Hybrid assistive limb

Technology

Hybrid Assistive Limb (HAL-5) 1. Introduction. People often suffer from various disorders related to their physicalhealth, which also include disorders of the nervous, vascular and integumentary systems, muscular and neurologic diseases. Consequently, these violations probably affect the musculoskeletal system and complicate the daily lives of these people. However, with the daily development ofscience and technology, doctors and inventors are trying to create some kind of device that can make life easier for people with such disabilities. To date, some examples of these developments are already invented.

One of these developments is a powered exoskeleton Hybrid Assistive Limb (HAL-5). Hybrid Assistive Limb (HAL) is a full-body suit, which was designed to help people with degenerated muscles or spinal injuries or brain disorders. Now we are going to describe appearance, functions and main characteristics of this robotic device. 2. Data and producers. The wearable-type robot “ Robot Suit HAL” was created in Japan, notably by Cyberdyne, Inc. This company was founded in 2004 to exploit the work of a group of cybernetics researchers headed by Yoshiyuki Sankai, a Professor of System and Information Engineering at Tsukuba University. 4] The study about Hybrid Assistive Limb was started by professor Sankai in 1992 and lasted until 1996. The result of thishard workwas HAL-1 (fig. 1), first prototype of HAL series robots. The next robot which was built with cardinally other design is HAL-3 (fig. 2). It was invented in 1999 and had been used for 6 years. Final version of HAL robot, HAL-5 (fig. 3), was discovered in 2005 and still is being developed by professor Yoshiyuki Sankai in his laboratory at

University of Tsukuba. Cyberdyne Inc. has been manufacturing and is currently distributing of the HAL-5 to the residences of Japan and Europe.

Figure 1. HAL-1 robot, 1996 Figure 2. HAL-3 robot, 1999 3. Functions and applications of the system HAL-5 is expected to be applied in various fields such as rehabilitation support and physical training support in medical field. Also, it can be used in a range of another non-military uses, for example, in including allowing workers to carry heavier. [4] HAL-5 helps users lift up to about 40 kg more than they normally could. To be exact, a healthy adult male, wearing this suit, can lift approximately 80 kg, roughly double what he can without it.

Hybrid Assistive Limb can multiply the overall original strength of the wearer by a factor of 2 to 10. The general concept of a HAL-5 robot is simple in general. The components HAL are very easy to construct, however, the complexity of the HAL occurs primarily in its programming and way of working. Professor Sankai says that “ the suit detects faint biosignals on the surface of the skin when the human brain tries to move the exoskeleton”. When the Robot Suit detects these signals, it helps the user to move.

HAL-5 can operate indoors and outdoors; although, it is strongly recommended to use this suit indoors until better batteries allow more prolonged use. One of the main advantages of this robot is the ability to change between two types of control: Cybernic Voluntary Control and Cybernic Autonomous Control. By using phase switching with the autonomous control function, the healthy function of a limb could be reproduced by the HAL. Based on this capability, it appears that the HAL would be effective for use in the rehabilitation of patients suffering from loss of nervous function in a limb. 4.

System design The most visible part of the HAL-5 is the exoskeletal frame, which consists of a frame made of nickel molybdenum and an aluminum alloy. Moreover, it was strengthened by a plastic casing and the metal bars, which is strapped to the body and helps the user externally. The bars run along the lateral sides of the legs and arms. Additionally, there are several electric motors act as the HAL-5's muscles, which have to provide powered assistance to the wearer's limbs. Currently, the total weight of the Hybrid Assistive Limb suit is 23kg, but man, wearing this device, does not feel any weight.

It happens because the suit can support its own weight. Also, HAL-5 has a small pouch attached to a belt on the suit that contains a computer, Controller Unit, which controls the suit and a Wi-Fi communications system. The bindings at the shoulders take the form of backpack-like straps to attach the battery and Controller Unit. The frame also has soles, which are used to help stabilize balance, at the ends of the leg bars to eliminate the need for the user to support the weight of the suit. All of these details you can see from fig. 3, and fig. 4. Fig. 3. and Fig. 4.

System architecture with sensors, battery and Controller Unit 5. Sensors and actuation mechanisms On the side of the joint nearest the corpus, two sensors are placed upon the skin. One sensor is placed over the muscle group, which causes the limb to extend, and one on the surface of muscle group, which causes the limb to flex. Each sensor consists of two electrodes which measure potential difference between them as a function of the nerve impulses, which cause the contraction of muscle fibers. These sensors first filter and then amplify the signals of passing such kind of nerve impulses.

Also, the suit is powered by both nickel-metal hydride and lithium battery packs. Full charge of this battery lasts approximately for 2 hours and 40 minutes, with both the upper and lower body parts in action. Cyberdyne Inc. has announced that one part of its research is focused on increasing this time to about 5 hours. HAL-5 Speficications: | Height | 1600mm| Weight | Full Body Type: 23kg | | Lower body: 15kg| Battery | Drive Charged battery (AC100V)| Continuous operating time | Approximately 2 hours 40 minutes| Motions Daily Activities | Standing up from a chair| Walking| | Climbing up and down stairs| | Hold and lift heavy objects up to 80kg| Cybernic Control:| Cybernic Voluntary Control| | Cybernic Autonomous Control| Indoor and outdoor| ? | 6. Conclusion In conclusion we can consider that the wearable-type robot HAL-5 is a tool with enormous potential for improving quality of life. In addition, the HAL-5’s frame can incorporate recycled materials, which can include fiberglass, certain plastics, silicon, aluminum, and steel. Such materials can also be recoverable for recycling into other products.

Improvements in battery efficiency and frame weight would reduce energy requirements, and in the case of outdoor use, energy requirements could be offset by solar cells on the frame. So, the program is currently being continuing and developing. Sankai says that one of his main aims is “ to create technologies that are designed for the benefit of humankind rather than for destructive purposes. ” For example, he refused offers from the U. S. Department of Defense in Washington DC and the government of South

Korea to work on a robot for military use. This adds more confidence in the good intentions of professor Sankai.