PhD studentship (Full-time)

Institution	Xi'an Jiaotong-Liverpool University, China
Department	Department of Computer Science and Software Engineering
Supervisors	Principle supervisor: Dr. Ka Lok Man (Xi'an Jiaotong-Liverpool University) Co-supervisors: Prof. Jeremy Smith (University of Liverpool, UK); Prof. Steven Guan (Xi'an Jiaotong-Liverpool University)
Application Deadline	Open until the position is filled
Funding Availability	Funded PhD project (world-wide students)
Project Title	Massively Scalable Sensing-as-a-Service: The Tangible Cloud 大规模可扩展的传感即服务：有形云
Contact	Please email ka.man@xjtlu.edu.cn (principle supervisor's email address) and copy doctoralstudies@xjtlu.edu.cn with a subject line of the PhD project title

Requirements:

The candidate should have a first class or upper second class honours degree, or a master's degree (or equivalent qualification), in Computer Science/Computer Engineering/Electrical and Electronic Engineering. Evidence of good spoken and written English is essential. The candidate should have an IELTS score of 6.5 or above, or an equivalent qualification, if the first language is not English. This position is open to all qualified candidates irrespective of nationality.

Degree:

The student will be awarded a PhD degree from the University of Liverpool (UK) upon successful completion of the program.

Funding:

The PhD studentship is available for three years subject to satisfactory progress by the student. The award covers tuition fees for three years (currently equivalent to RMB 80,000 per annum) and provides a monthly stipend of 3500 RMB as a contribution to living expenses. It also provides up to RMB 16,500 to allow participation at international conferences during the period of the award. It is a condition of the award that holders of XJTLU PhD scholarships carry out 300-500 hours of teaching assistance work per year. The scholarship holder is expected to carry out the major part of his or her research at XJTLU in Suzhou, China. However, he or she is eligible for a research study visit to the University of Liverpool of up to three months, if this is required by the project.

Project Description:

Sensor networks are increasingly a driver of commercial and scientific activity and lie at the heart of solutions to 21st century challenges including climate change, global security and ageing populations. Despite their proven efficacy, sensor network applications remain expensive to deploy and maintain in the field. This is caused by two critical problems: firstly, the successful deployment and management of a sensor network requires expertise in specialized hardware and software technologies that is far beyond the capability of those application experts who require or commission sensing services. Secondly, there is a fundamental mismatch between the characteristics of the emerging sensor network use-cases and the features of current software development approaches for sensor networks. A fundamental rethinking of the place of sensor services in large-scale software architectures is required to address these limitations.

This leads us to sensing-as-a-service, the key concept behind the Tangible Cloud. By analogy to software-as-a-service and infrastructure-as-a-service (concepts common in cloud computing), sensing-as-a-service decouples the provision of sensing services from the capacity of interested parties to procure, deploy and maintain sensor networks in the field. This decoupling replaces ad hoc approaches to sensor network engineering with a streamlined value chain in which each stakeholder operates within their area of core competence. Specialization and infrastructure reuse are key drivers of innovation in complex systems along with huge data, where infrastructural investment may be unjustifiable for a single application, but lead to major economic and scientific value where the infrastructure supports multiple applications. Much as cloud computing allows small organizations to leverage large infrastructure without massive up-front investment, sensing-as-a-service allows small organizations to collect and reuse sensor data, without having to master other elements of the value chain. This allows large-scale IT infrastructure providers to focus on procuring, maintaining and updating sensing infrastructure by leveraging their core competencies in facilities management.

To realize our vision, this Tangible Cloud project aims to address the following four objectives (OB1-OB4):

[OB1] Assimilation of heterogeneous devices: realizing a usable planetary-scale sensing infrastructure that is fit for purpose requires the integration of resources from purpose-deployed sensing infrastructure, legacy sensing infrastructure (such as traffic cameras and weather stations) and third-party consumer devices such as smart phones. The Tangible Cloud empowers infrastructure providers with simple, safe and secure mechanisms to assimilate their devices into a federated sensor network of greater scale and capability. This will encourage the formation of strategic alliances that exploit stakeholder synergies to increase the scientific and economic impact produced by sensor network infrastructure.

[OB2] Seamless virtualization and re-use of sensing services: in resource-constrained sensor networks, it is essential to promote the reuse of scarce sensing resources. The Tangible Cloud achieves this through the creation of a pay-per-use service marketplace in which services are recursively reused to create higher-level services. For example, location services deployed on in-car navigation devices may be composed together with logic to identify areas with slow moving vehicles to implement a traffic jam detection service. The resulting “traffic jam detection service” may then be composed (potentially by a different organization) with route-finding logic to implement a traffic jam avoidance service. At each level of service re-use, additional value is created. In order to minimize the complexity of multiple applications competing for scarce embedded resources, virtual sensor networks will be dynamically assembled from the federated sensing infrastructure. These virtual sensor networks provide assured quality of service that meets the requirements of their hosted applications throughout their lifetime, while shielding service and application developers from deployment concerns. This approach constitutes a foundational shift in how sensor network applications are developed and managed.

[OB3] Stakeholder-optimal programming models: large-scale sensor networks require programming models that are tailored to the needs of each stakeholder. At the level of individual devices, infrastructure providers require mechanisms to configure an appropriate software environment, while at the level of a sensor network, mechanisms are required to coordinate and manage software evolution. At the level of sensing applications, service developers require mechanisms to develop, monetize and advertise sensing-related software services. Finally, application developers require support for the specification of application ‘missions’ that define application behaviour throughout its lifetime. At all levels of abstraction, dynamic operating environments necessitate support for rapid local adaptation (autonomy) and reliable external specification of network behaviour (heteronomy). The ability for stakeholders to work within their core areas of expertise while being shielded from other concerns is a radical departure from how present day sensor network applications are implemented.

[OB4] Secure Federation: federated sensor networks present a challenging security landscape. Key issues include: fine-grained control of resource consumption to ensure fair allocation of resources, assurance of trust between the providers of federated infrastructure elements and enforcement of data ownership to allow for safe reuse of sensor data. The Tangible Cloud provides a rich security toolkit for federated sensor networks that addresses these concerns. This security toolkit will be verified in the creation of two ambitious proof-of-concept scenarios: assisted living in the smart city and intelligent traffic management, which present distinct and challenging security requirements.

In summary, by addressing objectives OB1 to OB4, the Tangible Cloud will create an important new ICT marketplace that supports new classes of sensing applications and that addresses key emerging scientific, societal and economic issues. Furthermore, the Tangible Cloud will reduce the risk and cost of developing large-scale sensor network applications or undertaking large-scale sensor network research.

For more information about doctoral scholarship and PhD programme at Xi'an Jiaotong-Liverpool University (XJTLU): Please visit

http://www.xjtlu.edu.cn/en/admissions/phd.html

http://www.xjtlu.edu.cn/en/admissions/phd/feesscholarships.html

How to Apply:

Interested applicants are advised to email ka.man@xjtlu.edu.cn (principle supervisor's email address) the following documents and copy doctoralstudies@xjtlu.edu.cn (please put the project title in the subject line).

- CV
- Two reference letters
- Personal statement outlining your interest in the position
- Proof of English language proficiency (an IELTS score of above 6.5 or equivalent is required
- Verified school transcripts in both Chinese and English (for international students, only the English version is required)
- Verified certificates of education qualifications in both Chinese and English (for international students, only the English version is required)

Informal enquiries may be addressed to Dr. Ka Lok Man (ka.man@xjtlu.edu.cn), whose personal profile is linked below, http://academic.xjtlu.edu.cn/csse/Staff/ka-man