL-5 and the company Cyberdyne had fulfilled the dreams of Sankai's childhood (1).

In the late 1960's in third grade, Sankai read the book 'I-Robot' which changed his life from that day. The doctor in the book designed these robots and sparked the fire within Sankai that aspired his becoming a Doctor of Robotics. Immediately, Sankai began conducting experiments and learned a great deal of electrical engineering by the time he graduated primary school (1).

In high school, Sankai noticed the correlation between old age and the need for assistive living. He knew that technology was the only means to live the remainder of one's life in happiness. Realizing that the skin is an impenetrable barrier, Sankai knew that an external Robotic suit would be the only solution (1).

Yoshiyuki Sankai began studying for his PhD in 1987, at the same time he began testing methods of building an exoskeleton for the human body. He discovered that faint bioelectric signals generated by muscle neurons can be detected on the surface of the skin with electrodes. Using these bio-signals, Sankai began designing a computer that could process the signal into a robotic movement that exactly mimicked the human motion (1).

HAL-5 is the product of Dr. Sankai's long journey of perfecting the exoskeleton technology. The robot-suit works by detecting nerve signals that are sent from the brain to the muscles via motor neurons. These signals are immediately processed by the onboard computer, which can detect the intended power the wearer desires to generate. The computer then calculates the amount of power needed and the power units generate torque moving the exoskeleton and human limbs (3).

What is so impressive about this computer system that Dr. Sankai developed? It can detect the signal and move the exoskeleton before the human body would physically move. This is called a 'voluntary control system' in which the wearer has complete control. He also programmed the computer to update information that the sensors collect and store them in an onboard database that memorizes the movements of the individual. Therefore, over time the HAL suit begins to individually meld with the wearer's average daily living (ADL). Just like a humans 'autonomous control system', the HAL suits database functions as a 'robotic autonomous control system' (3).

This is especially important in the application of this technology in disabled and elderly patients. The ability of the suit to remember specific movements and its ability to balance itself can help protect the elderly from serious falls. It can also help individuals with spinal injuries if they have strong enough electrical signals that can be utilized. Furthermore, if signals cannot be detected, the HAL suit can be programmed for the individual and still be a tremendous improvement to their ADL (3).

The HAL-5 suit itself is classified as a Hybrid system in which there is voluntary and involuntary control of the suit. The full body suit weighs approximately 25 kg with a battery life of about 2 hours and 40 minutes. HAL-5 can amplify human strength from a factor of 2 to 10 times the original strength. This demonstrates the awesome potential of this technology (3).

Cyberdyne, the company producing the HAL-5 suit, founded by Dr. Sankai, estimated a production of 20 suits by 2007 and 400-500 suits by 2008. Currently, the suit is only available to Japanese residents and the cost to purchase the suit is from $42,000-$59,000 dollars. The future of the HAL-5 suit can potentially aid factory labor, walking assistance, ADL, and disaster rescue (2).

Works Cited

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3. "What's "HAL" (Hybrid Assistive Limb®)? -." *CYBERDYNE*. Web. 01 Nov. 2009. <http://www.cyberdyne.jp/English /robotsuithal/index.html>.