AN APPROACH FOR INFORMATION EXTRACTION USING JADE: A CASE STUDY

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Abstract- There is plethora of documents available on web that are very difficult to access and extract relevant information from them. The reason is uncertainty of huge documents that confuse users by providing several keywords and results in context of given query. This paper illustrates working of JADE by implementing case study on Online Shopping System. It defines schemas (classes and subclasses) and instances (objects) with user defined methods that helps in execution of program by writing code in Java Script. It is known that responsibility of developing agents in complex and business environments is controlled by software framework called JADE (Java Agent Development Framework). In addition, a concise and clear description of JADE, its intended architecture model including its packages and features is presented here. The results of our case study are shown in JADE GUI environment by invoking JADE painter. It gives new idea of extracting relevant information about given system.

Index Terms- Information Extraction, Multi Agent Systems (MAS), JADE

INTRODUCTION

In past years, researchers rely on Knowledge Management (KM) solutions for integration of knowledge processes from distributed model that extracts resources at centralized location. It was unable to access knowledge from complex systems. It leads to development of Multi Agent Systems (MAS). The systems where individual self authorized agents derive new facts with the help of other agents are called Multi Agent Systems [1]. In these systems, individual agents create their different models and prototypes instead of following traditional models. The growth in network of information resources requires distributed systems with decentralized architecture that can work with other systems. Such systems cannot work in traditional client server approach. The solution to realize these systems is use of Agent Based Technologies that have been increased with development of MAS.

However, JADE is considered as agent middleware that implements Agent Platform and development framework. JADE compiles with FIPA Specifications [2]. FIPA stands for Foundation for Intelligent Physical Agents. It is non-profit organization registered in Geneva. Its aim is to promote success of emerging agent based application and services. FIPA deals with two assumptions [3] that are as follows:

a) The time to define agent standards should not be too long.

b) Only external behaviors of system components should be specified.

In this paper, results of Online Customer Form are shown using JIT (Jade-In-Time) Debugger and Inspector. It also shows concept of single level Inheritance among classes by using ‘is a kind’ relationship. OnlineCustomer is made as Super class. It is extended by two subclasses- ShoppingCart and OnlinePayment. It facilitates the process of Online Shopping System. First, a literature survey on different companies working on JADE is presented. Then, pros and cons of JADE are covered in Development of JADE section. Throughout the paper, the results are presented in terms of GUI application by developing a form in JADE and analyzed by graphical tools like Debugger and Inspector.

LITERATURE SURVEY

The efforts led by various researchers and developers have contributed to the development of JADE. The developers working in different companies have made great use of technology in providing innovative solutions for creating agents in complex systems. It is known that there are two conditions of JADE that must be fulfilled to work on it.

a) FIPA-compliant agent platform.

b) Package to develop agents.

JADE is fully implemented in Java language. Have we ever thought that what is the reason that JADE is implemented in Java language only? It is because:

a) Java is object oriented programming language in distributed environments.

b) Object Serialization is available.

c) It has different API’s and RMI (Remote Invocation Method) to connect to remote computers.

Serialization is a process of converting object state to sequence of bytes and vice versa. It is used when we want to run object. During serialization, the state of object will be saved instead of its file and methods.

Companies working on JADE:

a. Telecom Italia Lab: - This Company has developed JADE in originated open source community in Feb
2000. Its first version developed was JADE 1.3. It is responsible for creating more innovative solutions in technology and carrying out feasibility studies.

b. **BT Exact**: - It has developed LEAP add on for mobile terminals. LEAP is modified version of JADE platform that can not only run on PC’s and servers but also on mobile devices. It should follow one condition that mobile devices have Java enabled.

c. **Caboodle Networks**: - It utilizes JADE to build an open source semantic search platform for Internet and wireless portals. We utilize JADE to create an agent framework that allows users to search for multimedia. This company has developed its first product named Ontology Navigator which allows users to search ontologies.

d. **White Stem Technologies AP**: - It has been using JADE platform for various research projects. The use of JADE in medical fields has greatly made its effective. By using JADE, we have developed agent based system for decision making support in organ transplant centers.

**DEVELOPMENT OF JADE**

Several researchers are working towards agent technologies like Knowledge Sharing effort [4], OMG [5], FIPA [6]. Researchers are also working in realization of development environments to build agent systems like RESTINA [7], MOLE [8], and ZEUS [9]. These environments provide predefined agent models and tools to make development easy. There is developer named Acklin B.V. He used JADE in IBROW (Intelligent Brokering on Web). The goal of the project is to develop technologies for automatic selection configuration of new applications by reuse of services. He also developed Bean Generator plug-in that supports automatic generation of message content ontologies.

**Why JADE has been developed?:**

a. **Problem**: - Since Internet is based on traditional client server approach, it is contributed by excess of central servers comprising of various domains. The information is transferred to users by means of several links like browsers but the way of transferring information is not proper. It gives inaccurate results. There is no concept of middleware among users.

b. **Birth of Middleware**: - Direct communication between users that have same capabilities and same method led to development of middleware.

c. **Solution**: - In order to reduce the context of above problem, JADE is developed. It uses Java based middleware that collects all blocks of information and offers set of API’s along with testing tools for the development of agent based applications. JADE allows users to:

   a) Work in proper way by following rules and standards.

   b) We can communicate with other users on remote servers.

   c) Maintain coordination to solve complex problems.

JADE systems are designed and deployed in fields like Internet Services, Mobile environments and distributed tasks. JADE is portable i.e. it can run in different environments.

**What is JADE?**

JADE is open framework RAD tool for development of J2EE. Its aim is to allow developers to create high quality, consistent and efficient database applications. There are various tools for deploying JADE like Dreamweaver, Tomcat, MySQL etc. The word ‘open source’ does not just mean free access to source code. JADE is realized under LGPL license that offers rights to make and distribute copies of JADE. It also has access to Software and source code.

JADE provides agent behavior abstractions that allows to distinguish across wide range of devices.

**Features of JADE:**

Following are the typical features of JADE:

a) **Distributed Agent Platform**: - The agent platform has several hosts and agents. Only one Java Application and Java Virtual Machine (JVM) is executed on each host. Agents are implemented as java threads and lives in Containers. A Container is running instance of JADE environment containing several agents.

There is **Main Container** (It is always active and has two agents in it-AMS and DF) and **Other Containers** (They locate RMI registry on main container and provides host run time environment).

![Main Container](image1)

**Figure 1. Main Container (AMS + DF)**

Following are the functions of Main Container:

i. It manages CT (Container Table) that has transport addresses of all container nodes in platform.

ii. It manages ADT (Agent Description Table) that contains registry of all agents where they are located.

![JADE Distributed Platform](image2)

**Figure 2. JADE Agent Platform Architecture**
b) **FIPA Compliant Agent Platform:** JADE justifies syntactic as well as semantic compliance with FIPA specifications. It has new component in addition to AMS and DF called Message Transport System (MTS). It is also called Agent Communication Channel (ACC). Its aim is to provide track of messages received to final destination.

c) **GUI Interface:** The agent platform provides development environment for Remote Management Monitoring and controlling of status of agents like start, stop etc.

Below screen shot describes interface showing status of customers in Online Shopping system.

d) **Intra-platform agent mobility:** It includes transfer of state and code of agent.

e) **InProcess Interface:** It allows external applications to launch agents.

f) **Debugging and Graphical Tools:** They help to develop agent applications based on JADE.

g) Efficient transport of messages inside platform.

h) It supports application content and ontologies.

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**Agent Tasks:**

Every JADE agent is composed of single execution thread and all its tasks are modeled and implemented as BEHAVIOIRS. Each agent has its various states that have different purposes. The states are collectively termed as Agent Life Cycle.

i. **Initiate:** In this, agent object is built but is not registered with AMS. It has no name and address.

ii. **Active:** Agent is registered with AMS and has name and address.

iii. **Suspend:** Agent object is stopped.

iv. **Waiting:** Agent object is blocked, it waits for something. It is in sleeping state and when some message arrives, it will wake up using wakeup() method.

v. **Delete:** Agent is stopped and terminated its execution.

vi. **Transit:** When agent moves to another location, it uses this method.

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**JADE Packages:**

JADE framework has various packages and sub-packages that allow programmers to design tasks easily by using abstract interfaces.
JADE Graphical Tools:

i. Remote Monitoring Agent (RMA): - It is graphical output for platform management and control. It controls agent life cycle.

ii. Dummy Agent: - It is monitoring and debugging tool. It is inside GUI and JADE agent.

iii. Sniffer Agent: - It is an agent that stops messages while they are in sending mode and displays them graphically in UML diagrams.

iv. Directory Facilitator (DF): - It is GUI that interacts with other DF's.

v. Log Manager Agent: - It allows setting logging information at run time.

vi. Socket Proxy Agent: - It is simple agent that is bidirectional between JADE and TCP/IP connection. It handles firewalls.

A CASE STUDY ON ONLINE SHOPPING SYSTEM

This section illustrates the working of JADE application framework in context of Online Shopping System. Since the main component of JADE application is an Object. An object is any entity (Real or Abstract) that has well defined behaviours and unique identity. Our application is defined with schema named Online Shopping Schema. It defines various classes and its sub-classes with different attributes and methods.

A class is template or blueprint that is used to build an object in run time database. It describes common characteristics and behaviours of set of objects. We have constructed UML diagram using UML Modeling Tool for showing the concept of Single Level Inheritance that is implemented using JADE also.

Here, we have OnlineCustomer as super class. It is abstract class that has no instances. It has properties like customerld, password, Product Qty etc. It has methods like signin(), signup() and calcFinalAmount(). This super class is being extended by two sub-classes i.e. Shopping Cart and Online Payment. They have common method named as calcFinalAmount().

Figure 6. UML Diagram showing super class and two sub-classes that inherits some properties and methods.

Figure 7. Implementing concept of Single Level Inheritance using JADE 6.3.11.
We have created a class named *Customer* which has method called `createCustomer()`. This method returns the values of Customer class like name, address, custId etc.

![Figure 8. Use of Debugger in JADE 6.3.11](image1)

We have created a Form in JADE by invoking JADE Painter. It enables us to build GUI environment by using various options like Label, Text Field, and Button etc. Use of JADE Schema Inspector is also shown in Figure 9 for inspecting database objects in our Form. It inspects Online Shopping Schema and displays list of instances for classes belonging to Form.

![Figure 9. JADE Painter showing our Form](image2)

![Figure 10. JADE Schema Inspector](image3)

**CONCLUSION AND FUTURE WORKS**

One of the first agent frameworks that fully comply with FIPA specifications has been presented here. JADE is trademark registered by CSELT which is called TILAB now. In this paper, we have demonstrated an application framework on Online Shopping System using JADE platform. It supports various classes with their user defined methods and properties, thus representing it as real environment. As for future work, we will try to design and implement a framework for MAS using JADE with ontology. We will refer this case study on Online Shopping System for demonstrating it.

**REFERENCES**


Short Bio Data for the Authors

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