Smart Healthcare System with Federated Learning

1. Context

World report on ageing and health from World Health Organization (WHO) in 2015 shows that the problem of global population ageing is becoming more serious. The proportion of population aged over 60 years old will increase from 12 % in 2015 to 22 % in 2050. With a twice growing speed, the number of elderly people aged 60 and over will reach 2 billion during next 35 years. Increasing demand and costs for healthcare is a challenge because of the high populations and the difficulty to cover all patients by the available doctors. In this case, one possible solution is incorporation of both wearable computing and Internet of Things (IoT) technology into health. After an operation, patients usually go through the rehabilitation process where they follow a strict routine. All the physiological signals, as well as behaviors of the patient, are possible to be monitored with the help of smart garment. The system can be tuned to the requirement of the individual patient. The patient's health status and behavior can be observed remotely by doctors.

2 . Objectives

The aim of this project is to propose an AI and cloud enabled smart healthcare system. In order to to collect the patient's health status data, we can use "intelligent garment" instead of wearable sensors. In the intelligent garment, body sensors are integrated with textile garment, which shall take various factors into consideration, such as sensor type, strategic location for sensor placement, layout of flexible electricity cable, weak signal acquisition equipment, low-power wireless communications and user comfortableness. The pulse sensor, body temperature sensor, electrocardiography (ECG) sensor, myocardial sensor, blood oxygen sensor, electroencephalographic (EEG) sensor and batteries are all connected with flexible wires. In order to facilitate the washing of the smart clothing, the non-waterproof components can be all removed by taking off the buttons of clothing. Users can remove these components before washing and then reinstall them to the garment by snap on the buttons back. We propose to develop a smart healthcare platform, which is composed of three key components: 1) federated learning models that are trained using data stored at multiple different homes of the patients without the data ever shared with a hospital or a tech company's servers, 2) one or several computing devices that serve as the "edge" servers locally, and 3) the intelligent garment that can communicate with the edge device(s). The PhD student will extend the state-of-the-art in the area of Federated Learning, Deep Learning applications for Smart Healthcare System. An important part of his/her work will be devoted to publishing and presenting in peer-reviewed journals and at relevant conferences.

3. Location/Lab/Collaboration context

Candidate will be working (50%) in Human Centered Design (HCD) team, the GEMTEX research laboratory belongs to ENSAIT, French Grande Ecole in Roubaix, France and be supervised by Prof. Kim Phuc TRAN and Prof. Ludovic KOEHL. Candidate will be also supervised by Prof Shujun Li (supervisor in the UK), Director, Kent Interdisciplinary Research Centre in Cyber Security (KirCCS); and Professor of Cyber Security, School of Computing; University of Kent, UK.

4. Requirements

Applicants should hold a master's degree or equivalent in Computer Science, Automation or a closely related area. Candidates should have an excellent background in computer science/engineering and the ability to work on inter-disciplinary research project. Acquaintance with machine learning as well as programming skills in Python will be considered as strong

assets. The working language in the group is English. Applicants must have English language levels equivalent to IELTS 6.5 or higher to successfully apply the application requires, among other documents, a CV, a cover letter describing the applicant's research interests. Applicants are invited to send their applications via e-mail under reference SHSFL to quoc-thong.nguyen@ensait.fr by 1/4/2019.