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ScienceDirect

Procedia Computer Science 63 (2015) 439 – 444

Procedia Computer Science

The 5th International Conference on Current and Future Trends of Information and Communication Technologies in Healthcare (ICTH 2015)

Integrated Care Concept using Smart Items and Cloud Infrastructure

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Abstract

In this paper, we explain the OpSIT approach of an integrated cloud system targeting health care facilities and their care staff. Main objective is providing a platform that integrates different smart items in order to support care processes. Therefore, knowledge of the business processes and their related tasks is highly necessary and can be properly gained with the use of Business Process Modeling Notation. We present two independent use cases which are integrated with a secure hybrid cloud system using different access levels and mechanisms, smart gateways for pre-processing and smart items for measuring. The considered smart items are smart blister dispenser, smart emergency button and smart watch.

Peer-review under responsibility of the Program Chairs

Keywords: Smart Items; Cloud Computing; Health Care; BPMN; Sensors; Cloud Security

1. Introduction

1.1. Objective

Recently, smart sensors become more and more popular for the use in healthcare facilities. However, while many standalone products are available on the market, integrated systems are currently focused on smart home and end-consumers but do not oriented toward businesses and professional caretakers. Our aim is to create a cloud platform which is open to integrate different systems in order to optimize their use in professional care. In this paper, we first give a short overview of the research background and important definitions. Second, we provide an exemplified business process model written in BPMN (Business Process Modeling Notation) to point out the importance of considering processes and roles before developing an IT solution. Third, we briefly explain the technical

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Peer-review under responsibility of the Program Chairs
doi:10.1016/j.procs.2015.08.365

implementation of the secure hybrid cloud system using different access levels and mechanisms as well as the smart gateways for pre-processing and smart items for measuring. Finally, we want to encourage the scientific community and businesses to prepare health care business processes for the integration of smart items.

1.2. Challenges in the German Health Sector

Care facilities in Germany are gradually transforming from explicit stationary environments to residential facilities with some stationary elements. This change is an implication of the demographic change: A larger number of old and care-dependent people are contrasted with a smaller number of care professionals available on the market at the same time [1]. While the number of care takers will increase from 2.4 million in 2010 to 4.5 million until 2050 [2], care facilities need to optimize the work load in order to keep their care professionals. Moreover, an increasing number of high quality care services is requested by the customers whereas meeting this challenge may lead to a competitive advantage [3]. Enhance care facilities with smart home environments is a promising approach towards solving the problem. While most research is focused on the patient as the end-consumer of smart home environments (patients approach), we concentrate on the optimization of the workload in the care facility (professionals approach). So, the OpSIT research project ("Optimaler Einsatz von Smart Items in der stationären Pflege") is seeking to enhance the use of smart items in care facilities supporting the care givers. In other words, the technical environments are reinterpreted as "Ambient Assisted Working" instead of "Ambient Assisted Living" [4].

1.3. Definitions

Smart Items

In this paper, we are following an enhanced distinction of Smart Items against traditional sensors: Smart Items are sensors composed of transducers capable of detecting physical signals, as well as transmission units capable of forwarding the collected data to gateways which process these data immediately (Fog Computing approach) and/or send it to servers (Cloud Computing approach) [5]. Therefore, Smart Items integrate advantages like continuous sensing, reliable data availability, reduction in labor costs, small size, and energy efficiency [6].

Cloud Computing

Cloud Computing can be understood as a general model of abstraction and virtualization in order to enable "convenient, on-demand network access to a shared pool of configurable computing resources that can be rapidly provisioned and released with minimal management effort or service providers interaction." [7] While abstraction refers to the concept where the main information of the technology is undisclosed to the customer and the end users, virtualization refers to the concept of resource sharing and resource pooling. Services offered by Cloud Computing can be specified in different distinctions, [8] such as the most common classes: Infrastructure as a Service, Platform as a service, and Software as a Service.

Smart Residential Care

Residential care facilities are becoming very popular in Germany since they combine the customers' advantages of self-determined life and continuous availability of professional care, especially when traditional practices of care-taking within the family needs to be substituted [10]. The care facilities benefit from both the room rental fee and the nursing charges of the health insurance and moreover can offer extra services to their customers. As a result, the integration of Smart Items reduces expenses sustainably while it supports the care facility to offer better and reliable services. Since smart home environment are standard home environments enhanced with Smart Items [11], they are generally easily to build. Energy-harvesting sensors are even completely independent. Furthermore, if the sensor gateway has any kind of radio standard capability, its only demand for cable is related to the power supply.

2. Integrated Care Concept

In order to organize and analyse the main activities, organisations can benefit from adequate modelling instruments which provide better understanding of the key business processes involved [12]. Business Process