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Intelligent Location Dependent Query Processing Algorithm for Retrieving Medical Information in Mobile Cloud

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Abstract – Recently, data retrieval has become a challenging task in mobile cloud environments. Many query processing algorithms have been introduced by many researchers for retrieval. However, most of the existing schemes do not achieve better performance on retrieval process. Therefore, this paper proposes an intelligent medical information retrieval model for effective retrieval in mobile cloud environments. In addition, it uses rules for performing suitable mobile database operations. Experiments have been carried out in this work for evaluating the proposed system by using UCI Repository medical datasets enhanced with mobility features and hospital based mobile databases and found that the proposed system is useful for effective information retrieval.

Keywords – Mobile Cloud, Medical Information System, Mobile Transaction Model, Retrieval, location dependent queries, Mobility features.

I. INTRODUCTION

A mobile healthcare application for providing health care services must take care of the diagnosis, treatment, and prevention of disease effectively from anywhere at any time. In the past, the expert system developed for medical diagnosis including MYCIN provided effective health decisions using knowledge based approach by performing deductive inference on symptoms. However, the large volumes of patient data and medical records make it necessary for converting the knowledge based systems into database systems applications. After the arrival of internet and web, the size of data stored is increasing continuously to maintain patient histories effectively. In such a scenario, more healthcare applications are moving their data into cloud data storage. Though database systems provide facilities for data storage, retrieval, transactions with concurrency and recovery they do not provide support for making decisions and the relational databases do not allow the queries from mobile devices. Moreover, the mobile databases have limited data storage facilities if the database is stored in mobile devices. On the other hand, cloud databases provide large amount of memory and dynamic processing power (Muthurajkumar et al 2015). Hence, it is necessary to integrate the features of database management systems, mobile computing and cloud computing with knowledge based systems to develop intelligent mobile healthcare applications (Muthurajkumar et al 2015).

In spite of the availability of relational database systems for health record maintenance, a web based solution is necessary for providing e-health services and to make cost effective treatment methods. Moreover, the cloud database systems provide facilities for large scale real time data storage and retrieval features. They also provide distributed query processing facilities using map-reduce procedures. In addition, the existing database systems require the provision of queries from nodes available in fixed networks. Hence, it is necessary to propose a data model that includes cloud storage, security, mobility and rules to provide effective cloud based services.

In this paper, we propose a new model for effective medical information retrieval from cloud database. Rest of this paper is organized as follows: Section 2 provides the literature survey. Section 3 discusses about the proposed algorithms in detail. Section 4 provides the results and discussion. Section 5 gives conclusion and future works.

II. LITERATURE SURVEY

There are many works have been done in this direction by various researchers in the past. Among them, a study on methods for disregarding heterogeneities in node availabilities which affects negatively the performance of heterogeneous cloud infrastructures was made by Lluis Pamies-Juarez et al (2011). The main advantages of their model include the proposal of an algorithm for measuring data availability in heterogeneous storage infrastructures, an optimization algorithm for finding the best way for assigning redundant blocks to the set of storage nodes and the proposal of a new mechanism to determine the minimum data

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redundancy that achieves a desired Quality of Service. An identity-based data storage scheme called selective-identity model was proposed by Jinguang Hana et al (2013).This scheme is suitable to the cloud computing scenario and it supports both intra-domain and inter-domain queries.

Sai-Qin Long et al (2014) proposed a multi-objective offline optimization approach for replication using a newly proposed algorithm. Their algorithm provides optimal solutions using mean and variance features. Ganapathy et al (2012 & 2013) developed new intelligent security mechanism for providing security to intellectual data on ad-hoc networks environment and also discuss about agent based feature extraction. Jingwei Li et al (2014) proposed a new fine-grained access control technique for searchable encrypted data. They have considered a hybrid architecture in which they used a private cloud as an access interface between user and the public cloud. A practical keyword search scheme has been proposed by them to support fine-grained access control over encrypted data for their architecture.

Muhammad Shiraz et al (2013) reviewed the features of the existing Distributed Application Processing Frameworks for Smart Mobile Devices in Mobile Cloud Computing domain. The main objective of their work is to highlight the issues and challenges present in the existing cloud based distributed frameworks for developing mobile applications. Attaur Rehman Khan et al (2014) developed new applications which support an effective execution platform using mobile cloud. Their mobile cloud execution platform provides an energy efficiency model for smart phone based applications.

An efficient authentication scheme for distributed and mobile cloud computing based services was proposed by Jia-Lun Tsai and Nai-Wei Lo (2015). Their scheme provides effective security and ease of use for mobile clients in order to access multiple services from multiple service providers using a single private key. Lihui Lei et al (2015) proposed a new mobile cloud database service solution for efficiently storing and managing mobile data on cloud databases for mobile applications. They also provide location dependent query processing features. However, security issues are not focused in their work. Ruhui Ma et al (2015) proposed a novel encrypted search system for effective searching in mobile cloud networks. The main advantage of their work is the reduction in time complexity and efficiency in searching.

In spite of the availability of all these existing works, the privacy preservation for different types of users and applications are not considered in the existing works. The proposed model is helpful to retrieve the data effectively from the cloud database.

III. PROPOSED WORK

In this work, location dependent query processing is performed using a set of intelligent agents namely, Sender Agent (SA), Receiver Agent (RA), Coordinator Agent (CA), Participant agents (PA_1, PA_2, …. PA_n) and Location Management Agent (LMA). When a query is issued by a client, the query is by the CA to the SA. The sender agent sends the query to all participating agents using the receiver agent. During query processing, location management is performed by LMA using the agents present at the home location and all the base stations.

A. Location Dependent Query Processing algorithm

Input : Location dependent query

Output : Tuples obtained by query execution at various sites of the computer network

Step 1: The CA issues the user query to the sender agent which makes a broadcast of the query who is within the specified range of distance from the home location of CA.

Step 2: The receiver agents receive the query at all sites

Step 3: At each site, the receiver agent receive the query.

Step 4: At each site, the receiver agent calls the location management agent and checks the distance.

Step 5: If (distance < Base station range) then check the cache at its location for information.

Step 6: If found send it to the coordinator agent.

Step 7: If not found in cache read information from database and send it to the CA.

Step 8: Upon receiving the responses from all the sites, the coordinator merges them by performing union operation.

Step 9: The CA provides the result to the user.

This LDQP algorithm has been developed to provide location based services in an efficient manner by making use of intelligent agents. Since location based queries raise new research challenges, this proposed work use this query processing algorithm that performs searching the cache memory first in order to improve the performance. Moreover, the searching is done by all participants simultaneously at different sites of the computer networks and hence the query processing performance is enhanced.

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B. Mobile Transaction Model

In this work, a new cluster based transaction model is proposed for handling mobile transactions. In this model, the cluster heads are used for communication and they act as the local coordinators for executing the transactions. The steps of the transaction processing algorithms are as follows:

C. Transaction Processing Algorithm

Step 1: The coordinator starts the transaction by issuing the begin transaction primitive, after starting a timer.
Step 2: The coordinator performs clustering using K-Means clustering algorithm (Ganapathy et al 2013).
Step 3: The coordinator initiates the cluster head election process.
Step 4: The coordinator asks for commit or rollback messages from all cluster heads.
Step 5: At each clusters, the cluster head asks the ready messages from the participants.
Step 6: If all participants from a cluster send ready message then the cluster head send a willing to commit message to the coordinator.
Step 7: If coordinator receives commit from all cluster heads, he performs a global commit.
Step 8: If any one of the cluster heads did not respond or sent a rollback message then the coordinator checks the mobility speed and current location of all nodes.
Step 9: If any node is in outlier then the coordinator gets a direct message on commit or rollback.
Step 10: If all nodes sent commit message including outlier nodes then the coordinator performs a global commit.
Step 11: If any one of the participants or cluster heads sent rollback message or did not respond up to the end of timer then the coordinator issues an abort message.
Step 12: All the participants performs a local abort when they receive an abort message from the coordinator.
Step 13: The coordinator closes the transactions by using end transaction primitive.

This algorithm is an extension to the two phase commit protocol using clustering and mobility management. Since the existing two phase commit protocol fails most frequently when applied to mobile transactions, the challenge is addressed in this work by proposing this cluster based transaction processing algorithm.

IV. RESULTS AND DISCUSSION

This section provides the result and discussion of the proposed information retrieval model. In addition to that, the description of dataset which are used for evaluating the proposed system is also given in this section. The proposed system has been implemented in Java programming language.

A. Medical Data Sets

We have used the standard medical data set (UCI Repository) (Murphy et al 1995) for training and testing. In addition, we have used hospital datasets for testing and also analyzed the tidies diseases such as cancer, diabetics and heart.

B. Experimental Results

The experiments have been conducted by using Figure 1 shows the query processing cost analysis for mobile database queries between the proposed work and the existing work by Vijayalakshmi et al (2009).

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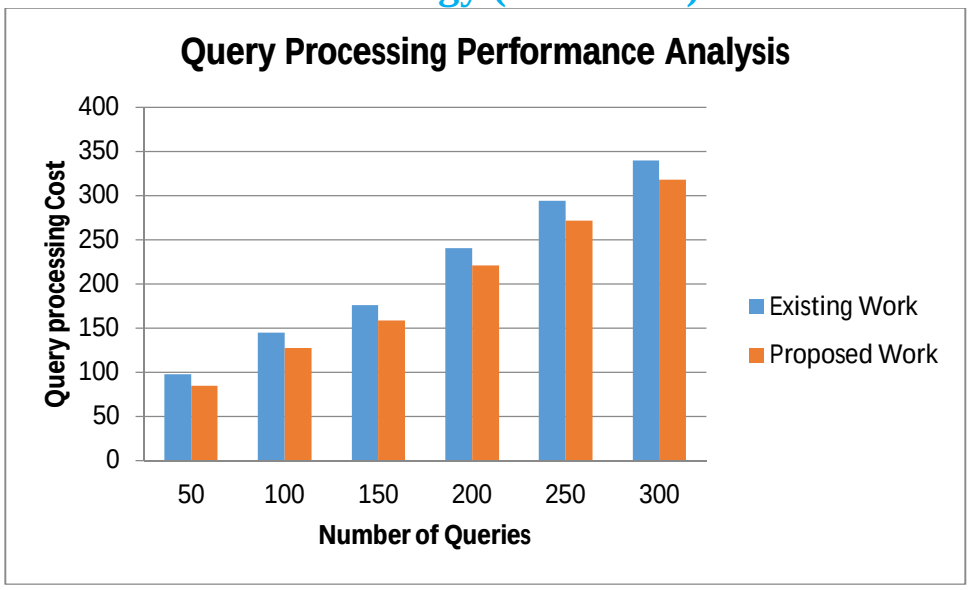

Figure 1 Query processing Performance Analysis

From figure 1, it can be observed that the cost of query processing is reduced in the proposed work than the existing work proposed by Vijalakshmi et al (2009). This is due to the fact that the proposed work uses a cluster based approach for communication. Moreover, in both approaches the costs of queries are measured using input / output cost, network cost and mobility cost. The experiments have been conducted with different mobility speeds and the average values are plotted in the graph.

Figure 2 shows the transaction performance in terms of transaction processing time between the proposed model and two phase commit protocol by Sekar Ganesh et al (2007). In this work, different number of transactions were executed on the proposed mobile cloud database systems and also using the existing mobile database system. In the existing work, the storage was limited because of the limited memory provided in the mobile devices. On the other hand, in the proposed work, additional memory and additional processors were added for transaction processing. However, the same transactions were executed in both scenarios and the results are used for comparison.

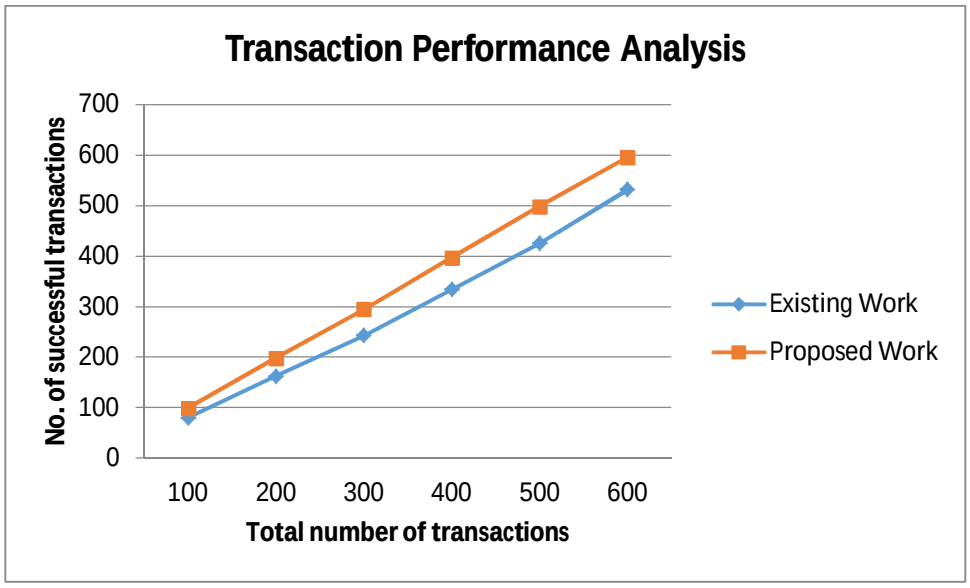

Figure 2 Transaction Performance Analysis

From figure 2, it is observed that the number of successful transactions is more in the proposed work than the existing work. Even though, many transactions fail in a mobile environment the failures are reduced in the proposed work using clustering and communication using clustering. In both a cases, a relaxed form of two phase commit protocol in which consistency within clusters were only considered. However, the proposed work performed better due to the use of mobile cloud networks rather than simple

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mobile communication for distributed processing.

V. CONCLUSION AND FUTURE WORKS

In this paper, an intelligent medical information retrieval model has been proposed and implemented for effective retrieval in mobile cloud environments. The proposed model consists of two algorithms called location dependent query processing algorithm and mobile transaction model. In addition, it uses rules for performing the effective information retrieval and recommendations. Future works could be the introduction of fuzzy rules for effective information retrieval and recommendation under uncertainty.

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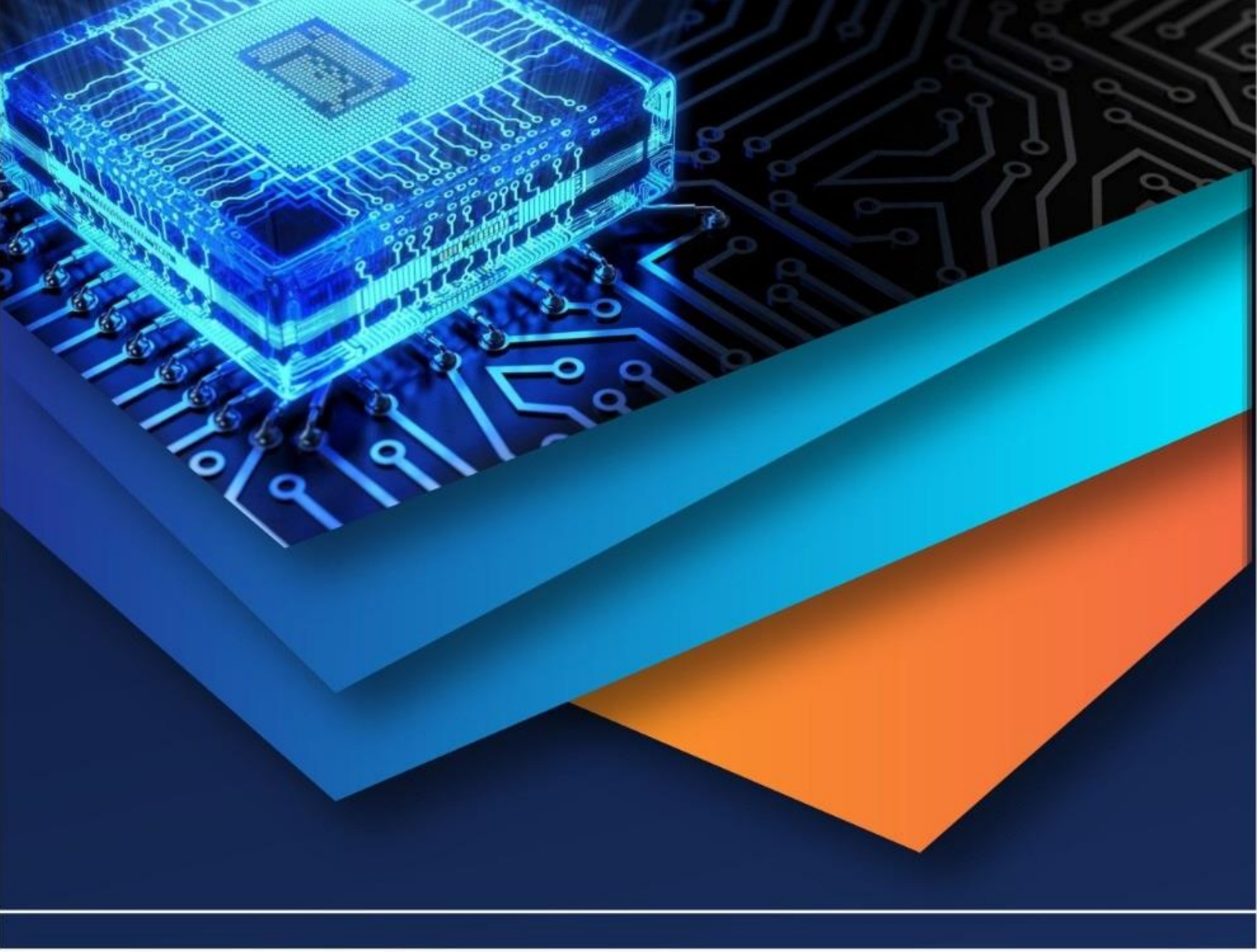

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