A Smart Decisional Cognitive System based on Self-adaptability of Web Services to the Context

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Abstract: Memory loss or cognitive stimulation application for handicapped people is the subject of a recent field of studies in a information systems. In this way, Web services are a solution for the integration of distributed information systems, autonomous, heterogeneous and auto adaptable to the context. In this paper, we are interested in defining a new solution for a smart and decisional cognitive system based on self-adaptability of Web services to the context and showing this solution by a case study.

1 INTRODUCTION

Cognitive stimulation (Emilie et al., 2007) key many parts in a person who suffers from a loss of autonomy such as Psycho-Social, Cognitive and Functional. It strengthens motivation and verbal and nonverbal communication. It also keeps the residual cognitive resources and optimal autonomy and optimize cognitive functioning (memory, language, attention,..) and social (motivation, sociability) preserved by exploiting the capabilities of patients.

System information must meet some specific constraints surrounding context adaptation in the case of ubiquitous computing (Weiser, 1993). Computing applications now operate in a variety of new settings; for example, embedded in cars or wearable devices. They use information about their context to respond and adapt to changes in the computing environment. They are, in short, increasingly context aware. Considerable approaches related to adaptability with different modes of implementation such as: Aspect Oriented Programming (Kiczales et al., 1997). This aspect used by various platforms on the goal to adapt the Web service (WS, 2004) to the context dynamic changes of environment. Web services, like any other middleware technologies, aim to provide mechanisms to bridge heterogeneous platforms, allowing data to flow across various programs. The Web services technology looks very similar to what most middleware technologies looks like. The emergence of Web services as a model for integrating heterogeneous Web information has opened up new possibilities of interaction and adaptability to context when offered more potential for interoperability. However, from a set of requirements on SOA (Service Oriented Architecture) (Curbera et al., 2008), and to provide self adaptation to the context of Web services, we need to integrate more generic connector that takes into account all ambient or distant events. The SOA offer great flexibility that is a great ability to functional and technical changes. Moreover, this type of architecture is most often used as Web services support, which provide the flexibility and interoperability expected, that is the ability to communicate between heterogeneous systems. The application in such information systems that incorporate SOA need to communicate across the exchange software (middleware or platforms). These middleware are the source of our work. It is on them that will think the same expectations in terms of flexibility, interoperability and adaptability

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The rest of this paper is organized as follows: In Section 2, we present our solution for a smart decisional cognitive system. In section 3 we present our approach for a context meta-model for a self

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adaptability of SOA. In Section 4, we review previous research on context awareness and adaptability of Web services. Finally, we summarize our work and discuss future research in Section 5.

2 SMART CONITIVE SYSTEM

2.1 Architecture

Our smart cognitive system helps doctors and memory handicapped person workers to evaluate state of patient and use a new event related to patient and help them to refresh her cognitive memory in a short time.

In Figure 1, we presented our architecture general solution for pervasive decisional and smart cognitive system. This architecture represents the different tools and components necessary that helps a doctor to evaluate and treat the condition of a patient has memory loss.

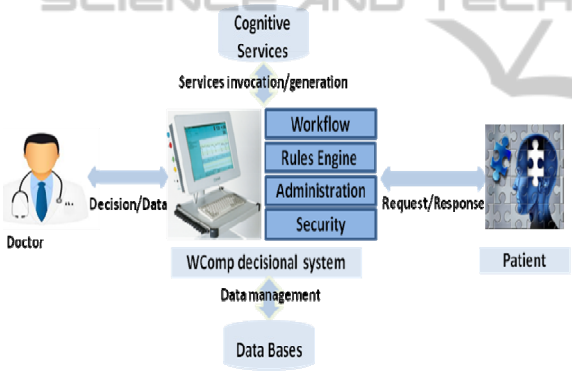

Figure 1: Smart cognitive system.

Our system is based on a workflow; this workflow can test a request from a doctor by a rules engine that will transform the requests in the form of rules. Our system can also give and automatically generate Web services that represent different functionality of the test used by a doctor to evaluate memory state of patient and host under a registry "Cognitive Services". The personal information for each patient is provided by the middleware stored in a "Data Base" for subsequent needs state.

Under WComp we have integrated a rule engine that can provide management rules that deal with business logic. The rules engine can communicate with a workflow engine, which helps optimize and evolution of these assemblies separating the events produced by the components defined in an application WComp.

2.2 Modelling

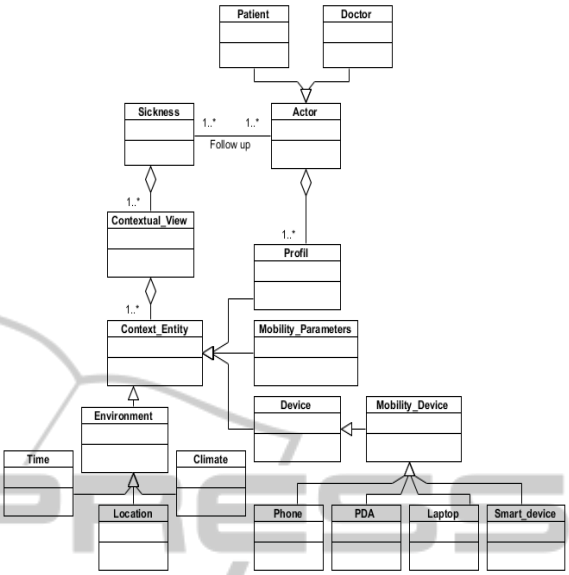

Figure 2: System modelling.

By using our meta model of context, Figure 2 represent the model of our solution to help doctors to invoke web services related a new event related to personal information of patient. This model represents many equipment and resources used in ambient space.

2.3 Implementation

We chose to implement a decision support for patients who have memory loss. Our smart system is a set of ordered tests and uses personal information for patients, such as privacy in its ambient space, these contacts, these family, and every time we introduce events that can refresh his memory. Thereafter, and end testing stages, the doctor can see the score as a percentage of correct answers.

Figure 3: Color recognition.

This result helps him to the decision on the patient's condition and assesses his memory.

In Figure 3, we present a first step of test. This step is color recognition, when the patient must know the color presented.

In Figure 4, we present a Final step of test. This step is face familial recognition, when the patient must know the person in her family or her friend.

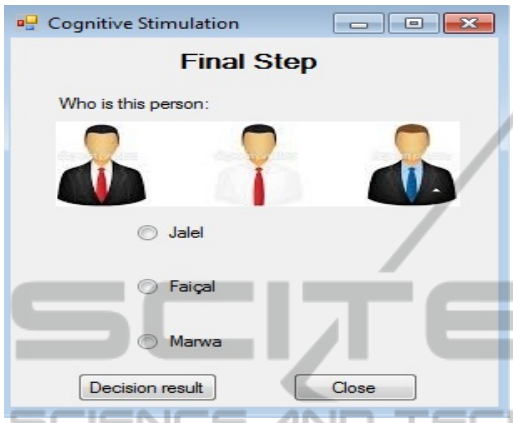

Figure 4: Face familial recognition.

In Figure 5, we show the end result percentage test, accurate answers. This result gives an idea of the patient's memory status and helps the doctor decide whether to continue treatment taken by the patient.

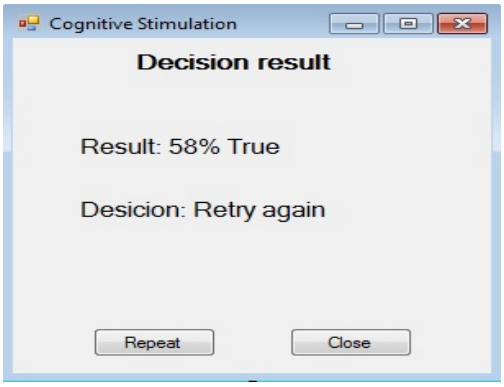

Figure 5: Decision result.

3 SELF-ADAPTABILITY OF WEB SERVICES TO THE CONTEXT

3.1 Architecture

In Figure 6, we presented our research results based on the needs in terms of self adaptability of service oriented architecture to the context. Our architecture

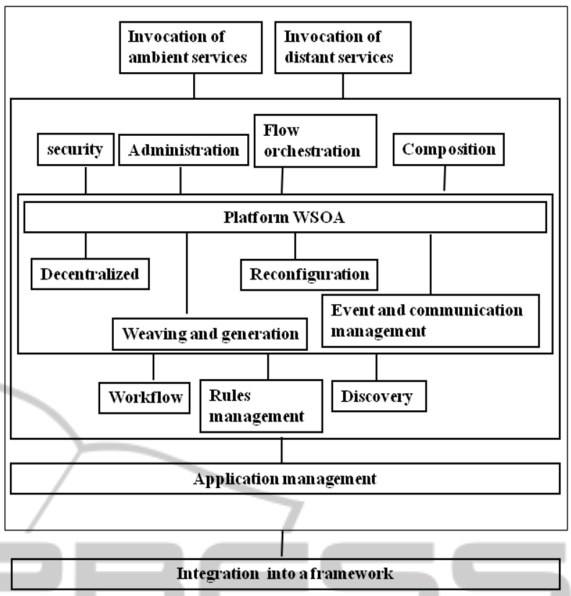

Figure 6: System architecture.

is based on objects or components to make the dynamic reconfiguration of components using more advanced mechanisms. It qualifies the distribution of applications across multiple servers and not the increase in service levels. There is a distributed architecture whose purpose is to deliver services to their audience and they will be accessible from any types of clients. Security and administration are offered by this system in treating the business logic from the workflow and rules.

Contextual resource discovery is the use of context data to discover other resources within the same context. The invocation of distant and ambient services is also permitted by this architecture using technologies dedicated to each type of invocation.

3.2 Context Awareness Modelling

This model (Figure 7) shows the different entities involved in consideration of context. Contextual view consists of several entities of contexts such as the environment (time, location, climate, etc...), mobility profile of the actor (all information that can specify the actor, age, gender these studies, the leisure ...) computing entity at large (especially with mobile device such as a laptop, PDA, phone, etc...) etc…

All the information related to the three dimensions can also be shared by other mobile applications. Our meta model identifies and adds the most relevant and generic contextual entities that will be held in account in modeling any mobile and context aware application. This context metamodel

consists of six generic contextual entities and four deduced entities specific to a category of mobile applications. The class “ContextView” groups all contextual entities involved in a given application. It is identified by name attribute and has two types of relation: the aggregation “involves” and the association “belongsTo”. The first relation expresses that a given “ContextView” is composed of many “ContextEntity” that are involved in a context-aware application. The second relation “belongsTo” expresses the use of historical context information. A given context entity may have participated in different context views. This information can be helpful in the design of future context views. The second generic entity of the meta model is the “ContextEntity”. As we see on the figure bellow, it is specialized in three generic entities: Actor, Computational Entity and Environnement. Actor may be a person or another object that has a state and profile. It evolves in an environment and uses computational devices to invoke services. With the Computational entity, the computational device is used by the actor to access the services and to capture contextual information from the environment.

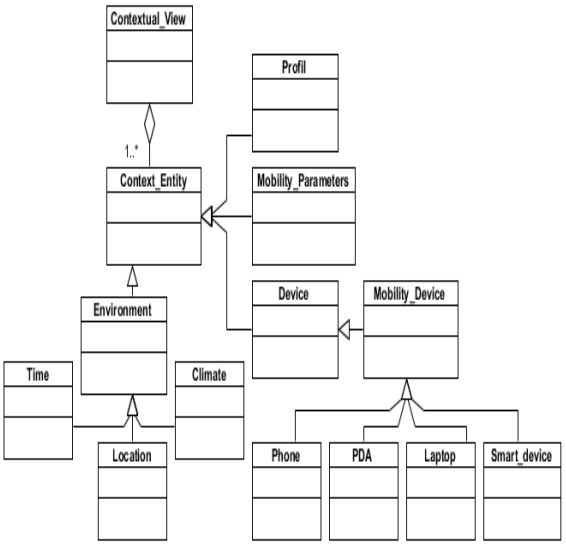

Figure 7: Context awareness meta-model.

Usually, a mobile device is used in context aware mobile applications, and can obtain information concerning the type of device it is (PDA, laptop, cellular phone…), the application, the network, etc. The environment is constituted of all the information surrounding the actor and its computational device that can be relevant for the application. It includes different categories of information as :(i) Spatial context information can be location, city, building, (ii) Temporal context information comprises time, date, season, (iii) Climate can be temperature, type of weather…. The last entity is a profile. We are convinced this entity is important in any user centered context aware application. In fact, profile is strongly attached to the actor and contains the information that describes it. An actor can have a dynamic and/or a static profile.

The static profile gathers information relevant for any mobile context-aware application. It can be the “date of birth”, “name” or “sex”. On the opposite, dynamic profile includes customized information depending on the specific type of application and/or the actor. It can be goals, preferences, intentions, desires, constraints, etc.

4 STATE OF THE ART

Cognitive stimulation techniques are represented in the form of applications that offer exercises and activities to improve and develop cognition of a person with a loss of autonomy, which needs a refresh and stimulate his memory.

Several studies show the cognitive stimulation in several technical and several forms. The Creasoft group (CREASOFT, 2014) gave us several applications. PRESCO is a program that focuses on memory, attention, language, visual spatial and executive functions. Tvneurones and Words and head travel are an applications in games form at different levels. They can stimulate the evocation to work the lack of the word, vocabulary and memory strategies proposed by various. MonAgenda Memory is a personal book; proposes adapted agendas and cognitive stimulation games. Allows the elderly and / or disoriented to keep his schedule and play regularly in cognitive stimulation activities.

The context awareness (Monfort & Felhi, 2010a, 2010b; Monfort et al., 2010) of such applications is the subject of a recent field of studies in pervasive computing called: context-aware systems. In (Monfort & Hammoudi, 2010, 2009; Vale & Hammoudi, 2008), authors define context-awareness as the ability of a program or device to sense or capture various states of its environment and itself. Referring to these latter definitions a context-aware application must have the ability to capture the necessary contextual entities from its environment, use them to adapt its behavior (run time environment) and finally present available services to the user. In (Gu et al., 2005), the authors introduce another definition in which they insist on the use of context and the relevance of context

information. The authors consider a system is context-aware if it uses context to provide relevant information and/or services to the user, where relevance depends on the user's task. In (Emanuele & Koetter, 2007), the authors considered context is any information that can be used to characterize the situation of an entity. An entity is a person, place, or object that is considered relevant to the interaction between a user and an application, including the user and applications themselves. The authors give a general definition that can be used in a wide range of context-aware applications. In (Winograd, 2001) the author approves this definition and claims that it covers all proposed works in context. However he considers it as a general definition that does not limit a context. Thus he proposes his own definition in which he limits a context in a set of information, which is structured and shared. It evolves and is used for interpretation. We stress that the notion of hierarchy (structure) of context introduced by (Winograd, 2001) is important. The definition proposed in (Chen & Kotz, 2000) also presents the context as hierarchically organized. In this work the authors differentiate between environmental information that determines the behavior of mobile applications and that which is relevant to the application. They thus define the context as the set of environmental states and settings that either determines an application's behavior or in which an application event occurs and is interesting to the user.

Web service is the best fitted technology for implementing Service Oriented Architectures (SOA) offering flexibility and interoperability. WSs provide a minimalist mechanism to interconnect different applications. But one fundamental point is the importance of the WSDL (Web Services Description Language) (WSDL, 2007) being the exact interface of the system. WSDL is responsible for the message payload, itself described with the equally famous protocol SOAP (Object Access Protocol) (SOAP, 2007), while data structures are explained by XML (eXtended Markup Language) (XML, 2012). Very often, WS are stored in UDDI (Universal Description Discovery and Integration) (UDDI, 2004) registry.

Many approaches treat the adaptability of SOA in joining with Web services, to context. Charfi and al. approach (Charfi & Mezini, 2004) propose a framework that provides support for middleware BPEL (Business Process Execution Language) (BPEL, 2003) engines. The authors apply the concepts of deployment descriptor and container for the Web service composition. Ferraz Tomaz and al. approach (Ferraz et al., 2006) proposed a tool for weaving aspects for a simple adaptability of the Web services, implementing aspects of the services as loosely coupled, where aspects are woven dynamically. In this approach, aspects are themselves Web services, thus they are independent of languages and platforms. Mehdi Ben Hmida approach (Ben Hmida et al., 2006) extended the solution proposed by (Ferraz et al., 2006) to specify BPEL processes adaptable, that is to say, the adaptability of complex services. Hence the need to extend the semantic aspects and Web services, which resulted in the ASW (Aspect Service Weaver). Aspects are themselves loosely coupled Web services, they are independent of languages and platforms, but, this approach has limitations.

Adaptation to context is not taken into account, that is to say, if an event occurred during a search on a Web service, this approach does not take into account this event. In the other approaches we find those based on context adaptation (Garlan et al., 2002; Biegel and Cahill, 2004; Anastasopoulos et al., 2006; Roman and Islam, 2004). The ambient computing encourages the proliferation of associated devices. We cited WComp approach (Tigli et al., 2009a, 2009b, 2009c) which represents the implementation of experimental models for lightweight components for service composition SLCA (Service Lightweight Component Architecture) which enables the design of ambient computing applications by assembling software components, orchestrating access to services through infrastructure devices from ambient. WComp supports protocols such as UPnP (Universal Plug and Play) (UPnP, 2012) and Web services, allowing components through the proxy to interact with them. To promote adaptation to context WComp uses Aspect Assembly paradigm. Aspect Assemblies can either be selected by a user or fired by a context adaptation process. It uses a weaver that allows adding and or suppressing components. With this architecture WComp allows: i) managing devices heterogeneity and dynamic discovering by using UPnP, ii) events driven interactions with devices, iii) managing dynamic devices connection and disconnection (dynamic re configuration on run time) in infrastructure.

In our research work (Felhi & Akaichi, 2012a, 2012b, 2013a, 2013b), we presented a proposal to a self-adaptable SOA to the context based on workflow (Workflow, 2006) by presenting the functional and technical architecture of our approach. In this architecture we have given different features in terms of the needs of self-

adaptability offered by the integration of workflow, which allows the management rules (Rules, 2010) and a kind of security and administration of Web services. This solution which can offer management rules that deal with business logic. Business logic can help in the development and optimization of these assemblies separating the events produced by the components of Web services.

4 CONCLUSIONS AND FUTURE WORKS

In this paper we have shown the interest of self adaptability of SOA based on workflow since it often involves multiple heterogeneous systems, and in particular for cognitive decisional and smart system. We proposed our solution helps doctors and memory handicapped person workers to evaluate state of patient and use a new event related to patient and help them to refresh her cognitive memory in a short time.

We hope in our future work enhance our approaches another application domain..

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