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AI Enabled SaaS Framework for Fashion Designing

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Abstract

This paper proposes a new AI (Artificial Intelligence) enabled SaaS (Software as a Service) Framework to facilitate the work of Fashion Designers to evolve new and innovative Fashion Designs. Fashion Designs are, more often than not, complex; using concepts of Service Choreography using Blackboard Architecture, we propose a new model for facilitating collaborative / individual innovative work of Fashion Designers.

Keywords *– AI; fashion; SaaS; service; cloud; blackboard; architecture*

1 Introduction

A fashion design, which is in general a complex creation of innovation, is during many instances the outcome of collaborative partnership between fashion designers, who may be located in different geographies. Creating innovative designs in an industry where the design life-cycle is very brief has become a key factor for survival in the competitive environment.

A complex fashion design may be considered to be a set of collaborative fashion designs. It may be looked upon as a higher level design made up of collaborative lower level fashion designs in a loosely-coupled way. Each lower level design may be considered to be a service. SOA (Service Oriented Architecture) is a design framework for construction of information systems through combination of services. A service is a program unit which can be called by standardized procedures, and which can independently execute assigned functions [4].

Designs / services may be deployed on clouds and offered as services (SaaS: Software as a Service) to the collaborators who use a Blackboard style Architecture, which is a well- established style for solving the problem of control, collaboration and communication in a system.

The domain of Fashion Designing has thus far remained unexplored in the field of Service Oriented Architecture. This paper explores the feasibility of AI (Artificial Intelligence) based Service Oriented approach for creation of complex designs facilitated by a SaaS (Software as a Service) framework which uses Predicate Calculus Knowledge Bases.

The rest of this paper is organized as follows: In Section 2 we furnish literature review of articles published in the relevant areas. In Section 3, we introduce our modeling framework. In Section 4 we carry out discussions on our proposed Framework. Section 5 discusses benefits of the proposed framework. Finally, Section 6 provides some conclusions.

2 Review of Related Work

A typical service-oriented architecture (SOA) has three main parts: a provider, a consumer and a registry. A registry provides the foundations for service discovery and selection [1]. Our approach proposes a Knowledge Base which is a repository of fashion designs / services.

The paper by El-Gayar et al. [2] reviews related work on service-oriented architecture (SOA), distributed infrastructure and business process management (BPM). In our Paper we focus on composing complex fashion designs, which is akin to composing business processes.

The paper by Fang et al. [3] suggests a framework for designing agile and interoperable Enterprises. Our Paper proposes a framework/architecture for agile fashion designing.

With the aim of facilitating the development of service oriented solutions, Marcos Lopez-Sanz et al [4] propose the specification of an architecture centric model driven development method. Our Paper adopts an Architecture Centric model based on Blackboard Architecture.

Service-based software architectures benefit in particular from semantic, ontology-based modeling.

Claus Pahl's paper [5] presents ontology-based transformation and reasoning techniques for layered semantic service architecture modeling. Our paper proposes service architecture modeling for fashion designing.

Arroyo et al. [6] describe the practical application of a semantic web service-based choreography framework. We propose a choreography framework for fashion designs based on blackboard architecture.

David Chen et al. [7] define and clarify basic concepts of enterprise architectures. We adopt an architecture based approach.

Advances in information and communication technologies and economic factors impelled organizations to engage in new forms of collaboration, such as Collaborative Networks (CNs) [8]. They require adequate frameworks, architectures, tools and platforms to support interoperability among heterogeneous and geographically distributed organizations. We consider a framework that supports interoperability among heterogeneous and geographically distributed fashion designers.

Existing business process modeling and enactment systems (workflow systems, project management tools, shared agendas, to do lists, etc.) have been mainly developed to suit enterprise internal needs. Thus, most of these systems are not adapted to inter-enterprise cooperation. Karim Baına et al [9] aim, through their paper, to present a model supporting dynamic heterogeneous workflow process interconnection. We also propose interconnection between heterogeneous fashion designs and designers.

Business Process Management Systems (BPMSs) are software platforms that support the definition, execution, and tracking of business processes. Daniela Grigori et al [10] present a set of integrated tools that supports business and IT users in managing process execution quality by providing several features, such as analysis, prediction, monitoring, control, and optimization. Such features are also important for our proposed framework.

The paper by Ricardo Jardim-Goncalves et al [11], presents emerging model-driven and service-oriented architectures. We adopt the service oriented paradigm for our proposed framework.

In their paper [12], Jagdev et al show how emerging semantic web services technologies facilitate the creation of applications. We propose an approach that adopts semantic predicate calculus knowledge bases.

Jung et al [13] in their paper propose architecture for integrating Knowledge Management Systems (KMSs) and Business Process Management Systems (BPMSs), to combine the advantages of the two paradigms. We propose a Knowledge Based framework that focusses on composing complex designs, which is akin to composing business processes.

The paper by Rezgui [14] argues that a role based authorization approach to service invocation is necessary in order to enhance and guarantee the integrity of the transactions that take place in the business environment of a VE. This aspect is also important for the framework proposed by us.

The book by Luger [15] captures the essence of artificial intelligence -- solving complex problems that arise wherever computer technology is applied. Luger demonstrates techniques and strategies for addressing the many challenges facing computer scientists today. Diverse topics on this exciting and ever-evolving field range from perception and adaptation using neural networks and genetic algorithms, intelligent agents with ontologies, automated reasoning, natural language analysis, and stochastic approaches to machine learning. We apply artificial intelligence concepts for developing knowledge bases in our work.

Korotkiy and Top [16] propose an approach to service composition based on the ideas from Blackboard Systems. Our paper also proposes a Blackboard system based architecture.

The Wikipedia [17] provides background on the Blackboard Architecture on which our paper is based.

3 AI (Knowledge Based) Service Oriented Modeling Framework

The realization of each complex design requires the orchestration / composition of the lower level designs (services) into consolidated design using Blackboard Architecture.

We use the following representative set of Predicate Calculus expressions, which serves as the common cloud-based Knowledge Source (KS):

1. design (design1)
2. design (design2)
3. design (design3)
4. …

A. Composite Fashion Design Representation using Predicate Calculus

The Service 'composite design' is represented as a goal: design (compositedesign1). This is represented by the implication:

{design (design1) Λ design (design2) Λ design (design3) Λ
… → design (composite design1)

Similarly service choreography / composition using composite fashion designs can be represented as:

{design (compositedesign1) Λ design (compositedesign2)
Λ design (compositedesign3) Λ … → design (newcomposite design).

4 Creating Complex Designs Using the Blackboard Architecture

The following scenario provides a simple metaphor that gives some insight into how a blackboard system in our context of fashion designers works [17]:

A group of specialists (fashion designers) are seated in a room with a large blackboard. They work as a team to brainstorm a solution to a problem (which is a goal as defined in Section 3 A above), using the blackboard as the workplace for cooperatively developing the solution. The session begins when the problem specifications are written onto the blackboard.

The specialists (fashion designers) all watch the blackboard, looking for an opportunity to apply their expertise to the developing solution. When someone writes something on the blackboard that allows another specialist to apply their expertise, the second specialist records their contribution on the blackboard, hopefully enabling other specialists to then apply their expertise. This process of adding contributions to the blackboard continues until the problem (creation of a complex design collaboratively) has been solved.

4.1 Blackboard Architecture

The specialists (fashion designers) are allowed to interact via the blackboard only and their access to the blackboard is managed by a dedicated controller. Thus, we can distinguish three main elements in a Blackboard System [16]: the Knowledge Source (expert), the Blackboard and the Controller, shown in figure below.

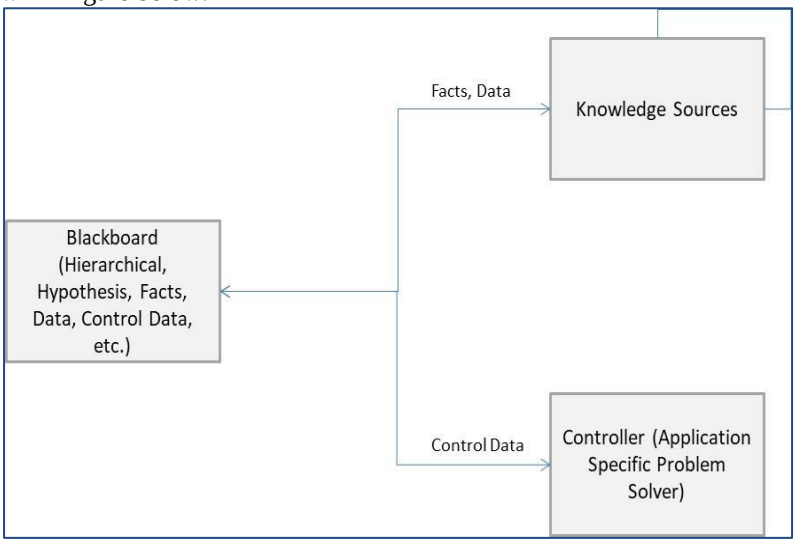

Figure 1: Blackboard Architecture

Knowledge Sources (KS) are mutually independent functional components capable of inspecting and modifying the Blackboard. KS represent experts (fashion designers) from different domains that

cooperate to solve a complex problem. In many Blackboard Systems a KS consists of trigger and action procedures. The trigger procedure allows a KS to determine if a blackboard contains facts sufficient to contribute to it. Triggers enable the Controller to schedule KS to achieve the most efficient problem-solving process.

The Blackboard is a heterogeneous repository shared by all KS and the Controller. This repository enables cooperation among KS, and serves as a temporary buffer. The Blackboard can contain symbolically represented and, often, hierarchically organized solution space as well as control data employed by the Controller. The structure of the Blackboard is usually application specific to achieve the most efficient communication among KS and the Controller. It is assumed (rather implicitly) that there is a certain syntactic and semantic compatibility between KS. This allows them to (at least partially) understand the content of the Blackboard and extend it with new facts, which in turn can be understood by other KS.

The Controller synchronizes and coordinates KS to establish an effective and efficient problem-solving process. Overall application-specific problem-solving strategy is normally embedded into the Controller. The strategy is flexible enough to enable an arbitrary scheduling of KS that is decided upon by the Controller on the basis of trigger procedures.

4.2 Creating Complex Designs

Complex Designs are created using the Blackboard Architecture referred to above by the following methodology

- The common Knowledge Source (KS) comprises of the AI (Predicate Calculus) Knowledge Base of Designs
- The Knowledge Source is cloud based and may be distributed
- The User Interface (UI) for the Blackboard will be Web 2.0 based and will allow co-browsing (joint navigation through the Internet by two or more specialists accessing the same web pages at the same time).
- The UI for the Blackboard will be a Mash-up which will consume the component designs (services). These components may be atomic designs or composite designs
- The designs (exposed as services) will be available to the collaborating specialists based on the SaaS (Software as a Service) paradigm and adhering to the security requirements such as Authentication and Authorization

5 Benefits of Proposed Framework

In AI the following benefits of Blackboard Systems are emphasized [16]:

- ✓ Blackboard Systems are arguably considered to be the most general and flexible architecture for building knowledge- based systems.
- ✓ Blackboard Systems provide for an excellent integration framework for components (Knowledge Sources) that employ heterogeneous representations and expertise.
- ✓ Separation of concerns between the Controller and KS allows a Blackboard System to make dynamic control decisions.
- ✓ The inherent modularity of a Blackboard System and independence of KS provide for significant software- engineering benefits.

Other benefits are

- Cloud based Knowledge Source available universally.
- Web 2.0 based Mash-up {User friendly Interface for creation of designs consuming underlying services (designs)}.

6 Conclusion

The paper presents an AI enabled Service Oriented Framework for the hitherto unexplored domain of fashion designing. This paradigm will facilitate the process of creating new and complex designs collaboratively by fashion designers who are globally / geographically dispersed. The designs, both atomic and composite, will be exposed as reusable services on cloud, and will be available to designers as SaaS (Software as a Service).

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