Chapter 1

Introduction

1.1 An Introduction

Nowadays, people are engaging in more and more online activities ranging from reading news to banking to conducting business, education, advertisement, research etc. The web is a world of information available at the click of a mouse. Web is network of servers which are connected with each other via a common protocol and whose backbone is HTML. A web page may contain text, images, and other multimedia information. The World Wide Web is also commonly referred to as the web, WWW [124, 182 and 175] and W3. Web can be accessed by a computer connected to an Intranet, an interconnection of computer networks or through the public Internet. Initially, web was designed for communication of people as an interactive world of shared information via computer machines.

People use the terms web and Internet synonymously. In casual conversation such as "I was on the Internet" or "I was on the web," there is no difference. However, in fact, the web is just one of the services deployed on the Internet. For example, Internet is a road and web is vehicle which moves on the road. Internet provides various services. For example, chatting, e-mail through outlook express and many other services. With its advent, security also has emerged as a prominent issue in the vast network. Its associated technologies and use had introduced increasing number of security threats from which users must be protected to make it more reliable and convenient for the organizers and web users. Network attacks are serious problems for businesses that store sensitive data such as financial records, personal medical, Government and military etc. It is a known fact that query is the primary way of extracting information from information systems. In web, a query may be typed in address book or it may be hyperlinked. A query implies an online request as required. Query may also be used to search a single file or collection of files. Optimization is
used by a quality-aware query optimizer to compile a valid query execution plan, which is believed to fulfill the users’ quality constraints.

Query Optimization is a function of many relational database management systems in which multiple query plans for satisfying a query are examined and a good query plan is identified. The current research work aims to primarily address the issues pertaining to query optimization and in addition an attempt towards adding security in the proposed work is being made. In order to achieve the stated objectives, it is proposed to introduce extended and portable cache memory. Also, an in depth review of literature suggests that ants which are actually intelligent agents can also be deployed to achieve the set targets. Therefore, next section presents the motivation behind the current work and its perspective solutions.

1.2 Motivation

Today's users can no longer depend on conventional information sources to cope with the latest developments in their respective fields. In the era of networked information, Internet, the largest worldwide network of networks, has emerged as the most powerful tool for an instant access to information. Information is now just a ‘finger touch’ distance away from the user and it would not be an exaggeration to say that the Internet has become the biggest global digital information library which provides the fastest access to the right kind of information in nano-seconds of time to end-user at any time and at any place in the world. The Internet has become the most extensively used information source that empowers the average person to get in roaming with the latest information.

The success of Internet and web, however, lead to several problems in parallel. The huge number of available web pages, web users and sensitive information on Internet decreases the performance and security of web. With the revolution in the technology, the computer users become more faster. The organizations and the web users want more secure queries and response from the web. Long waits, insecure
transmission and slow access is annoying to web users. If a page takes more time to open then users try to search another page relevant to their need within 30 seconds. The need to make web much faster, more secure and better performer has been realized by many and hence the idea of this research is being conceived and is presented in the upcoming sections.

1.3 Design Challenges

The growing popularity of the WWW, caching mechanisms have been proposed to rescue the Internet by reducing the page waiting time and the network traffic. According to literature, different caching techniques can be more generally applied to reduce the page access time by selecting the cache servers as their proxy server.

Improved performance has become a critical factor in determining the usability of the web in general and of individual sites in particular. The developers have been trying to make web access faster and in order to make it a better resource, the need for efficient techniques to retrieve web document information is highly apparent. As a result, the role of Information Retrieval (IR) systems is becoming more important. The most important and difficult operations in information retrieval is to generate queries that can succinctly identify relevant documents and reject irrelevant documents. Number of algorithms such as Genetic Algorithm (GA)[51, 52 and 141], Memetic Algorithm (MA) [150 and 171], Particle Swarm Optimization (PSO)[82, 156 and 161], Ant Colony Optimization (ACO)[29, 30 and 52] and Shuffled Frog Leap (SFL)[53] are playing vital role in the information retrieval. These algorithms are being studied, compared and analyzed [26] during this research. It was discovered that the genetic algorithms has some initial setting of the parameters where as PSO method is generally found to perform better than other algorithms in terms of success rate and solution quality, while being second best in terms of processing time. ACO is the main research destination of various researchers in networking and Internet. Hence, the work finds its motivation in using ACO algorithms.
A critical look at the literature highlighted the following challenges that still remain open towards improving the performance of web:

1. Slow accessibility of web
2. Insecure web applications
3. Overloaded and unbalanced web servers
4. Congested network paths
5. Delayed response time
6. Choice of web servers
7. Optimal network path
8. Collection of data

The above mentioned challenges are just the glimpses of serious issues arising with the growth of web and expansion rate of information on the same. Therefore, a solution addressing the above stated needs is very much apparent and is presented in next section.

1.4 Proposed Solution

A thorough literature survey showed that researchers have been working towards decreasing the access time in two different ways- first is to improve the hardware and second to modify the ways the requests are made to the server i.e. improvement in the query set for the request and hence optimizing the response. The main aim of this research is to overcome above challenges, decrease the response time and to improve web performance. This research work aims to propose various algorithms to find solutions for unfolded challenges. Web pages are becoming more complex with animated pictures, sounds, dynamically generated pages and multimedia components. According to literature, web developers are converting text data into images. This not only increases the total size of the web page, but also more resource-intensive to send and retrieve the information. The result is network congestion. Network traffic and more loads on server affect the web performance. To
solve these problems, a Portable Extended Cache Approach (PECA) that could reduce web traffic is being proposed [24]. In this framework, it is desired to conserve the heavy data at the client side. The experiments were performed on few dummy web sites of different sizes while saving heavy data at client side. Difference in the access times of different sites via traditional method and with the proposed approach was compared. A major improvement in the access time was observed in contrast to that by using traditional methods. Also, an attempt was made to reduce server load and network traffic congestion and it actually resulted into the decrease in the response time and hence an improved web performance could be observed.

Turning our attention towards the security of sensitive information such as that shared via bank transactions, ecommerce, to transfer secure data, business deals, confidential records, health related etc. It is evident that the web security is of utmost importance but very less attention has been give to online security mechanism. Therefore, a Secure Web Access Model (SWAM) [47] in the context of biometric recognition is being proposed. Online web services will be more secure using the online SWAM. The proposed security model SWAM provide an interface to the authorized user’s and reduce the threats regarding their sensitivity.

Some organizations are using multiple servers for load balancing and for backup. In Load Balancing Techniques, if any server is overloaded, its jobs are shared by other underloaded servers. Load balancing systems monitor the health of the available servers and make decisions to route the traffic for optimizing the performance and availability. But the challenge is- Which server is credible? Which path is shortest to reach to the best server? How data should be collected from multiple servers? Should the reply from server to client follow the same path? In order to address these issues, a Collective Intelligence based Framework for Load Balancing of web servers namely Active Online Load Balancing (AOLB) [48] is being proposed. The aim of this research paper is to find the overall best server with shortest path and hence online balancing of web servers could be achieved with the help of collective intelligence based framework for online load balancing. Collective
intelligence has evolved from the simulations of biological systems such as ants where individual ants explore pathways to food sources, and leave pheromone markers to demarcate their paths. These paths can be traced back by other ants that prefer the strongest pheromone, but will randomly deviate at certain positions, thereby further exploring the space of possible paths. Primarily, two ants namely, client ant and server ant are being deployed at client and server end respectively. The job of client ant is to search the credible server in shortest path while the server ant applies collective intelligence to search the nearest path towards client. Extraction of most relevant information in minimal amount of time improves the overall performance of web.

Following are some of the objectives that are being achieved in this research work:

1. Comparison and analyses of existing techniques of query optimization.
2. Development of a Portable Extended Cache Memory based Approach (PECA) to reduce web traffic.
4. Design of a collective Intelligence based framework for balancing the load on web server.
5. Evaluation of the proposed work.

1.5 Organization of Thesis

This thesis comprises of five chapters. The overview of these chapters is described as follow:

Chapter 2 provides a detailed review of query optimization techniques. Also the research challenges pertaining to data-centric and web-centric integration has been presented.
Chapter 3 presents the literature review and explores the issues to improve secure web performance. The chapter further highlights the work done by various eminent researchers in the related as well as allied fields. An extensive study about the literature in the area of web query optimization, various caching techniques, security mechanisms and load balancing of web servers to improve web performance is being carried out.

Chapter 4 presents the proposed work in three major parts highlighting the objectives achieved. First part focuses on the design of a Portable Extended Cache Memory Approach (PECA) that could reduce web traffic. Next section emphasis that web security can be improved with the biometric system and a novel Secure Web Access Model (SWAM) is being proposed. Part three presents a Collective Intelligence based Framework for Load Balancing of web servers finding the overall best server with shortest path and hence online balancing of web servers could be achieved.

Chapter 5 evaluates the performance of the overall research work. Result analysis and discussion reveals that the results are consistent with the existing schemes. Overall performance of web could be improved both by extending the cache and balancing the load. Also, security feature has its own added advantages.

Chapter 6 concludes the research work and presents the future scope for extending the current work.