NEWS

XML JSON

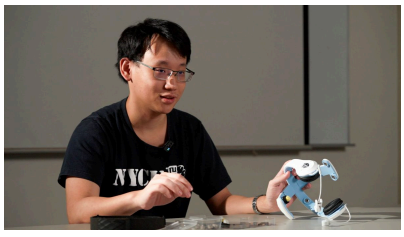
Smart Healthcare Publish Date：2024-10-08

NYCU Wearable Wireless BCI Device: Leading Smart Healthcare in Taiwan

Photo from ZDunemployed studio

By NYCU Elite

———



At the beginning of 2024, Elon Musk, the founder of SpaceX and Tesla, published a case of a

paralyzed patient with an AI chip implanted in his brain using his mind to control the device, making the Brain-Computer Interface (BCI) grab the attention of the public again. However, the risks, such as invasive surgery and its sequelae, are also a matter of concern.

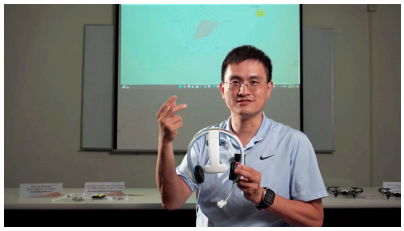
The team directed by Dr. Li-Wei Ko, the Professor of the Institute of Electrical and Control Engineering and Deputy Director of Digital Medicine and Smart Healthcare Research Center at National Yang Ming Chiao Tung University (NYCU), paves another way to develop a wearable wireless BCI device integrating graphene/GO dry electrode electroencephalogram (EEG) sensors, AI algorithms, and deep learning core technology. This device has been successfully applied in the fields of lower limb neurorehabilitation for

Dr. Ko's team developed graphene/GO dry electrodes, eliminating conductive gel and improving BCI device convenience, particularly for stroke rehabilitation with minimal training. (Photo from ZDunemployed studio)

"My central idea is in the hope that any neurological-related diseases can use wireless BCI devices for diagnosis or treatment." Dr. Ko then shares an R&D case in collaboration with Director Shuu-Jiun Wang of the School of Medicine of NYCU and Taipei Veterans General Hospital —the "Intelligent System of Migraine Detection and Neural Stimulation for Assisting Treatment," which was awarded the 2021 Future Tech Award.

"According to Director Wang's research, 1.5 million people in Taiwan suffer from migraine, which are more common in the young productive population, and the economic loss due to

stroke patients, assisted diagnosis of Attention Deficit Hyperactivity Disorder (ADHD) in children, a system for improving sleep quality, and an intelligent system for detecting migraine and providing neural stimulation to assist in treatment.



Dr. Li-Wei Ko, Professor at the Department of Electronics and Electrical Engineering at NYCU, leads the team that developed a non-invasive, wearable BCI device using graphene sensors and AI, applied in stroke rehabilitation, ADHD diagnosis, sleep improvement, and migraine treatment. (Photo from ZDunemployed studio)

Serving Those in Real Needs

In the science fiction movie "Avatar" released in work absences related to migraine is estimated to be as high as NTD 460 million (approximately US $14.38 million) per year! We hope that in the future, migraine detection can be as simple as blood pressure measurement. Patients can use wireless BCI devices at home. As long as they detect the special brainwave signals before the onset of migraines, they will be reminded to take the medication in advance to inhibit the upcoming migraine. The goal is to be able to alert migraine 8 to 24 hours before its onset. It is similar to the concept that patients with hypertension take the antihypertensive medication in advance whenever they feel dizziness," Dr. Ko explains.

Early diagnosis, Early Treatment

"If you open too many tabs at the same time, the operation speed of the computer will become

2009, the scenario that the paralyzed hero who can remotely control the Na'vi-human hybrids called "Avatar" in real time with his brainwaves and mind through the neural network connectivity technology can be said to aptly depict the origin and ultimate goal and vision of the BCI research.

Dr. Ko says that BCI research emerged around the 1990s and has been an emerging research field in neuroscience. The researchers initially hoped to help patients who were paralyzed from the neck down to communicate with the outside world, and the idea was to capture brain signals and convert them into action commands, which could be used to click buttons (e.g., typing) or even to control devices such as prosthetic limbs. The BCI equipment can generally be categorized into invasive BCI (e.g., using surgery to place electrodes directly into

slower, and as long as the pressure is too great overload for the brain, it will remind you of 'pain.' Some people will use sleep to 'reset' their brain, which is a protection mechanism. We are also trying to use wireless BCI devices to detect sleep quality and assess the relationship between work efficiency and stress index changes. The team has also proved that lavender essential oil can promote deep sleep and slow-wave occurring at night, which can greatly enhance sleep quality," Dr. Ko adds.

According to the Ministry of Health and Welfare, ADHD is a disease of abnormal brain physiology, and the development of some areas of the brain in children with ADHD is delayed by an average of three years compared with that of normal children. While the prevalence rate of ADHD in Taiwan is 9.02%, only

the cortex) and non-invasive BCI based on the methods used to capture brain signals.

BCI research, which began in the 1990s, aims to help paralyzed patients communicate by converting brain signals into action commands, using both invasive and non-invasive methods. (Photo from ZDunemployed studio)

Dr. Ko pointed out that he had researched applying wearable BCI devices to drowsiness detection and driving fatigue prevention while studying for his doctoral degree when there were still very few cases of wearable BCI device-related research on the globe. "2010 can be considered a watershed year for research on BCIs, and the number of research papers grew by a large number. I graduated from

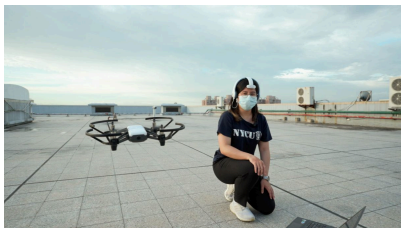
1.62% of the patients receive a diagnosis, which results in 70% of the children who do not receive the appropriate treatment and assistance, resulting in an increased risk of developing the seven comorbidities such as anxiety, depression, and learning disorders. To help children with ADHD receive early diagnosis and treatment, Dr. Ko's team has also collaborated with Hsinchu Ton Yen General Hospital and Kaohsiung Chang Gung Memorial Hospital to develop the "Intelligent ADHD Early Warning Platform," assisting clinicians in diagnosing ADHD with an accuracy rate of up to 95%.

"We let the children wear the testing device to play the 'game-based attention test' by the research team. At the same time, we analyze their brainwave changes to determine whether they tend to hyperactivity, which can shorten the

my doctoral program in 2007. I just happened to catch up with this explosive growth period of the field!"

"In 2023, our team surveyed the world's wearable BCI devices, most of which were research and development products of American companies, and China was also proliferating the device. However, most devices were only brainwave measurement devices and were not involved in subsequent data analysis and applications. We now integrate brainwave signal measurement, analysis, and control functions into a smart healthcare application system. We have shifted from the consumer application of driving fatigue prevention to smart healthcare research because I believe that the BCI technology should be used by those in real need!" Dr. Ko says earnestly.

traditional diagnostic process that takes three months to one month," Dr. Ko emphasizes.



The team aims to develop efficient BCI devices, secure medical certification, and strengthen AI chips to help Taiwan lead in BCI and smart healthcare innovation. (Photo from ZDunemployed studio)

Dr. Ko highlights, "In the past few years, Taiwan has moved from 'brain science' to 'brain technology,' emphasizing the need for traditional scientific research to be locally commercialized." He also believes that among the research institutes in Taiwan, NYCU is relatively pragmatic and is good at facilitating the commercialization of research results locally. NYCU has excellent R&D capabilities in ICT technologies, such as chip

Breaking the Bottleneck by Dry Electrodes

In traditional brainwave detection, a wet, adhesive conductive gel has to be applied to the scalp of the subject to fix the electrode patches, but the complex signal transmission lines and the need to choose an interference-free environment for measurement are not favorable for the wearable BCI devices to be applied to daily home life applications. Dr. Ko's team utilizes the patented graphene/GO dry electrode technology to measure brainwaves by directly touching the scalp without applying the conductive gel, reducing the subjects' rejection. In addition to the wireless transmission technology, the convenience of the measurement is greatly enhanced.

Breaking through the technological bottleneck development and miniaturization of circuit systems, which are solid advantages for the continuous development of improved wearable wireless BCI devices in the future.

In the future, the research team will not only continuously develop more power-saving, lightweight, and compact devices but also plan to obtain Taiwan's medical device certification as soon as possible. The initiative seeks to integrate NYCU's ICT R&D strengths as well as participate in the "Taiwan Chip-based Industrial Innovation Program" (Taiwan CbI) of the National Science and Technology Council (NSTC) to strengthen AI chip computing functions continuously and to assist Taiwan in becoming a global leader of BCI and smart healthcare research and innovation.

has enabled a wide range of applications for BCI devices in the medical field. For example, Dr. Ko's team collaborated with the Department of Rehabilitation Medicine of Kaohsiung Medical University Memorial Hospital on the "Exoskeleton BCI System for Stroke Rehabilitation," in which the patients only need to go through 2-3 sessions of concentration training using the wireless BCI device to learn how to intuitively manipulate the exoskeleton with their mind and achieve central nerve and peripheral nerves synchronized rehabilitation. The research involving the use of implanted chips to control exoskeletons in other countries requires a minimum of 24 months of training. Therefore, the research and development results of Dr. Ko's team can be considered a great blessing for stroke patients and their families.

NYCU ELITE: NYCU Wearable Wireless BCI Device: Leading ...

Related Image(s) :

cover image

Back

Open/Close

NATIONAL
YANG MING CHIAO TUNG
UNIVERSITY

Contact Us

Yangming Campus

Address：

No. 155, Sec. 2, Linong St. Beitou Dist., Taipei City 112304, Taiwan

Phone：+886-2-2826-7000

Chiaotung Campus

Address：

No. 1001, Daxue Rd. East Dist., Hsinchu City 300093, Taiwan

Phone：+886-3-5712121