**ABSTRACT**

An agent is a computational entity similar to a software program that can be viewed as perceiving and acting upon its environment and autonomous in its behaviors partially depending on its own experience. As an intelligent entity, an agent operates flexibly and rationally in a variety of environmental circumstances. An agent on the basis of any key process such as problem solving, planning, decision-making and learning achieves behavior flexibility and rationality.

Multi-agent systems are those in which several agents employ their knowledge and coordinate their activities and reason about the processes of coordination. Distributed problem solving systems are those in which the work of solving a particular problem is divided among a number of nodes that divide and share knowledge about the problem in developing a solution. A key pattern of interaction in Multi-Agent Systems (MAS) is a goal and task-oriented coordination, both in cooperative and competitive situations. The long-term goal of multi-agent systems is to develop mechanisms and methods that will enable agents to interact amongst themselves as well as with humans.

A web digital library is a modern computing platform, which is distributed, large, open and heterogeneous in nature. Digital libraries are emerging as additions/replacements of traditional large libraries which
store shelves with books, journals and employ technical staff to manage and classify content, provide assistance to users in day-to-day jobs. Web digital libraries are emerging technologies for content management. The design and development of a digital library requires addressing many issues and it must be able to perform intelligent human-oriented tasks in order to make it highly sophisticated and effective. The retrieval effectiveness is one of the attributes to measure the effectiveness of the system. It depends on various design factors of issues such as optimal content storage, content catching, content classification, retrieval, etc.

**Previous research on these issues were predominantly focused on**

1. Simple mathematical model for an optimal content allocation in a hierarchical network for handling static number of requests. The most important constraint is that the number of content requests in the web-based system is unpredictable.

2. Content caching is the second important issue that decides the fast and economic retrieval. The existing caching proxies use static policies and the hit-ratio cannot exceed 50% on an average thereby limiting the performance measure to a large extent. This necessitates a higher performance measure by introducing a new method to increase the existing hit-ratio.

3. Simple text classification and retrieval are other important issues for relevant retrieval in the federated subject-specific digital library environment. The most important problem in this case is the information integration on account of inter-disciplinary content arrival. The design of a single agent system in this case is
meaningless while considering the acquisition of new concepts as well as the text.

**The main research contributions in this thesis are:**

1. It studies the various types of architecture and characteristics of the multi-agent systems that decide the dynamic nature of the system as well as its application. The study also highlights various tools and their capabilities which are used for the development of the multi-agent systems. It gives the specific technical details of an *aglet*, which is used for the current system development. Aglets are Java-based autonomous agents developed by IBM.

2. To solve the problem of optimal content allocation while handling unpredictable requests (Partially Observable Markov Decision Problem) in the hierarchical network, a multi-agent based user-access patterned system is being designed and developed. This thesis advocates the multi-agent system capable of bringing in the content and user knowledge into the system as it is the only solution to the problem in such a dynamic environment.

3. To achieve the high-hit ratio in caching proxy for content caching the user and content access pattern is studied to meet system dynamic performance. In addition, invariably digital library client users expect quicker responses to their content related requests. In this present design hit-ratio increases from 50 to 60%. Specifically the incorporation of such domain knowledge in the rational proxy enables the system to achieve such high performance.
4. To solve the problem of the distributed text classification and retrieval on the process of integration of domain-specific (Subject specific) servers, an integrated classification as well as user adaptive recommender/retrieval system is needed. A concept-matrix patterned approach is designed and developed. The ACM computing review classification method is adopted for the purpose.

In these simulation experiments, it is proved that in all the above cases of system design, the performance of the system improves because of the content as well as user learning. This is proved by means of various simulation experiments.

In summary, the MAS solves the dynamic problems in the networked environment and in particular on (i) Optimal content allocation by handling the dynamic requests, (ii) Improvement in the caching ratio and (iii) Solution to the problem of distributed text classification and retrieval that shares domain knowledge among the number of servers. This makes the classification and user-adaptive retrieval relevant and effective. While incorporating the domain knowledge as the hypothesis to establish the design undertaken, the Multi-Agent System has improved the effective performance in a systematic way.