Dict-Based Energy and Latency Efficient Air Indexing Technique for Full Text Search Over Wireless Broadcast Stream

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ABSTRACT

Wireless data broadcasting seems to be an efficient way for dissemination of data to a large number of mobile users. Because of its scalability and flexibility, the service providers use this technology to resolve request of thousands of users in one single response. Full text search is the latest area of research in wireless data broadcasting. Access time and tuning time are the two metrics for evaluation of an indexing technique. In this paper, we propose an air indexing technique based on the dictionary data structure namely Dict-Based Air Indexing Technique for full text search over wireless broadcast stream that utilizes hash-tables. We also propose algorithms for the implementation of the technique. We analyze, evaluate and compare its performance with existing schemes. The results from simulation experiments demonstrate that the proposed technique is the most latency and energy efficient air indexing technique for full text searches.

KEYWORDS

(1, 0), (1, α) and (1, α(1, β)) Indexing Scheme, Air Indexing, Basic-Hash, Data Broadcasting, Dict-Based Indexing, Full Text Searches, Inverted List, Merged-Hash

INTRODUCTION

As smart phones are capturing the electronic market of the world, there is an urgent need to pay attention to the demands of mobile users. Using smart phones regularly requires frequent charging of the mobile device to use uninterrupted services. Although smart phones manufacturing companies are now a days, providing mobile devices with power management software for the optimum utilization of the scarce battery resource, yet they are helpless in minimizing the power consumption when fetching data from the network.

Wireless broadcasting has proved to be the most flexible and scalable technology. It is scalable because in one single response it can satisfy all mobile users falling in its range. It is flexible as it requires much less uplink transfer and uses downlink most of the time. The transmission of data from client to server is called downlink while from server to client is called uplink. The features of wireless data broadcasting technology make it suitable for using in mobile communication. In wireless broadcast system, a base station that periodically broadcast information to a number of users. Broadcast information like live cricket score, match updates, share market updates to the required mobile users.
A mobile device is characterized by limitations like scarce battery resource and limited bandwidth. Using this technology, the client can tune in to the channel and can download its interested data upon arrival (Acharya, 1997; Imielinski, 1994a; Imielinski, 1994b; Imielinski, 1997).

Full Text Search (FTS) is a query type that is used to efficiently retrieve the number of documents matching to given search query. To facilitate full text search in wireless data broadcasting is a very challenging task. Only a few researchers had made it possible to include full text search in data broadcasting on wireless stream. All those researchers have used B+ tree and inverted lists as the data structure. Some has used the hashing technique also, but in this work we have replaced inverted list with the dictionary data structure for further optimizing access time and tuning time. An example of full text query may be a client searching the information related to cricket or wireless technology. For this client can issue “cricket” or “wireless” as query. The result of this query should be the set of documents containing information related to cricket and wireless (Chung, 2010; Mahapatra, 2011; Yang, 2011).

A mobile device can operate in either active mode or doze mode for battery optimization. In active mode, the mobile device is fully functional while in doze mode it is in sleep mode. The power consumption in active mode is at least 20-30% higher as compared to doze mode. Thus, we must develop techniques that can keep mobile device in doze mode most of the time and can switch it to active mode only when the desired data arrives for saving scarce battery consumption (Imielinski, 1994a; Imielinski, 1994b; Imielinski, 1997).

Indexing technique refers to interleaving of index and data on the wireless broadcast stream. Due to indexing techniques, it has become possible to search data of interest by just reading the index information rather than reading the whole stream of broadcasted data. Index is the time offset. A mobile device uses this offset to know the arrival time of data. The mobile device switches itself from doze mode to active mode and starts listening to the channel according to time offset of desired data. It stays in doze mode for rest of the time and saves the scarce battery resource (Acharya, 1997; Chung, 2010; Goel, 2013; Hsu, 2002; Imielinski, 1994a; Imielinski, 1994b; Imielinski, 1997; Zhong, 2013b).

The inverted list is a famous data structure for document indexing and retrieval systems. This is also used as a technique for full-text search. To the best of our knowledge there is only few published work that facilitates full text search over wireless broadcast stream. The first work was proposed by Chung et al. (2010). They used index tree and inverted list data structures to index full text query processing over wireless broadcast stream. Based on these data structures they proposed three methods $(1, 0)$, $(1, \alpha)$ and $(1, \alpha(1, \beta))$. They used inverted list for guiding full text search and index tree for indexing the keywords in the inverted list. However, the methods proposed by this literature are not so energy efficient because it requires a reasonable amount of time for locating the keyword in the inverted list. The methods are not even latency efficient as the methods require replication of tree based indexes. The another published work by Yang et al. (2011) utilized hash technique and proposed two schemes namely Basic-Hash and Merged-Hash. However, these two schemes also create inverted lists of documents and then make use of hash function for indexing the keyword in the inverted list. Thus, this work is also not able to fully optimize the access time and tuning time. It also requires reasonable amount of time for creating the inverted list and then manually determining the hash value of keywords in the inverted list.

In this chapter, we have further optimized tuning time and access time by proposing a dictionary based indexing technique. This indexing technique automates the index creation process through the use of an entirely advance data structure: dictionary. This dictionary data structure internally implements hash-tables. It is a data structure that matches keys with its values. We have taken keywords as the keys and document pointers as their values. To summarize, our main contributions include:
A Study of Reusing Smartphones to Augment Elementary School Education
[www.igi-global.com/article/study-reusing-smartphones-augment-elementary/67098?camid=4v1a](www.igi-global.com/article/study-reusing-smartphones-augment-elementary/67098?camid=4v1a)

Systems Development Methodology for Mobile Commerce Applications
[www.igi-global.com/article/systems-development-methodology-mobile-commerce/58904?camid=4v1a](www.igi-global.com/article/systems-development-methodology-mobile-commerce/58904?camid=4v1a)