CHAPTER 8: CONTRIBUTIONS AND FUTURE WORK

In this chapter we summarize the main contributions and achievements of the research carried out as part of this thesis. It also summarizes the concluding remarks that could be gained from the architectural design and implementation of the Multi Agent Knowledge Management System (MAEKMS).

The overall goal of this work is to design a MAEKMS using Gaia, extended for open multi agent systems. Then this design framework is used to replicate architectural designs for IT industry, eHealth and e-commerce systems.

8.1 Contributions

The contributions of the thesis are as follows:

- Generic Architecture
  a. The architectural design of a Multi Agent Enterprise Knowledge Management System (MAEKMS) is generic which is applicable to various applications in diverse domains. Further, this design of MAEKMS is applied to replicate architectural designs of IT industry, Healthcare services and e-commerce systems.
  
b. An intelligent knowledge based retrieval algorithm is formulated together with case based reasoning, fuzzy c-means clustering and knowledge beads.

- One stop solution
  a. It provides a common platform to the user to search different products being sold on different sites.

- Knowledge acquisition and creation
  a. The new experiences or the payments done by the users are added to the case base. The feedback of the users is also recorded regularly so that the e-commerce sites modify their business strategies accordingly. The analysis of the payment history enables the sites to analyze the sales of different products and hence have mostly bought products in abundance in their stock.
• **Efficient knowledge codification and storage**
  a. The knowledge beads provide an object oriented way to specify the knowledge in the knowledge base.
  b. It represents various forms of knowledge which includes the specification of products, negotiation strategies, user preferences, constraints and the desired final deals in an efficient way.
  c. If an e-commerce site attempts to add a product with the same attributes again, then the previously stored details is deleted and the newly added case is stored in the database. So if the site wants to give some discount on any product, then the entry of that particular product can be changed in the product base.

• **Fast knowledge retrieval**
  a. The fuzzy c-means clustering enables fast information retrieval and easy access to the data stored in the database.

• **Knowledge reuse**
  a. The case based reasoning enables the customer to look into the past history of the products sold and then plan the purchase accordingly. This helps the experimental customers a lot.

• **Data analysis and interpretation**
  a. Linear and polynomial regression analysis techniques enable the e-commerce sites to analyse and interpret the sales data.
  b. Linear regression gives the dependency of one attribute with another. Polynomial regression is used to interpret the values of data which is not available in the database. It enables the e-commerce sites to predict the prices of the new products being launched in the market and then accordingly decide their business strategies.

• **Consumer behavior prediction**
  a. Multiple regression is used to analyze the relationship between attributes taking more than two attributes at a time. In MAEKMS for e-commerce, multiple regression enables the e-commerce sites to find out the attributes
which have least effect on selling of the goods. It determines the consumer buying behavior.

8.2 Future Work

In the future the authors wish to implement all the modules of the eHealth system. The authors also plan to do the evaluation of the proposed eHealth system as is done for the e-commerce system. The authors also plan to include auction module in the e-commerce system. Auction requires negotiation between the agents which is achieved through the implementation of argumentation as discussed in the chapter 4. In the current work MAEKMS for e-commerce considered the case of multiple regression using three attributes at a time. The future work will encompass increasing the number of attributes to the order of ‘n’.

8.3 Concluding Remarks

The work presented in this thesis contributes to pushing further the field of software engineering by making knowledge management a central element throughout the development of multi agent systems. This starts with our vision and approach to making KM a natural phase in the current development of agent systems that in turn can prove beneficial to IT industry, in health care services in the form of eHealth system. And last but not the least, in E-commerce, which is the current trend of the day.

MAEKMS has advantages of both Multi Agent Systems (MAS) and Knowledge Management (KM). MAS enables decomposing a big problem into small sub-problems which can be solved by different agents collaborating, cooperating and coordinating with each other to reach the common goal. The agents have decision making power and their autonomous behavior distinguishes them from object oriented approach. A knowledge management system enables a system to acquire, create, codify, store, retrieve, share and use knowledge in the most efficient way. Thus a MAEKMS is reactive, proactive, autonomous and intelligent enough to get the right information, at the right time, at the right place and in the right format.
The proposed architectural design of MAEKMS incorporate a number of agents cooperating with each other using FIPA agent communication language i.e. ACL and sharing a common ontology. The agents help the user in buying a product directly or through auction. The auction is multi modal and is realized using argumentation. Case based reasoning is used so that the complexity of the system reduces. Knowledge beads is used to extract, integrate, and utilize the knowledge. The time taken to display the results to the user, containing the list of sites selling the desired product; also reduces considerably.

The validation of the architectural design with respect to its feasibility and practicality has been accomplished through implementations of the MAEKMS for the e-commerce system. The developed system is evaluated and analyzed using linear, polynomial and multiple regressions.
APPENDIX A

Start

Attribute with the highest weight in the RFQ is compared with that in the case base

Is there a match

Yes

Store the matched cases in ‘Matched’ Array List

Delete that attribute value pair from the RFQ

Is there any attribute

Yes

Attribute with the highest weight in the RFQ is compared with that in the ‘Matched’ Array List

Is there a match

No

Store the case in Unmatched Array List

Attributes are finished

Yes

‘Matched’ is empty

No

Display Matched

C

A

B
Compare the non negotiable attribute in original RFQ with those in 'Unmatched'

Is there a match?

Yes

Non negotiable Attributes in are finished

Yes

Display 'Unmatched'

No

Remove that case from 'Unmatched'

No

End
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