CLOUD LARIISA, A PLATFORM FOR DATA INTEGRATION OF PUBLIC HEALTH SYSTEMS IN CLOUD COMPUTING ENVIRONMENT

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ABSTRACT

LARIISA proposes a framework to facilitate the development of context-aware applications in order to support decision making processes in the public health area. It acts in five different domains: Knowledge Management, Healthcare Normative Regulations, Clinical Epidemiology, Healthcare Administration and Shared Knowledge. This paper presents the LARIISA's cloud computing version, LARIISA's second rendition (Cloud LARIISA), whose main aim is to provide a software platform enabling the "facilities-like" offering of healthcare infra-structure, middleware and applications. LARIISA's SOA architecture will also provide features to facilitate the description, publication, discovery and integration of both public and private healthcare software systems in an open way. We highlight the solution based on semantic aspects that integrates the Brazilian health network as well as the improvement of the Primary Care access quality and the information systems to manage the Brazilian public health system (SUS).

KEYWORDS

Health Management, Ontology, Cloud Computing, Governance.

1. INTRODUCTION

The decision-making process in health governance systems is a constant challenge, whether in urban scenario, where available human resources and infrastructure hardly meet the growing demand, or in rural areas, where management is aggravated by precariousness of communications, etc. There are many reasons to these difficulties: the low level of coverage of the information; the delay between events of collection and analysis of information; and the low reliability of this information [1].

In addition to these problems, the information stored in health systems is ultimately designed for "human consumption" and, therefore, do not allow machines to understand the meaning contained in them (Figure 1). The use of Ontology as a tool for knowledge representation in health area has been effective to develop applications, since the semantic models have the ability to integrate different concepts from different domains of knowledge [5][6][7]. The primary motivation of this paper is to propose an ontological model enabling the interoperability of different domains of health knowledge management, providing conditions for understanding the governance information system, and aimed at a cloud computing platform [8], as shown in the Figure 2.

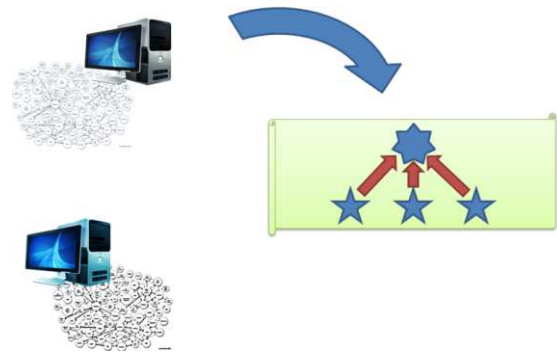Figure 1. The problem with different visions   Figure 2. The Solution using Ontology model

LARIISA [2][9][10][14][15] is a framework to facilitate the development of context-aware applications to governance in health management system in order to support decision making process. This paper presents Cloud LARIISA, a LARIISA's second rendition whose main aim is to provide a software platform enabling the "facilities-like" offering of healthcare infra-structure and middleware to provide features to facilitate the description, publication, discovery and integration of both public and private healthcare software systems in an open way.

2. OBJECTIVES OF CLOUD LARIISA

In addition to data integration and cloud computing, there are two other research areas that are also important to facilitate both the knowledge management and the interpretation of the integrated information, becoming instrumental to the support of decision-making in healthcare domain. These two areas are: analytic visualization and description logic. While the former is necessary to provide techniques for data visualization analytically (since the data amount to be integrated is too large and complex), the latter is useful in supporting the verification of the consistency of the generated knowledge, settling any possible contradictions involving information from different and heterogeneous sources.

The main objective of the Cloud LARIISA is to provide a cloud based platform allowing the integration of public healthcare systems through "open data". This platform will consist in many different services that will provide the necessary functionality to describe, to publish, to discover and to integrate data in an open way. We call "open data" all data having their description defined by a common vocabulary stated in a domain ontology.

Cloud LARIISA highlights the solution based on semantic aspects in order to integrate the Brazilian health network as well as the improvement of the Primary Care access quality and the information systems to manage the Brazilian public health system (SUS) [11].

Finally, the Cloud LARIISA has the following objectives:

- Proposing, researching and developing new solutions in the area of ICT that meets the need for automation of health in Brazil
- Developing prototypes and processes tailored to the needs of SUS
- Complementing and/or enhancing existing solutions within the SUS, in particular those developed in DATASUS.
- Analyzing ICT solutions used in other countries, assisting in the certification thereof for use in Brazil or proposing modifications to adapt them to Brazilian socioeconomic and cultural characteristics
- Proposing mechanisms for governance in health, its management and intelligent decision-making support.

3. CLOUD LARISSA, A PAAS FOR THE BRAZILIAN HEALTH PUBLIC SYSTEM

The LARIISA Framework proposed and the simplified versions of the local and global health context information models for governance decision-making are available in [10]. The LARIISA defines the basic architecture used for the building of context-aware applications for aiding decision-making along five intelligence domains: Knowledge Management, Normative, Clinical-Epidemiological, Administrative and Shared Management [1].

This platform, characterized by real-time information and inference systems based in an ontology model, will be context oriented, providing higher adaptability to the decision-making applications in the healthcare network. LARIISA is very complex because it integrates the five domains described above within the healthcare network. This project contemplates the context-aware platform [3] of the LARIISA project, such as the applications in health area aimed at Primary Care Network, more specifically, the infant-mortality area.

The LARIISA will be used as a software platform containing many services oriented to the publishing of open data, which will allow its future integration with data from other data sources. Another objective of this platform is to allow the building of mashup applications, which will be able to make use of other services provided by the platform, particularly services that enable the integration of data from different sources. Additionally, there will be oriented services for data visualization and decision support [5].
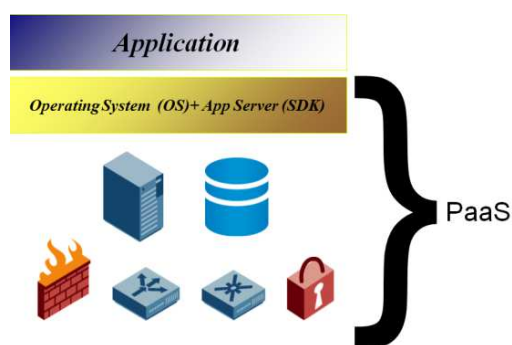
Figure 3. Cloud LARIISA as a PaaS
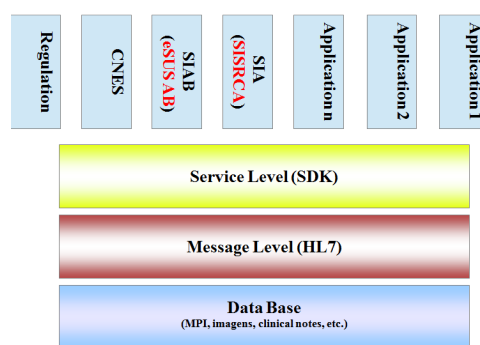
Figure 4. Cloud LARIISA Architecture

4. CLOUD LARIISA: OPEN QUESTIONS

This project addresses the following problems, divided by search area [5][6][7]:

4.1 Data Base

P_DB1. What is the impact of the usage of cloud computing technology in the process of data integration? To integrate data in a cloud environment creates many opportunities and challenges and to understand these questions is very important to formulate the right solution.

P_DB2. How should processes publishing governmental data through the framework of the W3C Linked Data be specified? Particularly, we will detail this process for the case of the public health information system;

P_DB3. What are the requirements of services for publication and integration of governmental open data in a cloud environment? In this problem, we will analyze the requirements of the applications to be developed in cloud environment, trying to identify which integration services are necessary to support these applications. Moreover, we'll investigate how publishing services should be orchestrated to support the process presented in the problem P_DB1.

4.2 Cloud Computing

P_CC1. How should cloud-based services for publication and integration of the governmental data be? This problem should deal with the level of service that applications will be made available by the cloud and the interface of this level with the level of the data storage service.

P_CC2. How should databases of governmental applications be apped to the data model supported by cloud infrastructure? The mapping should take into account the heterogeneity of existing sources data models.

P_CC3. How should governmental data be published, particularly data relating to healthcare, according to protocol security and access control? The definition of this protocol should consider the dissemination of data within the parameters of health ethics. This problem should define the security model of the data sent to the cloud, and the verification protocols of the right of access to the information.

P_CC4. With the cloud usage depending directly on the need and the allocation of resources, how can the processing and data volume requirements fit to the budget? The contract of service is also defined by these requirements for the publication of the data has a level of availability expected. The processing and storage requirements must be built from the existing data volume and the need for availability of services publication.

5. CONCLUSION

Although the contextual knowledge and the real-time information are key ingredients for the intelligent governance of health systems, these are not always present at the time of decision making by managers of health. This framework reverberates in the various spheres of health systems administration, resulting in management decisions made "in the dark" or not made at all. A direct consequence of it is the inefficient usage of resources applied and/or lack of treatment/control of health problem (e.g., an epidemic). The situation becomes even more complex when the health governance decisions seek for synergy with the reality of the ultimate beneficiary of the health system: the families. The decentralization promoted by this new health paradigm focused on families, naturally, makes the decision-making management and the application of knowledge in health area even harder.

A cornerstone for the establishment of governance may be the adoption of information technology as a mechanism to allow the publication and distribution of information to all segments of society. The electronic governance or e-governance can be understood as the application of IT resources in public and political management of the organizations. Economic factors have led to the increase of the infrastructure and facilities for providing computing as a service, known as cloud computing, where companies and individuals can rent computing capacity and storage, rather than making large capital investments required for the construction and the provision of installing large-scale computing.

These services are typically hosted in data centers, using shared hardware for processing and storage. Of course, cloud computing emerges as an appropriated response to the needs of handling large volumes of data that need to be processed, integrated and available for users and applications. This way, cloud computing is the ideal candidate to support the applications development for electronic governance.

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