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Department	School of Engineering and the Built Environment
Supervisors	Professor Hongnian Yu, Dr Pelagia Koufaki and Professor Michael Vassallo
Funding Status	Funded PhD Project (Worldwide)
Application Deadline	14/04/2022
Project Title	An intelligent multi-sensor based personalized risk assessment system of elderly gait and stability

PROJECT DESCRIPTION

This project aims to design three smart multi-sensor instruments that would allow a personalised assessment of gait and stability in elderly people. A device incorporated with accelerometer, magnetometer and gyroscope sensors will be placed insole shoes, two devices will be placed on thigh and knees and one device will be placed at the back of ear for analysing gait pattern and to detect falling over. A pair of force sensors will also be placed insole for analysing bilateral imbalance. Additionally, a pair of ultrasonic sensors and light intensity sensors will be placed at the front of each shoe for detecting obstacle and darkness. For collecting biological information Electrocardiogram (ECG), Oxygen Saturation (SpO2), Pulse Rate (PR), Respiratory Rate (RR), and Body Temperature (BT) sensors will be placed in a user-friendly chest belt. The information collected from these sensors will be transferred to a local computer using wireless network. The data will be stored and perform different analysis to bring out decisions and provide time to time interventions. The computer will be connected with the internet and be used to perform different analysis to show risks associated with imbalance in the elderly. It is expected to collect a vast input of sensory data from the instruments in a variety of situations. These will be initially derived from volunteers in real life and simulated situations. After collecting the data and optimising the instrumentation, we will put the devices out for everyday use with elderly volunteers.

This project is supervised by the multidisciplinary team which includes research expertise, clinical experience and the networks of people from Edinburgh Napier University, QueenMargaret University, and Royal Bournemouth Hospital. Building on our previous work, we will implement new methodologies and develop new tools to record and monitor quantity and quality of human movement, incorporating data analysis, with state-of-art wearable devices, to offer novel insights into gait pattern of elderly and frail individuals and the relationship to health and wellbeing outcomes.

Academic qualifications

A first degree (at least a 2.1) ideally in Computing, or Computing Engineering, or Electronics and electrical engineering, or IoT, or Robotics, or Mathematics or Health and Exercise related disciplines with a good fundamental knowledge of wearable sensors and quantitative data analysis and experience with working with human participants in research or practice settings..

English language requirement

IELTS score must be at least 6.5 (with not less than 6.0 in each of the four components). Other, equivalent qualifications will be accepted. [Full details of the University's policy](#) are available online.

Essential attributes:

- Experience of fundamental sensor technology and data analysis
- Competent in statistics and data modelling
- Knowledge of applied statistics
- Good written and oral communication skills
- Strong motivation, with evidence of independent research skills relevant to the project
- Good time management

Desirable attributes:

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Indicative Bibliography	<p>[1]. Arif Reza Anwary, Hongnian Yu , Andrew Callaway, Michael Vassallo, Validity and consistency of concurrent extraction of gait features using inertial measurement units and motion capture system, IEEE Sensors Journal, 21 (2), Pages 1625-1634, 2021</p> <p>[2]. Sajjad Akbar, Hongnian Yu , and Shuang Cang, Performance Optimization of the IEEE 802.15.4 based Link Quality Protocols for WBASNs/IoTs in a Hospital Environment using Fuzzy Logic, IEEE Sensors Journal 19 (14), 5865-5877, 2019.</p> <p>[3]. Arif Reza Anwary, Hongnian Yu and Michael Vassallo, Gait Evaluation using Procrustes and Euclidean Distance Matrix Analysis, IEEE Journal of Biomedical and Health Informatics, 2019</p> <p>[4]. Yan Wang, Shuang Cang, Hongnian Yu, Improving Daily Activity Recognition Accuracy for Older People: Data fusion based on a case study in a Hybrid Sensory Environment, IEEE Sensors Journal, 18(16), pp. 6874 – 6888, 2018</p> <p>[5]. Arif Reza Anwary, Hongnian Yu and Michael Vassallo, Optimal foot location for placing wearable IMU sensors and automatic feature extraction for gait analysis, IEEE Sensors Journal, pp. 2555 – 2567, 18(6), 2018</p> <p>[6]. Saisakul Chernbumroong, Shuang Cang and Hongnian Yu, A practical multi-sensor activity recognition framework for home-based care, Decision Support Systems, 66, pp. 61-70, 2014,</p> <p>[7]. Saisakul Chernbumroong, Shuang Cang, Anthony Atkins, Hongnian Yu, Elderly activities recognition and classification for applications in assisted living, Expert Systems with Applications, 2013</p>
Funding notes	This project may be funded by a scholarship of the School of Engineering and Built and Environment. Please see School-funded PhD scholarships - RESEARCH AND INNOVATION (napier.ac.uk) for information on the scholarships and how to apply for them.
Enquiries	For informal enquiries about this PhD project, please contact Professor Hongnian Yu (Email: h.yu@napier.ac.uk) or Dr Pelagia Koufaki (Email: PKoufaki@qmu.ac.uk)
Web page	https://www.napier.ac.uk/research-and-innovation/research-degrees/application-process
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