2021-03520 - PhD Position F/M [Campagne Cordi-S] --
Bringing social sensors to the IoT for enhanced accuracy and resource-efficiency --

Type de contrat : CDD
Niveau de diplôme exigé : Bac + 5 ou équivalent
Fonction : Doctorant

Contexte et atouts du poste
Research Team:

- MIMOVE (inria.fr) @ Inria Paris (www.inria.fr/en/centre-inria-de-paris)

Supervisors:

- Valerie Issarny (valerie-issarny.me/),
- Françoise Sailhan (cnam.fr/~sailhanf/)

Research context — Leveraging mobile sensing in the IoT:

Sensor and actuator networks, possibly wireless, have drastically evolved over the last few years, with rich sensors being embedded in most devices and deployed everywhere, as highlighted by the Internet of Things (IoT) vision. However, in spite of significant advances, the key challenges of these systems arise from largely the same attributes as those of early-envisioned mobile systems: relative resource-poverty in terms of computation and communication, variable and unreliable connectivity, and limitations imposed by a finite energy source. These remain true even though modern mobile devices are significantly more powerful compared to their ancestors; the work we expect them to do has increased and will keep increasing, and the computation and storage abilities available through fixed infrastructure such as the cloud are larger by order of magnitudes than any single mobile device.

Following the design of algorithms and protocols to efficiently coordinate the sensing, processing, and actuation capabilities of the large number of mobile devices in future systems is a core area of MIMOVE'S research. The focus of MIMOVE’S research interests then lies mostly in the systems resulting from the increased popularity of sensor-equipped smart devices that are carried by people, which has led to the promising field of mobile phone sensing or mobile crowd-sensing. The paradigm is powerful, as it allows overcoming the inherent limitation of traditional sensing techniques that require the deployment of dedicated fixed sensors. In this context, we are specifically interested in the challenges facing the sensors from the potentially very large scale of mobile crowd-sensing, combined with the openness, heterogeneity and dynamism of the related sensing and actuation environment.

Mission confiée

PhD research project – Socially-aware mobile sensing in the IoT:

The proliferation of new sensors embedded in everyday mobile devices at the edge of the Internet is fueling the evolution of the Internet of Things. The data provided by sensing applications, including mobile crowdsensing apps, contains insights about the physical and social environment – spanning the personal and urban scales –, and concerns users' activities and environment.

In practice, physical sensors are not intended to operate individually and on their own: contributed data are unusable unless first assessed, fused, contextualized, classified and more importantly, enriched. From this perspective, a growing technical challenge lies in effectively integrating multi-source, multi-modal, social data. In that context, social sensing has emerged as a powerful paradigm, which lies in data collection from humans or their devices on their behalf. This includes in particular leveraging contribution to social media, which involves including humans in the sensing-analysis-control loops to interpret, observe, fully characterize, and report a broader spectrum of events than does a physical sensor. The added value of social sensing to the IoT is significant. Not only this potentially contributes to limit the misrepresentation of physical reality; it may also collectively help building smarter urban services. However, this raises tremendous challenges among which: (i) Effectively enhancing the accuracy of the “sensed” information while guaranteeing the energy-efficiency of the system; (ii) Guaranteeing the trustworthiness of the system from the standpoint of both the data consumers and providers, the latter expecting privacy preservation. This calls for a distributed group-based middleware solution whose development –from design to prototype implementation and evaluation– is the focus of the PhD.

The PhD thesis will focus on enabling group-based virtual sensors that supply quality measurements that are not directly available, by combining the measurements provided by a group of heterogeneous sensors. This also involves broadening the types of context the sensors characterize through the integration of other sources of information of a social (as available from social networks) and/or environmental nature.

Following it, is crucial to define new applications/context-aware protocols for cooperation between physical, virtual and social sensors to deliver the trustworthy and accurate knowledge the upper-layer application requires. Specifically, the protocols will enable the sensors to cooperate toward performing complex and virtual tasks supporting the enrichment, analysis, fusion, interpretation and transformation of data provided by both virtual and physical human-centered sensors, while ensuring the trustworthiness of the enabled collaborative system.

Finally, a prototype will be developed and experiment-based performance evaluation will be performed.

Related references from the team:


Principales activités
In relation with the description of the PhD research project introduced above, the PhD work will subdivide into the following tasks:

- State of the art analysis of the research background on social sensing in the IoT, from which to derive the baseline of the PhD research as well as identify the key shortcomings of the related work.
- Elaborate and formally define the concept of application-aware trustworthy group-based virtual sensors combining physical, social, and inner virtual, sensors.
- Design energy-efficient protocols supporting the enactment of the defined application-aware trustworthy group-based virtual sensors.
- Implement a prototype implementation of a middleware solution integrating the above protocols.
- Evaluate the solution through experiments, possibly leveraging large-scale traces.

The above steps will result in relevant publications at relevant major venues as the work progresses, while early results will be submitted to a doctoral symposium of a related conference.

According to the doctoral school and Inria processes, the work progress will be assessed by a committee composed of 2 external researchers at the end of the first year.

Compétences
Required skills and background:

The applicant should have a Master degree (or equivalent) in computer science with background and/or strong research interests in the following areas:

- distributed systems,
- middleware,
- sensing apps,
- social networking,
- statistical analysis and data analytics,
- wireless networking.

Experience in the implementation of software prototypes is expected.

Prior internships with R&D expertise in these areas will be a plus.

The applicant must be fluent in English.

Contact:
Before applying, it is advised to contact the scientific advisors for more information on the research project. Please contact valerie.issarny@inria.fr and francoise.sailhan@inria.fr before applying online.

Avantages
- Subsidized meals
- 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 (after 6 months of employment) 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

Rémunération
Monthly gross salary: 1982 € during the first and second years. 2085 € the last year.