

**ERDF Industrial Intensive Innovation Programme
PhD Project**

Project Title: Deep Learning based Health and Safety Monitoring and Fraud Detection in Retail Stores

Background

The PhD project forms part of the Intensive Industrial Innovation Programme (IIIP) funded by the European Regional Development Fund. Northumbria University is collaborating in the IIIP, with Durham, Newcastle and Teesside Universities.

The IIIP Programme aims to encourage a culture of innovation that benefits business, leading to greater export opportunities and increased graduate employment, particularly in science and engineering. The Programme will enable small and medium-sized enterprises (SMEs) to develop new products and services.

Each Northumbria University PhD funded with the IIIP will exclusively support the research and development needs of an SME partner located in the Northumberland and Tyne & Wear Area, working in regionally important sectors.

To meet the requirements of the ERDF funding, the PhD students will need to keep timesheets and at least 51% of their time must be on-site at Northumbria University. The remainder is likely to be spent with the SME.

Project Rationale and Description

Compensations for fraud cases such as fake falls and refund of stolen objects cost millions of pounds in retail stores per year. This project aims to address the above challenges by conducting hazard and fraud case (e.g. fake falls) detection in retail stores using videos and CCTV footage.

Unlike existing models, this project proposes a novel deep learning architecture incorporating object detection and recognition, scene classification, face detection and recognition, human attribute prediction (e.g. age, gender, ethnicity, etc), human action (e.g. falls) and gait recognition. Specifically large-scale object detection and recognition may not only identify hazards (e.g. boxes and spilled liquid) on the floor to prevent potential falls, but also help to distinguish organised crimes (e.g. fake falls, stealing objects in the store and returning them with a receipt) from genuine falls and usual refund cases. As an example, object recognition and attribute prediction may help to indicate if customers carry certain objects when entering the store when a refund case is involved if necessary.

The deep learning models will also be developed to conduct biometric recognition, i.e. face and gait recognition. Human action classification will also be conducted to identify fall action and suspicious behaviours. Human attribute prediction (e.g. age, gender, ethnicity, top colour, etc) will be performed when required. Such functions enable the recognition of the persons of interest when fake falls or any fraud refund claim cases are involved and help to raise alarm when they enter other stores.

The proposed deep learning architecture will be extensively evaluated using real-life images/videos. This research will build a new partnership with Ocucon Ltd. It shows great potentials in changing/upgrading existing retail customer services and addressing the increasing

demand of the health and safety issues and fraud prevention. The project will also foster wider multi-disciplinary national and international research collaborations.

Eligibility and How to Apply:

Please note eligibility requirement:

- The IIP PhD funding is available to Home and EU students.
- Academic excellence of the proposed student i.e. 2.1 (or equivalent GPA from non-UK universities; or a Masters, or APEL evidence of suitable practitioner achievement)
- Applicants cannot apply for this funding if currently engaged in Doctoral study at Northumbria University or elsewhere

Deadline for applications: midnight 16th July 2018

The deadline for applications is midnight, 16th July 2018. To apply, please send the following information to Alison.Vipond@northumbria.ac.uk by the deadline:

- A covering letter, clearly indicating the title of the studentship project you are applying for and that you meet the eligibility criteria
- A current CV – maximum 2 pages
- Contact details for two referees – including postal and email address
- Transcripts – candidates should supply clear and legible transcripts of their previous qualifications

Interviews will be arranged to take place between 19th and 25th July 2018

PhD Start Date: 1st October 2018

Northumbria University takes pride in, and values, the quality and diversity of our staff. We welcome applications from all members of the community. The University holds an Athena SWAN Bronze award in recognition of our commitment to improving employment practices for the advancement of gender equality and is a member of the [Euraxess](#) network, which delivers information and support to professional researchers

Faculty: Engineering and Environment

Department: Computer and Information Sciences

Principal Supervisor: Dr Li Zhang

Recent publications by supervisors relevant to this project

- Kinghorn, P., **Zhang, L.** and Shao, L. (2018). A Region-based Image Caption Generator with Refined Descriptions. *Neurocomputing*. 272 (2018) 416-424. **(IF: 3.317, Journal Ranking 18%)**.
- Mistry, K., **Zhang, L.**, Neoh, S.C., Lim, C.P. and Fielding, B. (2017). A micro-GA Embedded PSO Feature Selection Approach to Intelligent Facial Emotion Recognition. *IEEE Transactions on Cybernetics*. 47 (6), 1496-1509. **(IF: 7.384, Journal Ranking 4%)**.
- **Zhang, L.**, Mistry, K., Neoh, S.C. and Lim, C.P. (2016). Intelligent facial emotion recognition using moth-firefly optimization. *Knowledge-Based Systems*. Volume 111, Nov. 2016, 248–267. **(IF: 4.529, Journal Ranking 12%)**
- Pandit, D., **Zhang, L.**, Chattopadhyay, S., Lim, C.P. and Liu, C. (2018). A Scattering and Repulsive Swarm Intelligence Algorithm for Solving Global Optimization Problems. *Knowledge-Based Systems*. **(IF: 4.529, Journal Ranking 12%)**

- Kinghorn, P., **Zhang, L.** and Shao, L. (2018). A Hierarchical and Regional Deep Learning Architecture for Image Description Generation. *Pattern Recognition Letters*. (In Press) (**IF: 1.995**).
- Neoh, S.C., **Zhang, L.**, Mistry, K., Hossain, A., Lim, C.P., Aslam, N. and Kinghorn, P. (2015). Intelligent facial emotion recognition using a layered encoding cascade optimization model. *Applied Soft Computing*, 34. 72-93. (**IF: 3.541, Journal Ranking 13%**)
- Zhang, Y., **Zhang, L.**, Neoh, S.C., Mistry, K. and Hossain, A. (2015). Intelligent Affect Regression for Bodily Expressions Using Hybrid Particle Swarm Optimization and Adaptive Ensembles. *Expert Systems with Applications*, 42 (22) 8678-8697. (**IF: 3.928, Journal Ranking 14%**)
- Zhang, Y., **Zhang, L.** and Hossain, A. (2015). Adaptive 3D facial action intensity estimation and emotion recognition. *Expert Systems with Applications*, 42 (3) 1446-1464. (**IF: 3.928, Journal Ranking 14%**)

Funding Notes

The studentship is available to Home and EU students where a full stipend, paid for three years at RCUK rates (for 2018/19, this is £14,777 pa) and full Home/ EU Fees.



European Union

European Structural
and Investment Funds