ABSTRACT

In recent years, generations of wireless network technology, mobile phones and the internet have revolutionized the mobile communication environment and lifestyle of the people across the world. With these technologies and the ubiquity of location finding capabilities have spurred the development of a plethora of new mobile information services known as location based services, where people can acquire and disseminate information at any place, any time. Location based services are characterized by providing users with useful location dependent local information such as enhanced emergency services, yellow pages, entertainment and business services as the pervasive data access through mobile devices are available wherever they are. A location dependent information system uses business and landmark information, that has been compiled into Points of Interest or Places of Interest databases.

A location dependent information system uses location dependent query to provide the user with information such as the nearest hospital, nearest fuel station to a current location in an unknown place. The nearest neighbor and range queries are very popular location dependent queries. A nearest neighbor query retrieves the point of interest object of a certain class

which is closest to a certain object or location and range query retrieves the objects located within a certain range or region.

The location dependent information system, being wireless in nature, and dependent on pervasive access of location related information is plagued by mobility constraints like limited bandwidth, computational power, resource limitations, power constraints of smart mobile devices, client mobility and intermittent connectivity. An ideal location dependent information system should provide fast access to a high diversity of points of interest objects for a large number of mobile users via wireless channels.

The client-side data caching is considered as one of the significant techniques in a mobile environment because it improves access latency and data availability in case of disconnection. Caching frequently used data items in the mobile clients' local storage will save client's energy and alleviate the network bandwidth contention imposed on wireless mobile systems. As such a desirable caching technique should allow clients to assert query which can be completely answered by locally cached data. Caching reduces network bandwidth usage and load on the server. As a result it improves the system throughput, reduces user-perceived delays and improves data access performance. It also improves data availability in circumstances where the clients are weakly connected or totally disconnected, as well as reduces energy consumption, since wireless communication is not required for cache hits.

The major goal of this research work is to develop new models to address issues pertaining to client side data caching and prefetching strategies in order to achieve an efficient and effective location dependent information access in mobile environments.

The issues of cache replacement for location dependent data under a geometric location model is studied and a new cache replacement policy is proposed. This model considers the points of interest service type, area of valid scope, angle of bearing, beeline distance and access frequency while answering the nearest neighbor query to get the most relevant closest points of interest object to the user in an emergency scenario irrespective of the moving direction.

An efficient weighted association rule mining based data prefetching scheme is proposed to identify points of interest object to be prefetched while answering the location dependent query by integrating the opening time of objects.

A semantic caching mechanism is proposed to answer nearest neighbor and range queries from the semantic description in the cache by proposing the concept of partial objects in order to accurately answer user queries. The model is designed to store nearest neighbor and range query results as semantic regions in the cache using re-entry probability, area of

valid scope, age, rate of access as the spatial and temporal parameters in a cache replacement policy.

A new cache replacement weighted network distance based policy is proposed by considering spatial factors such as network distance, weights on the road network and weighted density of the valid scope and temporal factors such as opening time of the points of interest objects and access frequency, calculated replacement score for eviction.

An ontology-based user profile preference framework is proposed by collecting user profile and preferences for discovering the most relevant points of interest services with respect to user preferences.

Extensive empirical studies are conducted to evaluate the performance of proposed approaches for cache management, prefetching, semantic caching, nearest neighbor query access in the road network and on the ontology based user preference model. The experimental results demonstrate the efficiency of the proposed approaches and their superiority over state-of-the-art approaches in the corresponding domains. The thesis presents an overview of all the proposed caching policies and models in order to enhance the location dependent information system and suggests certain enhancements for the emerging mobile environment scenarios.