Cloud LARIISA, A Platform for Data Integration of Public Health Systems in Cloud Computing Environment

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Abstract

LARIISA is a project that proposes to build a framework for the development of context-aware applications to support decision making in the area public health. 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, 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.

1. Introduction

Nowadays, the governance theme is being largely used to show the new trends in public administration and public policies management. The purpose of these new trends is to mobilize all the knowledge available by society to improve the administrative performance and democratization of local decision-making processes. For example, the urban governance aims to promote a closer relationship of civil society with the public organizations for the improvement of the welfare on the big cities (PUTNAM, 2001; SCHERER-WARREN, 1999; CASTELLS, 1999). The concept of governance is also being used by international organizations such as: World Bank and the United Nations Development Programme (UNDP).

These organizations are developing projects to the practice of governance in developing countries aiming the participation of the entire society on public management. It demands an open government, clean, with participation channels; demands strong partnerships with other public institutions and the private sector; and a permanent and virtuous integration of the government with the citizen. And by keeping permanent respect to the ethical conduct, as an example, motivate the administration itself and encourage members of civil society to participate in the process of social development.

Among the problems of information management, in health area, we can observe how difficult is to a great part of the managers to act on decision-making at the three areas of government. There are many reasons to these difficulties such as: 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. One of the main causes to these problems is the fragmentation of health services, it means the decentralization of these services.

The Pan-American Health Organization shows many of these causes, with an especial attention to the specialization of the systems (that for historic reasons), according with social segments, generating social segregation and stratification incompatible with the universal right to health. This fragmentation increases the difficulties of the health authority to maintain system integration, with damage to its governance that dissociates and sprays.

2. Purpose of Cloud LARIISA

Several studies have highlighting and presenting proposals on the importance of health networks and their systemic integration, since no entity or organization can provide the integrality of the attention to the health services alone, because of the interdependence that exists between all the entities and organizations, even independent from each other.

We strongly believe that the application of techniques and methods of data integration combined with cloud computing infrastructure can bring great benefits to the systemic integration for various applications in the field of electronic governance. Moreover, a solution based on cloud environment will provide scalability and the necessary elasticity for these systems which requires great demands of access over a very great amount of data.

Beyond the researches areas related to the themes of data integration and of cloud computing, there are two others research areas that are as important as the cited above to make possible the knowledge management and the interpretation of the integrated information, both fundamental for the support to the decision-making. These two areas are: analytic visualization and logic of description. The first one is necessary to provide techniques for data visualization analytically, since the data amount to be integrated is too large and complex. The logic of description area should support the verification of the consistency of the knowledge generated, settling any possible contradictions involving information from different and heterogeneous sources.

The main objective of this project is to provide a software platform that allows the publication and open data integration related to public health into an environment of cloud computing. This platform will consist in many different services that will provide the necessary functionality to describe, to publish, to discover and to integrate data openly. It is understood by open data the ones which will have their description defined by a common vocabulary stated through domain ontology.

3. The LARIISA Framework

The figure 1 presents LARIISA Framework proposed at (OLIVEIRA 2010). Simplified versions of the local and global health context information models for governance decision-making are illustrated in the figures 2 and 3, respectively. The LARIISA defines the basic architecture used for the building of context-awareness applications for governance decision-making in one of the five intelligence domains: Knowledge Management, Normative, Clinical-Epidemiological, Administrative and Shared Management (MONTEIRO 2009). Therefore, the prototype presented in this paper implements LARIISA´s components, applying them to the scenario of decision-making to the control of dengue epidemics at Ceará State.

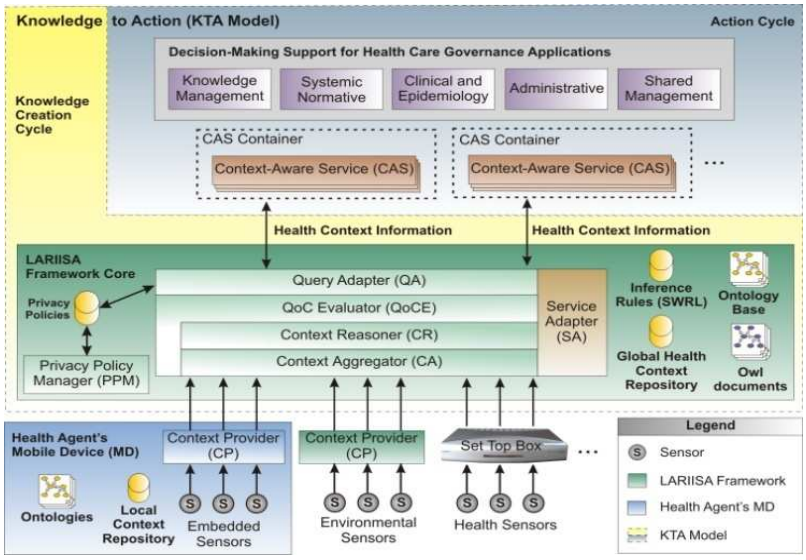

Figure 1. Framework LARISSA

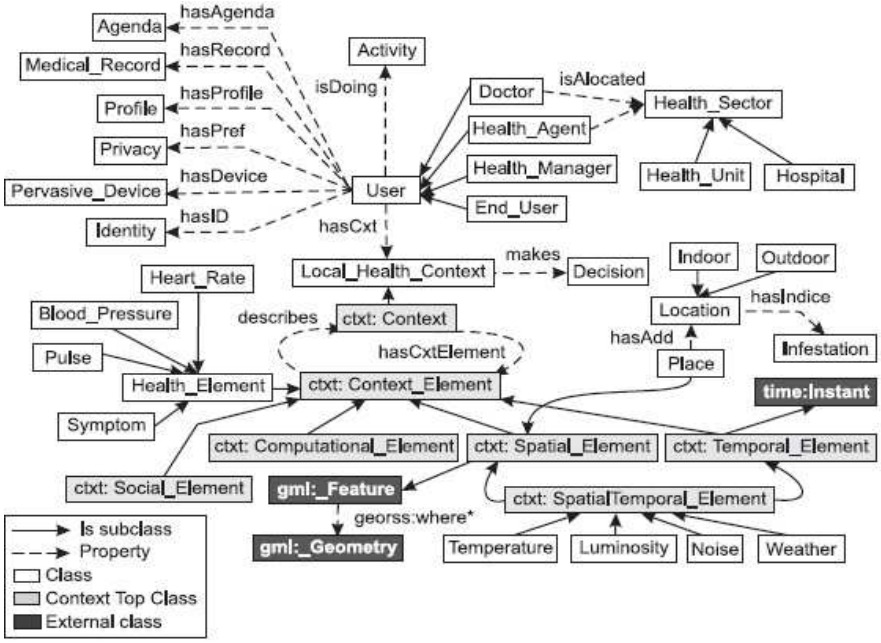

Figure 2 – LARIISA´s Local Health Model

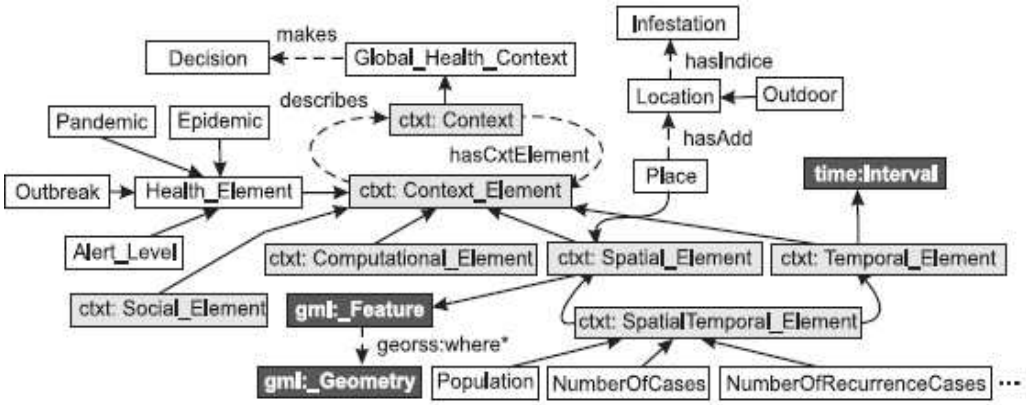

Figure 3 – LARIISA´s Global Health Model

This platform, characterized by real-time information and inference systems based in an ontology model, will be oriented to the context, giving higher adaptability to the applications on decision-making for the present reality, in that case, the health care network. The current health care network is divided in five areas: 1. Primary Care Network (also knew as Family Health); 2. Specialized Ambulatory Care Network; 3. Hospital Network; 4. Urgency and Emergency; 5. Mental Health. The LARIISA is very large because it integrates the five domains of the whole health care network. This project contemplates the context-oriented platform of the LARIISA project, such as the applications in health area aimed at Primary Care Network, more specifically, the infant-marten health area.

4. Cloud LARIISA

The figure 4 presents the computational model of the Cloud LARIISA. The LARIISA Framework (figures 1, 2 and 3) will play a very important function collecting and treating of information related to health, using the digital belt communication infrastructure. 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 others services provide 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.

According to the characterization of the earlier proposal, this project addresses the following problems (divided by search area):

4.1 Data Base

P_DB1. Which is the percussion of the usage of the cloud computing 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 shall be specified a process to publish governmental open data through the framework of the W3C Linked Data? Particularly, we will detail this process for the case of the public health information system;

P_DB3. How shall be defined the requirements for services for publication and integration of governmental open data in cloud environment? In this problem, we´ll 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 shall be specified a cloud architecture of applications or services for publication and integration of the governmental data? This problem should deal with the level of service that applications will be made available by the clouds and the interface of this level with the level of the data storage service.

P_CC2. How the data bases of governmental applications must be mapped to the data model supported by cloud infrastructure? The mapping should take into account the heterogeneity of the data models of existing sources. This problem must also define the sending data model to the clouds.

P_CC3. How shall be published governmental data, 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. The resources ticketing usage of the clouds depends directly on the need and the allocation of these resources, then how can be understood the processing and data volume requirements to budget the usage of clouds? 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

The decision-making process in health governance systems is a constant challenge, whether in urban scenario where human resources and infrastructure available not accompany the growing demand, or in rural areas where management is aggravated due to precariousness of contingent communication, etc.

The LARIISA project is an environment for developing context-awareness applications in decision making for the governance systems of Public Health. This paper presented the LARIISA 2.0 version, a computational model named Cloud LARIISA. The main objective of Cloud LARIISA is to provide a software platform that allows publishing and data integration related to public health in a cloud computing environment. This platform is composed of several services that will provide the functionality needed to describe, publish, discover, and integrate data openly.

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 making management decisions made “in the dark” in the hesitation of an action. A direct consequence 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 ends 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 becomes harder.

A cornerstone for the establishment of governance is to adopt 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. The terms “governance and electronic democracy” have focus in the usage of the information and communication technologies (ICT) applied to the govern activities and actions are government to government or, in particular, government to society and its citizens. Economic factors have led to the increase of the infrastructure and facilities for providing computing as a service, knew 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 govern.

Promoting electronic governance has as main agenda to provide citizens with a transparent view of the information generated and managed by public agencies. Thus, the first step in this direction is to provide methods and techniques to publish and integrate different data sources from these agencies in order to provide a unique insight to its users.

References

[AGM1985] C. E. Alchourròn, P. Gärdenfors, and D. Makinson (1985). On the logic of theory change: Partial meet contraction and revision functions. Journal of Symbolic Logic, 50:510–530.

[AND09] Andrade, L.O.M. Sistemas integrados de saúde, redes e linhas de Cuidado: construção de modelagem para estudo Comparado Brasil Canadá. Post-doctoral project at the University of Quebec in Montreal. CAPES, Education Ministry of Brazil. 2009.

[BCMNS2003] F.Baader, D.Calvanese, D. McGuinness, D. Nardi & P. Patel-Scheneider. The Description Logic Handbook. Cambridge, 2003.

[BGG1997] E. Borger, E. Gradel, Y. Gurevich. The Classical Decision Problem. Perspectives in Mathematics. Springer. Berlim. 1997.

[Bob1980] Bobrow, D.G. (1980). Special Issue on Nonmonotonic Logic. Artificial Intelligence, 13, 1980.
[Cos 1974] Costa, N.C.A. (1974). On the Theory of Inconsistent Formal Systems. Notre Dame Journal of Formal Logic, 15(4), 1974.

[FPA 2005] Giorgos Flouris, Dimitris Plexousakis, Grigoris Antoniou. On Applying the AGM Theory to DLs and OWL. In Proceedings of the 4th International Semantic Web Conference (ISWC-05), published in Yolanda Gil, Enrico Motta, V. Richard Benjamins, Mark A. Musen (eds), Lecture Notes in Computer Science, Vol. 3729 / 2005, Springer-Verlag, pages 216-231, 2005.

[KM1991] H. Katsuno and A. O. Mendelzon (1991). On the difference between updating a knowledge base and revising it. In Proceedings of the Second International Conference on the Principles of Knowledge Representation and Reasoning (KR'91), pages 387–394.

[Pap1994] C. Papadimitriu. Computational Complexity. Addinson-Wesley, 1994.

[Rei1980] Reiter, R. A Logic of Default Reasoning. Artificial Intelligence, 13:81-132, 1980.

[AAN09] Accar, S., Alonso, J., Novak, K. (editors). “Improving Access to Government through Better Use of the Web”. W3C Interest Group, 12 May 2009. Available at http://www.w3.org/TR/egov-improving/

[BH09] Bennet, D. and Harvey, A. “Publishing Open Government Data”. W3C Work Group, 8 September 2009. Available at http://www.w3.org/TR/gov-data/

[SCH99] SCHERER-WARREN, I. Cidadania sem fronteiras: ações coletivas na era da globalização. Rio de Janeiro: Hucitec, 1999.

[CAST99] CASTELLS, M. A sociedade em rede. A era da informação: economia, sociedade e cultura, v.1, São Paulo: Paz e Terra, 1999.

[PA01] PUTNAM, R. Bowling Alone: the Collapse and Revival of American Community. New York: Simon & Schuster, First Touchstone Edition, 2001.

[CLL09a] Casanova, M.A., Lauschner, T., Leme, L.A.P., Breitman, K.K, Furtado, A.L. and Vidal, V. M. P. (2009a) “A Strategy to Revise the Constraints of the Mediated Schema”. In: Proceedings of the 28th International Conference on Conceptual Modeling, Gramado, Brazil.

[CLL09b] Casanova, M.A., Lauschner, T., Leme, L.A.P., Breitman, K.K, Furtado, A.L. and Vidal, V. M. P. (2009b) “Modeling the Mediated Schema Constraints”. In: Proceedings of the 18th Conference on Information and Knowledge, Management, Hong Kong, China.

[VSM09] Vidal, V., Sacramento, E. R., Macedo, J.A. and Casanova, M. A. (2009) “An Ontology-Based Framework for Geographic Data Integration”. In: Proceedings of SeCoGIS 2009, Gramado. In: Proceedings of 3rd International Workshop on Semantic and Conceptual Issues in GIS (SeCoGIS 2009), in conjunction with the 28th International Conference on Conceptual Modeling (ER 2009). Berlin / Heidelberg : Springer, 2009.

[LCV09] Tanara Lauschner, Marco Antonio Casanova, Vania Vidal, José Antonio Macêdo , A Fast Decision Procedure for Query Containment and Related Problems, SBBD, 2009.

[SVM10] Eveline Sacramento, Vania Vidal, José Antonio Macêdo, Bernadette Lóscio, Fernanda Lígia Lopes, Marco Antonio CasanovaTowards Automatic Generation of Application, SBBD, 2010.

[OLI10] Oliveira, M.; Hairon, C.; Andrade, O.; Moura, R.; Sicotte, C; Denis, J-L.; Fernandes, S.; Gensel, J.; Bringel, J.; Martin, H. (2010) “A context-aware framework for health care governance decision-making systems: A model based on the Brazilian Digital TV”, In: IEEE International Symposium on a World of Wireless Mobile and Multimedia Networks, pages 1-6, Montreal.