Project Details	
Project Code	MRCNMH25Ca Pham
Title	Enabling continuous, personalised stress quantification and management with a wearable system
Research Theme	Neuroscience & Mental Health
Summary	Nine in ten adults in the UK suffer from high or extreme stress in 2023. Stress-related disorders and burnout cost the UK economy more than £28 billion, 23 million sick days, and 165,000 bed days for the National Health Service per year. there is an imminent need for a system that could continuously monitor stress levels throughout the day and provide personalised feedback/relief to prevent chronic stress development and build up resiliency. This project aims to investigate and develop a wearable system that could continuously monitor stress levels and provide a non-invasive, closed-loop, personalised biofeedback to relieve or manage stress.
Description	Nine in ten adults in the UK suffer from high or extreme stress in 2023. Stress-related disorders and burnout cost the UK economy more than £28 billion, 23 million sick days, and 165,000 bed days for the National Health Service (NHS) per year [1]. Long-term unhealthy stress could also develop chronic negative effects on our body such as increased anxiety and depression, degraded cardiovascular functions, reduced brain grey matter and a weakened immune system [2]. This significantly burdens our workforce's productivity, quality of life, and the NHS system. Thus, there is an imminent need for a system that could continuously monitor stress levels throughout the day and provide personalised feedback/relief to prevent chronic stress development and build up resiliency. Additionally, the developed solution needs to be unobtrusive, socially acceptable, and able to invisibly weave into user's daily activities. Unfortunately, existing solutions are yet to meet these requirements. The ability to constantly monitor stress is particularly important to users, who are suffering from post-traumatic stress disorder (PTSD) or working in high-stress environments, such as front-line workers, paramedics, firefighters, pilots, train/lorry drivers, etc. Aims: The project aims to investigate and develop a wearable system that could continuously monitor human stress levels and provide a non-invasive, closed-loop, personalised biofeedback to relieve or manage stress. In particular, the project will focus on people who are suffering from post-traumatic stress disorder (PTSD). We have the following objectives. (1) Explore the method to accurately and continuously track stress levels by using various biosignals such as brainwaves, cortisol concentration, heart rate variability, breathing rate, bioimpedance responses, muscle tension, etc. (2) Investigate and devise a non-invasive, personalised biofeedback technique and algorithms to manage or relieve stress based on the captured biosignals. Potential directions include transcranial magnetic stimulation, vagus nerve stimulation, vestibular stimulation, somatosensory, phototherapy, or guided meditation. (3) Develop a wearable hardware and form factor design that can facilitate both sensing and biofeedback functionalities. The form factor needs to be unobtrusive to daily activities and has the potential to

integrate into everyday wearables such as earphones, clothes, hats, eyeglasses, etc.

(4) Evaluate the developed system on human subjects to study the efficiency and usability of the proposed system.

The studentship will enable the student opportunities to work with experts in the field of cyber-physical systems and clinical stress physiology, who have a track record of publishing in high-quality conference and journal articles, and on an exciting research direction that could bring immediate positive impact on human lives. The student will join the new vibrant CardiffIoT group with 4 core academics, 24 PhD students, and 4 postdocs, which enables a wide range of collaboration opportunities and peer support. They also collaborate with experts in the Traumatic Stress Wales, National Centre for Mental Health (Cardiff), Academy of Nursing (Exeter), and Centre for Digital, Manufacturing & Design (Bath) which helps to broaden their research network and future careers. During the project, the student will be supported with state-of-the-art facilities to quickly design, fabricate research prototypes and conduct studies on human subjects. It will allow the student to travel within the UK and abroad to present their research outputs to wider audiences and research communities.

During the three-month 'Prep' period, our collaborators have promised to host the student for research fieldwork at Traumatic Stress Wales, where the student can interact directly with clinicians and PTSD patients. These experiences are critical to prepare the student for a research career. Furthermore, lab visits and training workshops will be conducted within the School of Computing and Informatics (Cardiff) and with the National Centre for Mental Health (Cardiff), Academy of Nursing (Exeter), and Centre for Digital, Manufacturing & Design (Bath). After this 'Prep' period, the student will be well-prepared to tailor the project proposal and start taking ownership of the project.

During this studentship, the student will be trained to become a future independent researcher. This includes skillsets such as critical literature reviewing, planning and self-reflecting on progress, leading a team of colleagues and junior students, and engaging with collaborators in multiple disciplines and institutions. Furthermore, the student will also be guided on how to file patents and engage with public members and industrial partners to disseminate and transfer the developed technology. The studentship will provide financial support for the student to work with state-of-the-art equipment, quickly fabricate research prototypes, and conduct studies on human subjects. It allows the student to travel within the UK and abroad to present their research outputs to wider audiences and research communities. These experiences and training are critical to prepare the student for a professional research career.

[1] AXA, "The true cost of running on empty", 2023, https://tinyurl.com/2a3pfbre
[2] Mariotti, Agnese. "The effects of chronic stress on health: new insights into the molecular mechanisms of brain-body communication." Future science OA 1.3 (2015).

Supervisory Team	
Lead Supervisor	
Name	Dr Nhat Pham
Affiliation	Cardiff
College/Faculty	Physical Sciences and Engineering
Department/School	Computer Science and Informatics
Email Address	phamn@cardiff.ac.uk
Co-Supervisor 1	
Name	Professor Jonathan Bisson
Affiliation	Cardiff
College/Faculty	Biomedical and Life Sciences
Department/School	School of Medicine
Co-Supervisor 2	
Name	Dr Holly Sugg
Affiliation	Exeter
College/Faculty	Health and Life Sciences
Department/School	Academy of Nursing
Co-Supervisor 3	
Name	Dr Runan Zhang
Affiliation	Bath
College/Faculty	Faculty of Engineering and Design
Department/School	Department of Mechanical Engineering, Centre for Digital, Manufacturing & Design