



**Project Title:**

Middleware and Context Inference Techniques from Data-Streams for the Development of Context-Aware Services using Mobile Devices

**Project Code:**

LISBOA-01-0145-FEDER-016883 [PTDC/EEISCR/6945/2014]

**Main Objective:**

The ubiquity of mobile communication devices such as smartphones enables the emergence of context-aware applications and services that proactively respond to specific user activities or situations. Context information, i.e., the specific state each user is in, allows communication providers to develop and thus offer new, added value, services for a wide range of applications such as social networking, advertising, navigation or leisure. Of growing importance are health-related services and applications that rely on the accurate detection of each user's physical activity either at specific instances or throughout days or even weeks.

Using this information, it is possible to discover and analyze physical activity patterns and, e.g., help individuals to lead healthier lifestyles.

**Coordination Institute:** Instituto de Engenharia de Sistemas e Computadores do Porto

**Participating Institutes:** Instituto de Engenharia de Sistemas e Computadores, Investigação e Desenvolvimento em Lisboa (INESCID/INESC/IST/UTL) Rua Alves Redol, 9 1000- 029Lisboa

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**Start Date:** 08-04-2016

**End Date:** 30-09-2019

**Total Eligible Cost:** 174 489, 00€

**Eligible Cost INESC TEC:** 100.730,00€

**Eligible Cost INESC-ID:** 73.759,00€

## **Objectives, activities and expected results:**

The proposed project addresses the key challenges and enabling techniques for context-aware application development in three major aspects. Firstly, we propose to research and develop activity detection techniques focusing on low energy, and high accuracy. Secondly, we will explore context aggregation approaches and algorithms based on statistical classification, to uncover activity patterns. Lastly, as mobile systems interface will undoubtedly evolve, we will develop a middleware and domain-specific programming environment for the rapid prototyping of context-aware applications.

The research efforts on classification techniques will be focused on context inference to be implemented in mobile devices with limited capabilities. The existence of instances without target labels will lead, necessarily, the research to the area of semi-supervised classification. Additionally, the techniques need to deal with data streams and with small windows of sensing data.

Furthermore, these techniques should be energy-aware and should manage multiple configurations to save energy, an important aspect in mobile devices. The objective is to minimize the classification error.

Specifically, we will address energy-aware algorithms for the detection of physical activities based on accelerometer and other sensor data. The outcome of these algorithms will be integrated with a high-level algorithm for the detection of high-level user contexts and related activities. To support the embedded software development of context-aware applications, we will continue the development of a flexible middleware and programming level environment. This environment will facilitate the integration of new sensors, energy saving strategies, and the definition of added-value services.

At the cloud side for continuous and incremental distributed data processing, the work entails enhancing data processing platforms, in order to increase their scalability, performance and flexibility of integration, to be able to operate adequately in the presence of Big-data workloads comprising continuous information gathered from sensing activity of possible thousands of users.

This entails three main aspects. First, by enhancing Big-data processing platforms with support for approximate computing. Second, by enhancing memory management in Java VM (underlying these Big-data processing platforms) to better fit the execution of Big-Data workloads (e.g., improving memory locality to speed up data access), we also improve resource efficiency, energy-efficiency and scalability of the platforms. Third, by allowing the placement of data processing platforms and mobile-aware applications closer to the edge of the network, we can support the reduction of latency, limit the amount of data to be exchanged across the networks, improving scalability and sustainability.