

HEALTHY LONGEVITY GLOBAL COMPETITION

2024 Catalyst Awardees

Sponsor: Academia Sinica

A Proposal for Innovating Elderly Mobility: Smart Knee Brace Development

Principal Investigator	Yen-Jung Chiu, PhD
PI Primary Affiliation	Department of biomedical engineering, Ming Chuan University
Co-Investigator(s)	NA

PROJECT DESCRIPTION

The motivation of this project is to enhance the quality of life for older people. Muscle loss, decreased mobility, and deterioration of physical function increase the risk of falls as people age. Due to poor repair capabilities, recovering from injuries becomes difficult, leading to a sharp decline in quality of life. To address this issue, the project proposes the development of a smart knee brace that combines IoT technology with medical electronic devices, allowing for flexible adjustment of knee brace strength. While reducing the risk of falls, this knee brace can also help the elderly strengthen their muscles, promote tissue repair, and improve their overall health and independence. The smart knee brace is expected to revolutionize elderly mobility care, reduce the risk of falls, enhance muscle strength, and promote independent living, improving the quality of life in old age and alleviating the societal healthcare burden.

Advancing Depression Treatment: A Cutting-Edge Closed-Loop EEG-Guided TMS System

Principal Investigator	Chun-Shu Wei, PhD
PI Primary Affiliation	National Yang Ming Chiao Tung University
Co-Investigator(s)	NA

PROJECT DESCRIPTION

Major Depressive Disorder (MDD) significantly impacts individual well-being and societal productivity, posing a global health challenge with increasing economic costs. Treatment-resistant depression (TRD), affecting about 30% of MDD patients, fails to achieve remission with standard treatments. Current TMS approaches such as rTMS and iTBS suffer from limited efficacy due to their uniform application. Our project proposes a closed-loop, EEG-guided TMS system that personalizes brain stimulation by dynamically adjusting parameters using real-time EEG data and advanced deep learning techniques. This approach moves beyond the one-size-fits-all model, offering a cost-effective, high-compatibility solution for psychiatric clinics worldwide.

An Innovative Wearable Device of Swallowing Function Assessment for Home-based Elderly Monitoring

Principal Investigator	Yi-Chun Du, Professor
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PI Primary Affiliation	National Cheng Kung University
Co-Investigator(s)	Hui-Chen Su, Dr. Wei-Siang Ciou, PhD Yi-Jing Huang, Master Chien-Yu Lee, BA

PROJECT DESCRIPTION

As society ages, elderly individuals face the challenge of swallowing difficulties, which, in severe cases, can lead to malnutrition, dehydration, and an increased risk of aspiration pneumonia, significantly raising mortality rates among the elderly. This study proposes an innovative wearable system for home-based monitoring of elderly swallowing function. The system quantifies swallowing parameters during the oral and pharyngeal phases using advanced intraoral endoscopy, multi-point tongue pressure sensors, and dual-channel technology, providing clinicians with a more comprehensive assessment basis. This home-based self-assessment system offers early detection of swallowing dysfunctions, reduces associated risks, and promotes rehabilitation tracking for the elderly. It addresses the unmet needs in current clinical practices and fulfills the market demand for home-based swallowing function self-assessment systems. The device is expected to significantly improve the objectivity and comprehensiveness of clinical assessments while mitigating the drawbacks of traditional invasive examinations and radiation exposure.

PlateSync Health Companion – The App & Plate Duo for Diabetes Management.

Principal Investigator	Tsai-ju Lee, PhD
PI Primary Affiliation	National Taiwan University of Science and Technology Graduate Institute of digital Learning and Education
Co-Investigator(s)	LING-HUA TIEN YUN-JUAN CHANG

PROJECT DESCRIPTION

"PlateSync Health Companion" aims to address the dietary challenges faced by diabetes patients. Inspired by the struggles of managing my grandparents' diabetes, this innovative solution includes a specially designed plate and an accompanying app. The plate is divided into three sections: one for proteins, one for vegetables, and one for carbohydrates, each with precise portions to facilitate balanced meals.

The app allows users to take photos of their meals, providing real-time nutritional feedback and suggesting healthier alternatives. It also enables users to share their dietary data with doctors and family members, promoting a supportive environment for diabetes management. This system aims to enhance dietary adherence, improve portion control, and ultimately help manage diabetes more effectively.

By combining modern technology with personalized dietary guidance, "PlateSync Health Companion" seeks to improve health outcomes for diabetes patients, reduce complications, and lower healthcare costs. This solution has the potential to become a benchmark in diabetes care, fostering better dietary habits and enhancing overall patient well-being.

Portable brain stroke imaging system for rapid transcranial classification of ischemic and hemorrhagic lesions

Principal Investigator	Ting-Wei Wang, PhD
PI Primary Affiliation	National Tsing Hua University
Co-Investigator(s)	NA

PROJECT DESCRIPTION

Brain stroke is an urgent age-related cerebrovascular disease. Both ischemic and hemorrhagic strokes are life-threatening, requiring timely and different treatment. MRI is a diagnosis benchmark, but only available in hospitals. In rural areas, limited access to MRI prolongs treatment, raising time risks, including ambulance waiting, transportation, and MRI diagnosis time. Rapid accurate brain stroke classification is crucial to prevent mortality and worsening. To this end, our group proposed a capacitive sensing-based portable brain stroke imaging system that allows electric fields to penetrate the deeper region below the skull and reconstruct the permittivity-based imaging in response to ischemic and hemorrhagic lesions. The main innovation of the proposed idea offers a new, low-cost, portable medical imaging system for rapid brain stroke classification. Our proposed imaging system offers a cost-effective, portable alternative to cumbersome MRI scans. It enables rapid brain stroke classification, aiding in not only timely intervention for life-saving but also post-operative monitoring for life quality improvement. In the future perspectives, this transformative technology can be easily deployed in ambulances, clinics, and brain stroke rehabilitation centers globally, advancing cardiovascular and brain science, and promoting healthy longevity.

RehabVerse: Multiuser NeuroRehabilitation in Mixed Reality

Principal Investigator	YuTe Wang, PhD
PI Primary Affiliation	Research Center for Information Technology Innovation
Co-Investigator(s)	Tony Chou, MD; Charles Chang, MD; Yu Tsao, PhD; Ivan Tashev, PhD

PROJECT DESCRIPTION

Home-based rehabilitation with AR/VR devices offers convenience by minimizing travel time and expenses. However, it presents challenges: (1) Absence of real-time objective metrics to evaluate neurorehabilitation performance; (2) Solitary rehabilitation may induce loneliness, and isolation; (3) Overreliance on assistive tools may reduce motivation for consistent engagement in repetitive rehabilitation activities. Our initiative aims to construct an integrated rehabilitation ecosystem utilizing Mixed Reality Brain Computer Interface (MR-BCI), featuring: (1) A real-time AI-guided coach analyzing users' neurophysiological and movement data; (2) A virtual rehabilitation verse fostering mutual support, mitigating feelings of isolation; (3) Collaboration with therapists to tailor game-like exercises with household elements, enhancing enjoyment and reducing monotony in rehabilitation endeavors. The MR-BCI approach could revolutionize home-based rehabilitation by providing neurofeedback performance metrics, making rehab engaging through gamification and social interaction, and motivating users with home-based elements and adaptive difficulty. This could lead to precise and improved rehab outcomes, increased regimen adherence, greater accessibility, cost savings, and potential global scalability, significantly enhancing users' quality of life.