Offer #2024-07955

PhD Position F/M Smart IoT networks for a sustainable manufacturing as a service paradigm in Industry 4.0

Contract type : Fixed-term contract

Level of qualifications required : Graduate degree or equivalent

Fonction : PhD Position

About the research centre or Inria department

The Inria University of Lille centre, created in 2008, employs 360 people including 305 scientists in 15 research teams. Recognised for its strong involvement in the socio-economic development of the Hauts-De-France region, the Inria University of Lille centre pursues a close relationship with large companies and SMEs. By promoting synergies between researchers and industrialists, Inria participates in the transfer of skills and expertise in digital technologies and provides access to the best European and international research for the benefit of innovation and companies, particularly in the region.For more than 10 years, the Inria University of Lille centre has been located at the heart of Lille's university and scientific ecosystem, as well as at the heart of Frenchtech, with a technology showroom based on Avenue de Bretagne in Lille, on the EuraTechnologies site of economic excellence dedicated to information and communication technologies (ICT).

Context

The potential offered by the abundance of sensors, actuators and communications in IoT is hindered by the limited computational capacity of local nodes, making the distribution of computing in time and space a necessity. Several key questions need to be answered to jointly exploit the network, computing and storage resources optimally, accounting at the same time for the trade-offs guaranteeing feasibility, sustainability and the generation of valuable insights. Our research takes upon these challenges, by dynamically distributing resources with the varying demand flow and available assets.

This position falls in the context of the HE UniMaas Project which aims to deliver a platform for flexible, agile and decentralized manufacturing, embracing the MaaS paradigm (Manufacturing as a service). UniMaaS will be built on five main technological pillars: (a) unified on-demand modelling of manufacturing resources and supply chains; (b) intent-based servitization and AI-based estimators; (c)Manufacturing Data Spaces facilitating the interoperable and trustworthy resource servitization; (d) flexible decision making for reconfigurable, circular and sustainable next-generation manufacturing execution systems (MES); and (e) cutting-edge digital technologies for Cloud Manufacturing (CMfg).

In this context, the FUN team is in charge of proposing self-organizing IoT networks allowing the collection of sensitive and real-time data showing the status of manufacturing resources in supply chain as well as the distribution of local decision-making processes based on available resources within the network (IoT - Edge).

Assignment

The recruited student will realise their study in the context of the UniMaas project. The aim will be to design an energy-efficient real-time data collection mechanism . This protocol will have to take account of available IoT heterogeneous resources for cloud-based manufacturing resource monitoring.

Particular attention will be paid to quantifying the resource usage efficiency of the data collection, transmission and processing methodologies in relation to the targeted operational objectives.

Main activities

The PhD student will be in charge of

- Realize a survey on IoT solutions in Cloud Manufacturing, Industry 4.0 and MaaS
- Identify, document and prioritize a set of requirements related to the management of intelligent IoT devices that are used for real-time monitoring of resources (e.g. equipment, technology infrastructure, environmental resource used in production) and assets (factory building. machinery, etc.).
- Propose and implement an energy-efficient real-time data collection mechanism taking into account the available resources of heterogeneous IoT devices allowing cloud-based manufacturing resource monitoring.
- Propose and implement a distributed decision-making mechanism taking into account the

available resources at the IoT and Edge and allowing flexible manufacturing resource planning and scheduling
- Participate in the UniMaas project life in interaction with UniMaas partners.

Time schedule

M1-M6 : The PhD student will survey the different kinds of IoT solutions used for Cloud manufacturing, industry 4.0 and MaaS, classify them and deduce management and operational requirements. He/She will study the different IoT self-organizing techniques.

M7-M12 : Based on the above mentioned analysis, the PhD will propose an energy-efficient and real-time data collection mechanism to be used by a network of IoT devices in the context of MaaS.

At the end of the first year, the student will be familiar with the data collection mechanisms from the end-devices perspective. He/She will have designed a first solution for real-time data collection.

M13-M16: Implementation and validation of the designed solutions under different settings and IoT devices.

M16-M20: Study of different resource -based distributed decision-making at the IoT and Edge layers of the IoT network as part of the resource planning and scheduling provided by UniMaaS. Resources here include processing, memory, energy etc. of IoT and edge devices.

M20-M24: Integration of the distributed resource allocation for multi-layer and flexible decision-making with the first solution designed during the first year. Implementation and experimentation.

At the end of the second year, the student will have designed a strong data collection framework and data processing strategy taking into account the MaaS paradigm.

M25-M29: Use of the proposed framework in industry 4.0 and supply chain scenarios featuring MaaS.

M30-M32: Study of limitations and enhancing overall performance by designing and implementing improvements.

M32-M34: Implementation and experimental validation

M34-M36: wrap-up, writing and defense of PhD.

Skills

- Knowledge in wireless networks (technologies, routing protocols, etc) and edge computing
- Skills in Simulation tools and development
- Skills in C/C++ and python
- English speaking
- Autonomy and curiosity
- Open minded
- Team working
- Capacity to write English reports and papers
- Sense of organization, autonomy, rigor

Benefits package

- Subsidized meals
- Partial reimbursement of public transport costs
- Leave: 7 weeks of annual leave + 10 extra days off due to RTT (statutory reduction in working hours) + possibility of exceptional leave (sick children, moving home, etc.)
- Possibility of teleworking and flexible organization of working hours
- Professional equipment available (videoconferencing, loan of computer equipment, etc.)
- Social, cultural and sports events and activities
- Access to vocational training
- Social security coverage

General Information

- **Theme/Domain** : Networks and Telecommunications
- **Town/city** : Villeneuve d'Ascq
- **Inria Center** : Centre Inria de l'Université de Lille
- **Starting date** : 2024-11-01
- **Duration of contract** : 3 years
- **Deadline to apply** : 2024-08-09

Contacts

- **Inria Team** : FUN
- **PhD Supervisor** :
  Habib Carol / carol.habib@inria.fr

About Inria

Inria is the French national research institute dedicated to digital science and technology. It employs 2,600 people. Its 200 agile project teams, generally run jointly with academic partners, include more than 3,500 scientists and engineers working to meet the challenges of digital technology, often at the interface with other disciplines. The Institute also employs numerous talents in over forty different professions. 900 research support staff contribute to the preparation and development of scientific and entrepreneurial projects that have a worldwide impact.

The keys to success

We are looking for a candidate that owns a Master in computer science, who is creative in proposing solutions and capable of critical analysis of results. We demand the student:

1. to be curious and interested in new technologies

2. to have a strong background in IoT and wireless sensor networks

3. to have excellent skills in scripting and programming (e.g., python, C/C++, Java) as well as previous experience with simulation tools

4. to be fluent in spoken and written English with strong communication and presentation skills

5. Experience with energy-efficient data collection, mobility modeling, resource management for wireless networks is considered a plus

> **Warning** : you must enter your e-mail address in order to save your application to Inria. Applications must be submitted online on the Inria website. Processing of applications sent from other channels is not guaranteed.

Instruction to apply

Defence Security :
This position is likely to be situated in a restricted area (ZRR), as defined in Decree No. 2011-1425 relating to the protection of national scientific and technical potential (PPST).Authorisation to enter an area is granted by the director of the unit, following a favourable Ministerial decision, as defined in the decree of 3 July 2012 relating to the PPST. An unfavourable Ministerial decision in respect of a position situated in a ZRR would result in the cancellation of the appointment.

Recruitment Policy :
As part of its diversity policy, all Inria positions are accessible to people with disabilities.