Abstract of the Research Work

Data plays a crucial role in all types of cross-organizational research and applications. The grid is an effective infrastructure for the coordinated use and sharing of distributed resources in a dynamic manner enabling the temporary pooling of resources to solve specific problems. Data grids rely on the coordinated sharing of and interaction across multiple autonomous database management systems to provide transparent access to heterogeneous and autonomous data resources stored in grid nodes. As data may distribute across multiple geographical locations and use different storage formats and access mechanisms, a solution to facilitate data access, integration and sharing would be advantageous and can be modeled by integrating the concept of an agent. An agent is a piece of software program which acts proactively on behalf of the user. Agents can be used in complex systems where expertise and resources are distributed like database grid. The agent paradigm is successfully employed in those applications where autonomous, heterogeneous, loosely-coupled, and distributed resources and systems need to interoperate in order to achieve a common goal.

Moreover, the grid community has historically focused on “brawn” i.e. interoperable infrastructure and tools for secure and reliable resource sharing within dynamic and geographically distributed Virtual Organizations (VOs), and applications of the same to various resource federation scenarios. Agent community has focused on “brains” i.e., on the development of methodologies, theories, algorithms and concepts for autonomous problem solvers that can act flexibly in uncertain and dynamic environments in order to achieve their aims and objectives. Agent systems require robust infrastructure and grid systems require autonomous, flexible behaviors. Therefore, this research work aims at providing an integrated approach to impart multi-agent knowledge-based systems in data grid to leverage the power of both grid and agent technology.

Apart from this, organizations generally strive for the data for analysis and decision making purposes. In any organization, such heterogeneous and geographically separated data are required on a real time basis for analysis and decision making. Knowledge-based system is used to provide intelligent decisions with justification. It is a system that draws upon the knowledge of human experts captured in a knowledge base to solve problems that normally require human expertise. Knowledge-based system can be implemented with the concept of an expert system. The expert system technology can be implemented by
incorporating fuzzy logic to handle qualitative and uncertain facts in the decision making process. Fuzzy set theory and rules can be used to achieve the benefits of the knowledge-based systems.

The objective of the research work is to develop a generic framework of multi-agent knowledge-based system accessing heterogeneous and geographically distributed databases within the data grid environment. As, data grid is a grid computing system that deals with large amounts of controlled, shared and managed distributed data and a software agent exhibits some form of artificial intelligence to assist users and acts on their behalf in performing various tasks, this research is carried out to integrate data grid technology with agent technology which can be useful in research, education and business fields. Also, the aim is to develop the fuzzy expert system modeled by incorporating agents on the top of the distributed database grid. It aims to accommodate the knowledge and expertise with reasoning capabilities that will provide a great support to executives for decision making in any research and commercial applications. The resulting framework hides the heterogeneity and provides transparent and single point access of heterogeneous and geographically distributed databases to client applications and users and handles the data access and integration through multiple collaborative agents.

As a case study, a grid-based model for integration of geographically distributed & heterogeneous educational resources for knowledge extraction & delivery which operates within the university domain has been developed. Also, the university domain is very large and may contain several different modules. Therefore, one of the module was taken to implement as an experimental system i.e. students' performance evaluation. The said experimental system was implemented based on the architecture mentioned in a generic framework.

Chapter 1 (Introduction and Overview) mainly focuses on research problem and fundamental concepts regarding data grid, multi-agent system, knowledge-based system and fuzzy logic and fuzzy set theory. It covers the details about the background of the study, purpose and significance of the study, approach of the study and objectives of the research work.

Chapter 2 (Literature Survey) presents the survey of literature accomplished for carrying out the research work. It also focuses on available applications and research work so far done in the area of data grid, agent and multi-agent systems and knowledge-based
Abstract of the Research Work

After studying and analyzing the current scenarios, in this chapter, the motivation behind the development of multi-agent knowledge-based system accessing distributed database grid has been explained.

Chapter 3 (The Generic Framework for Integration of Multi-agent Knowledge-based System and Distributed Database Grid) presents the developed integrated generic framework of multi-agent knowledge-based system accessing distributed database grid. It shows how different heterogeneous & scattered data resources are integrated via grid middleware and how knowledge extraction, presentation and delivery process is performed on the distributed database grid environment by using different collaborative agents. It demonstrates the high level view of the generic framework and also focuses on its detailing.

Chapter 4 (Detailed Methodology for Development of Framework) deals with the detailed methodology used to implement the generic framework mentioned in the previous chapter. It shows the sample code snippets and screen layouts necessary to explain the methodology used to implement the framework. It covers detailed aspects of implementation of OGSA-DAI (Open Grid Services Architecture - Data Access and Integration) and integration of the same with multi-agent system. It demonstrates how agents and multi-agent system is used to provide the data grid services to the client applications and users.

Chapter 5 (Implementation of Experimental System) introduces implementation details of an experimental system. The experimental system builds upon the architecture mentioned in the developed generic framework described in the chapter 3 and it uses the implementation methodology described in the chapter 4. It first explains the grid-based model for integration of geographically distributed & heterogeneous educational resources resides in the typical university domain for knowledge extraction and delivery. It, then, demonstrates the experimental system (students’ performance evaluation) implemented based on the developed generic framework and grid-based model. It also includes implementation aspects of the design and development phases of an experimental system in detail with essential screen layouts and code snippets.

Chapter 6 (Results, Conclusion and Future Extension of Research Work) discusses the results, conclusion and future extension of the research work. It discusses the major contributions of the research work carried out. Moreover, it demonstrates the features and
benefits of the research work in detail and explains the future extension of the research work.