IMPReSS

Issue #3 - published by the IMPReSS project - August, 2015

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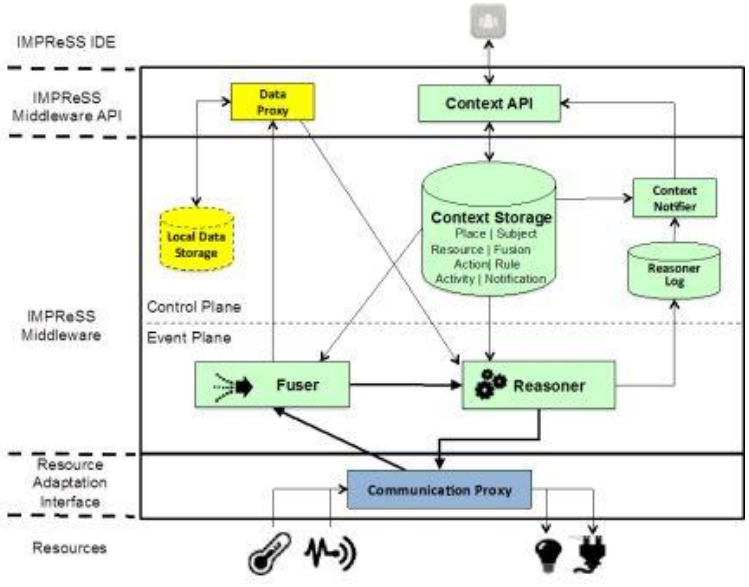
The IMPReSS Context Manager

In order to provide an efficient use of energy in buildings, the IMPReSS Systems Development Platform (SDP) must know what happens inside the buildings so that opportunities to save energy can be identified and effectively fulfilled. In other words, the IMPReSS SDP must be context aware.

The IMPReSS SDP is divided into IDE and Middleware, where the IDE contains a series of GUI modules and the Middleware contains modules with background management responsibilities for their IDE counterparts. The IMPReSS Middleware consists of four main modules: a Context Manager, a Data Manager, a Resource Manager, and a Communication Manager. In this article we will describe the Context Manager in more detail.

IMPReSS Context Manager Architecture

The IMPReSS Context Manager encompasses all background software components that a typical context-aware middleware offers to its users, such as context templates, context models, context reasoning engine, and algorithms for sensor and data fusion. It also interacts with storage modules to be able to store and retrieve context data. Resources might be accessed directly or preferentially through the Resource and Communication Managers. Based on research of the state of art in context modelling and reasoning, the design of the IMPReSS Context Manager architecture is based on object-oriented context modelling and rule-based context reasoning. The figure below shows the Context Manager architecture and its relationships with other components of the IMPReSS architecture:



The IMPReSS Context Manager Architecture

As illustrated in the figure, the Context Manager Architecture can be divided into two main planes inside the IMPReSS Middleware, namely Control Plane and Event Plane. The Control Plane comprises the two main components that operate in real time, i.e. the Fusion and the Reasoning module, receiving and processing data coming from sensors and sending commands to actuators. The Control Plane comprises modules for context template configuration, storage and notification, which are needed for the features of the event plane to work properly.

The IMPReSS Context Manager Modules

The IMPReSS Context Manager consists of nine modules. A summary description of three of the modules is presented here. A complete description of the IMPReSS Context Manager Architecture and the modules in the figure can be found in the deliverable D6.3 Context Manager Framework Architecture and

Dissemination Events:

Accepted Papers:

To date, the IMPReSS project has had six scientific papers, including a PhD Dissertation, accepted for publication:

User Activity Recognition for Energy Saving in Smart Home Environment was accepted for the 20th IEEE Symposium on Computers and Communications and will soon be available via the IMPReSS project website. The paper is a joint collaboration between project partners UFAM and FIT. It was presented By Weslen Souza, UFAM, at the ISCC 2015, 6-9 July 2015, in Larnaca, Cyprus.

The PhD Dissertation, Rapid Application Development in the Internet of Things: A Model-Based Approach, was researched and written by Ferry Pramudianto (FIT). It was accepted in February 2015 by RWTH Aachen University. Mr. Pramudianto has been actively involved in the research and development work in the IMPReSS project, and was supervised by project partners UFPE and UFAM. FIT provided the facilities and conditions for the doctoral research.

Extending Semantic Device Discovery with Synonym of Terms, published by IEEE and presented the 12th IEEE International Conference on Embedded and Ubiquitous Computer. The paper was produced by FIT.

Semantic Interoperability Architecture for Pervasive Computing and Internet of Things, published by IEEE ACCESS. The paper was produced by VTT.

IoTLink: An Internet of Things Prototyping Toolkit, published by IEEW: It was presented at the 11th IEEE International Conference on Ubiquitous Intelligence and Computing in December 2014. The paper was produced by UFPE and FIT.

Architecture for mixed criticality resource management in Internet of Things, published by the TRON

Design of Context Templates which is available for download via the project website.

Context API: The Context API is part of the IMPReSS Middleware API and exposes an interface, allowing other modules, both belonging to the IDE and Middleware, to interact with the Context Manager. Through the Context API the entity templates are configured in the Context Storage. The Context Manager learns about Resources through the Context API used by the application in the IMPReSS IDE.

Reasoner: The Context Reasoner is the piece of software able to infer logical consequences from a set of asserted facts. The Reasoner performs its function by reading entities from the Context Storage, i.e. Entity Templates such as Rule, Place, Resource and Action. Having all entities, whenever it is invoked with a set or parameters it searches the entire set of rules for a match. In some situations the Reasoner may find two or more rules that match the parameters, i.e. there may be a rule conflict. Whenever a conflict happens, the Reasoner must select only one rule to be executed based on some conflict resolution mechanism. The Reasoner is invoked by the Fuser whenever Fusion criteria are met. As a result of firing a rule, one or more actions are performed and they usually refer to changing the configuration of devices or equipment for dynamically adapting behavior, e.g. turning off an elevator or lowering the temperature of an air conditioner.

Fuser: This module is responsible for data fusion, i.e. a set of techniques that combine data from multiple sources such as sensors and gather that information in order to achieve inferences, which will be more efficient and potentially more accurate than if they were achieved by means of a single source. The Fuser is directly connected to the Communication Proxy for receiving real time sensor data and when fusion criteria are met it activates the Reasoner and stores the fused results in a data storage using the Data Proxy. Multiple fusion criteria may be active concurrently and therefore this module plays a key role for the performance of the Context Manager, because in a real scenario hundreds or thousands of sensors may send data values with a high frequency. The Fuser reads the fusion criteria from the Context Storage and that is how it finds out which data must be requested from the Communication Proxy. Whenever a new fusion criteria is configured the Fuser registers the corresponding resources to be monitored, e.g. sensors, in the Communication Proxy and the latter starts sending data to the former.

More information

The IMPReSS Context Manager, including a definition the entities and their templates for context modelling of energy efficiency scenarios and implementation guidelines, is described in detail in D6.3 Context Manager Framework Architecture and Design of Context Templates. Please visit the project website for access to the deliverable.

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The 6th Mobile Application Fair in Manaus

This year's Mobile Application Fair held at Federal University of Amazonas (UFAM) in Manaus, Brazil, demonstrated how Smart City applications and services can be used to improve city life for its inhabitants.

Students from the Institute of Computing have developed a range of Smart City applications in connection with the course, Distributed Systems, which draws on Professor Eduardo Souto's first-hand experience and knowledge from the development work in the IMPReSS project.

As a part of the course, students were organised in different groups representing a company and had to present a product according to a defined theme. As a first step, students had to identify real local needs for their given theme and analyse how these could be turned into potential business opportunities for application development.

Based on course material for Distributed Systems class, a total of 26 applications were developed covering areas such as ways to optimise waste collection, finding parking spaces, and reporting traffic accidents. The applications were developed using IMPReSS concepts such as the context awareness to develop a wide range of context aware smart city applications. Some of the most innovative applications that generated a lot of interest were:

Intelli Bin is an application that can monitor the amount of waste in bins by transmitting information about the waste storage levels in real time. With Intelli Bin you can also optimise the collection routes. The Intelli Bin has a very low production cost and can therefore be sold at a low price. It can be used to optimise waste collection from any location, e.g. neighborhoods, factories, private homes and schools.

Symposium. The paper was presented at the TRON Symposium in December 2014. The paper was produced by VTT, FIT and ISMB.

Completed Events:

ISCC 2015

6-9 July, Larnaca, Cyprus

The IMPReSS paper, "User Activity Recognition for Energy Saving in Smart Home Environment", was presented by Weslen Souza from UFAM at the 20th IEEE Symposium on Computers and Communications in Cyprus. The ISCC 2015 focused especially on the challenging issues and opportunities related to the computing, sensing and communication in the era of the Internet of Things, Cloud Computing and Big Data. The presented paper was written by project partners UFAM and FIT.

TRON Symposium

10-11 December 2014, Tokyo, Japan

The paper Architecture for mixed criticality resource management in Internet of Things written by IMPReSS partners VTT, FIT and ISMB was presented by Janne Takalo-Mattila (VTT) at the TRON Symposium on the 11th December.

UIC 2014

9-12 December 2014, Bali, Indonesia

Ferry Pramudianto, FIT, presented the IMPReSS paper IoTLink: An Internet of Things Prototyping Toolkit at the 11th IEEE International Conference on Ubiquitous Intelligence and Computing conference (UIC 2014). The paper, which was written by IMPReSS partners FIT, UFABC and UFPE, addresses the need of a development toolkit that allows inexperienced developers to develop IoT prototypes rapidly.

EU-BR Cooperation Consultation Workshop

10 November 2014, Brussels, Belgium

IMPReSS was presented at a workshop on the EU-Brazil Cooperation in the area of ICT by the IMPReSS Project Co-ordinator, Markus Eisenhauer, FIT.

EUC14

26-28 August July 2014, Milan, Italy

IMPReSS was represented at the 12th IEEE International Conference on Embedded and Ubiquitous Computing (EUC14) where FIT presented the paper Extending Semantic Device Discovery with Synonym of Terms. The IMPReSS paper was presented in the session on Mechanisms and Design Technologies for Future Embedded and Ubiquitous Software Systems.

EUBR 2014

28-31 July 2014, Brasília, Brazil

FIT and UFPE represented the IMPReSS project at the EUBR 2014 workshop in Brasília in July 2014. The IMPReSS consortium was invited to give a presentation on the project's aims and objective in the session entitled "EU-Brazil Cooperation in the area of ICT - Coordinated Calls". The IMPReSS project also had a booth in the Exhibition area which allowed the project partners to network and discuss the project in more detail with other participants.

SplitSystem is an application that can control and monitor Split air conditioners via the Internet. It is easy and simple to use; the user only needs to choose the air conditioner model in the application before using the remote control functionality.

Tase is an application to support the reporting of traffic accidents. Tase works as a collaborative network where people can send their own photos of traffic accidents together with the date, time and location to the accident response unit to assist them to assess the situation prior to arriving at the accident scene.

Wi-Light is an effective solution for managing city traffic via Internet-based traffic lights. With this application, an agent can manage traffic lights and control the congestion with just a simple action.

Lux Innovare - Solarium is an application that enables the self-sustaining control of public lighting. Today mal-functioning issues are reported directly by citizens. The Solarium application automatically informs the utility company of any failures or faults thereby improving the maintenance process and eliminating the reliance on citizens to report problems.

The 6th Mobile Application Fair was an excellent way to let students turn classroom lectures into actual mobile applications and services that can be used to make cities smarter and showcase these at the same time. It was organised by the Institute of Computing, Federal University of Amazonas, on 4 August 2015.

Read more about the event on the UFAM news blog (in Portuguese).

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Final Demo in Preparation

Development work on the final prototype of the IMPReSS SDP is progressing rapidly and preparations for the demonstration of the project's results are well underway.

The IMPReSS project is in its final stages as only 11 out of 38 research and development deliverables are yet to be submitted. At present, project partners are increasingly focusing on completing the integration work and preparing for the final demo.

The demonstration of the project's results will focus on the IMPReSS SDP innovative components and on the energy efficiency management systems implemented at the project's two pilot sites, Teatro Amazonas and UFPE. The demonstration will show how IMPReSS SDP components interact and how the IMPReSS SDP tools can be used to easily enhance existing systems without having to modify existing applications, implement a mixed criticality resource management system and finally to develop a new application.

The benefits of the main aspects of the IMPReSS SDP that will be demonstrated include:

Resource Adaptation & Discovery Manager: Easy integration of, and communication with, limited resource devices, and automatic discovery of new integrated devices.

Mixed Criticality: Easy management of resource priorities.

Data Storage and Analysis: Huge datasets are handled and easy access to machine learning algorithms which reason over dataset.

Context Management, Data Fusion and Model-driven Design: Easy modelling of contexts, visual modelling of rules, and context are being detected by fusion data from different sensors.

Energy Efficiency: The developed system consumes less energy than the system it replaces.

The final demonstration will mark the end of the IMPReSS project. It is planned for February 2016 in Brazil.

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IoT Week 2014

16-20 June 2014, London, UK

IMPReSS was presented at the IoT Week 2014 in London in conjunction with Almanac project. The IoT Week originated in the European IoT Research Cluster to become the pre-eminent event attracting industry and researchers from around the world.

CeBIT 2014

16-20 March 2014, Hannover, Germany

IMPReSS was presented at CeBIT 2014 in Hannover, Germany in conjunction with the GREENCOM project. CeBIT is the world's largest and most international computer expo. It is considered a barometer of the state of the art in information technology.

EU-Brazil Workshop

11 November 2013, Brasília, Brazil

The IMPReSS project was invited to participate and present the project's aims and visions at a high-level EU-Brazil workshop in Brasilia in November 2013. One of the objectives of the workshop to formally launch the four EU-Brazil projects, IMPReSS included, that have received funding under the 2nd EU-Brazil Call.

Deliverables released:

The following deliverables have been completed to date:

- D1.1. Project Quality & Risk Management Plan (confidential)
- D1.2.1 Intermediate Reports for the Commission (confidential)
- D1.3.1 First Activity, Management and Financial Report (confidential)
- D1.4 Plan for Managing Knowledge and Intellectual Property (restricted)
- D2.1.1 Initial Requirement Report (public)
- D2.1.2 Requirement and Lesson Learned Report (public)
- D2.2.1 SDP Initial Architecture Report (public)
- D2.3 Validation framework (public)
- D3.1 Resource Adaptation Interface Framework (public)
- D3.2 Resource and Service Discovery Solutions (public)
- D3.3 Communication Management (public)
- D4.1.1 Initial Application Classification Language (public)
- D4.1.2 Final Application Classification Language and Tool(public)
- D4.2 Device and Subsystem Resource Management (public)
- D5.1.1 Initial Data Analysis & Knowledge Repository Technical Specifications & Guidelines (public)
- D5.1.2 Updated Data Analysis & Knowledge Repository Technical Specifications & Guidelines (public)
- D5.2 Data Analysis and Forecast for Energy Consumption (public)
- D5.3 Data Mining and Machine Learning Tools (public)
- D5.4 Machine Learning for User Behavior and Occupancy Analysis (public)
- D6.1 Analysis of Energy Efficiency Context and Sensor Fusion Algorithm (public).
- D6.2 Implementation of Sensor and Data Fusion Module (public).
- D6.3 Context Management Framework Architecture and Design of

Context Templates (public).

- D6.4 Implementation of Context Reasoning Engine (public).
- D6.5 Implementation of Context Modelling Tool and Templates (public).
- D7.1 Integration and Test Plan (public).
- D7.2.1 Integrated First Proof of Concept IMPReSS Platform (public).
- D7.3.1 Initial Design and Implementation of the Configuration and Composition Manager (public).
- D7.4.1 Initial Design and implementation of the IoT Event Debugging Tool (public).
- D8.1 Specification of Proof-of-Concept Application (public).
- D8.2 Application Architecture for Energy Managment (public).
- D8.3.1 Application Development: The Teatro Amazonas: Initial Prototype (public).
- D9.1 Exploitation & Business Strategy Report (confidential).
- D9.2.1 Initial Dissemination Report (public).

Public deliverables can be downloaded from the project website after they have been reviewed and approved by the EC. Currently, 19 deliverables are available for download.

FORWARD TO A FRIEND

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The IMPReSS project is a 30-months EU-Brazil cooperative research project which started in 2013. The project is partly funded by the European Commission under the 7th Framework Programme in the area of EU-Brazil Research and Development cooperation under Grant Agreement no. 614100. The Brazilian funding is provided by CNPq Conselho Nacional de Desenvolvimento Científico e Tecnológico.

Read more at:
www.impressproject.eu

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