DATABASE DESIGN FOR REMOTE HEALTH MONITORING SYSTEM

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Abstract: *Remote health monitoring facility extends health services to people where immediate health facility is not available. This enables continuous health monitoring for critical diseased people from remote location. The typical system consists of health parameter sensing elements, communication infrastructure to communicate with a central monitoring location where medical facilities such as Decision supporting, scheduling of medical practitioners etc. are available. Electronic record maintenance is very important in remote health monitoring system. This paper aims at the design of the database for remote health monitoring system.*

Keywords: Database Design, network layers, security, data access.

I. INTRODUCTION

Now a day's every aspect of life is somehow how associated with Computing and communication b/w those computing elements. Information technology has revolutionized the lifestyle of human being due to advancements in the areas such as Telecom, Biotechnology, Defense, Health care etc.

Research in VLSI technology and Computing has enabled a lot of sophistication in Health Care sector by means of a variety of Surgical Instrumentation, Compact and portable monitoring equipment etc. Even technology expertise is existing, in most of the developing countries minimum health facilities is not reaching people living in Rural, Agency and Hill areas. Similarly in some cases the diseased person may not be immediately movable to the Health centre. In these scenarios Remote Health Management is a viable solution to extend the Health facilities.

This paper aims at the design of the database for remote health monitoring system. The data from the database is used by the artificial intelligence based supporting system to monitor the health of a patient without the necessity of any medical in charge. Based on this information, the intensity of patient's condition is observed and required treatment is prescribed. Based on this information healthcare professionals prioritize patients with high risks and provide best care at the right time. With the help of this database people are accessed to a fast and convenient care delivered at a consistently high standard. The complete history of a patient can be maintained and whenever he is hospitalized, his medical history is analyzed and required medication is prescribed.

The focus of this paper is on the following issues.

* A novel architectural design of the medical database which can store vast amounts of patient's information. This database must be integrated with other units like artificial intelligence and user interface to provide best possible care to the patient.

* A comparative study between characteristics of various databases and design a suitable architecture which suits the requirements of the medical database such as storing images which may be used to identify the disease and many more.

* Security of the data in this database is very essential as patients information is private and can be misused if data is not protected. The entire data is this database is not complaisant to everyone and several constraints are to be imposed on the data access.

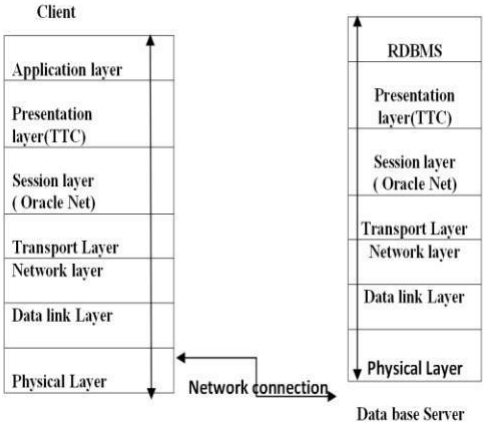

Fig 1:This is the ORACLE representation of OSI.

II. DESIGN

There are 4 tables required in the database of remote health monitoring system. A table which can store values like symptoms of a patient, images like MRI scan, X-Rays, medical practitioner details, specialist details is required. One table for storing the symptoms of patient, deciding the disease and suggesting the first aid and recommended medical practitioner or specialist based on intensity of the disease. Another table for insurance companies which contain the details of patients and cost of their medicine for claiming insurance. Another table for drug companies which contains patient's symptoms, disease and type of drugs used in their medication. Another table for patient relatives, technical staff of the hospital.

These tables are to be accessed by their specified users and the information in these tables should not be available for others. We are going for ORACLE 10G to satisfy the following specifications for remote health monitoring system.

1. Secured access to tables. Oracle provides security to tables by providing them with passwords and hence the access is secure.

2. The updation, retrieval of data must be easy. Oracle is very user friendly in creating tables, updating information and retrieval of data from the database.

There are 7 network layers for Oracle as in case of OSI model. But we are going for a four layer architecture which is suitable for a medical database for remote health monitoring system. There are four layers on both client side and server side.

Requests to handle database are passed to the OCI from client Application layer. The OCI defines server calls by doing SQL syntax parsing and validation, opening SQL cursors, variable binding into server memory, executing SQL statements, fetching of rows and closing cursors. OCI calls can pass messages to the server one at a time or in bundles of multiple messages. Bundles of multiple messages passed to the server minimizes network traffic by sending a procedure call, executing many commands on the server, and passing back the result.

The OPI is exactly the same as the client stack OCI except that the OPI functions by responding to messages sent by the OSI. The Oracle Server processes requests, executes SQL statements and passes results back to the OPI. The OPI will then format and return results to the client node.

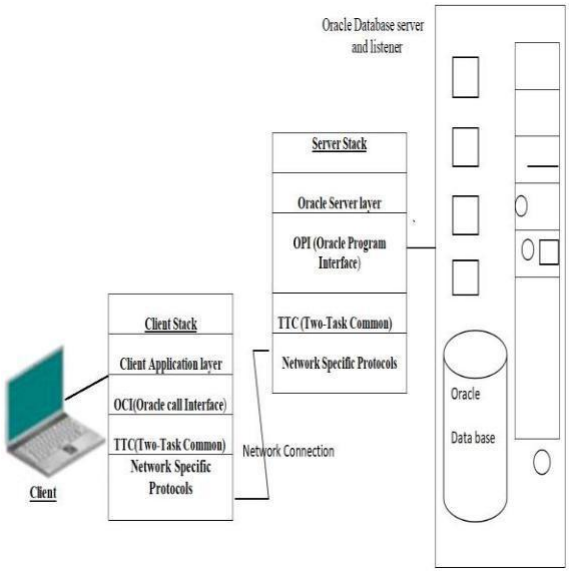

Fig 2: Four layer design for oracle database

We can represent the spatial data in a database by sampling at various points and making the area in to zones in which there is no variation. We use BLOB (Binary Large Objects) to deal with image storing in the database. The whole image need not be stored but we can store the path of the file where the image is stored and use it later whenever required. We use BFILES to access such data from a database. All these kind of features are feasible with ORACLE 10G.

III. ORGANIZATION OF DATA

Normalization of the tables in this database is also essential for speed access of data. Redundant information must be removed for better performance of the database. First, data in the tables must be made atomic. Next, there must be no functional dependency between key attributes and non-key attributes. For, medical database, patient's name is the key attribute and other's are non –key attributes.

Indexing in database is useful for speed access of data in the database. Indexing is very useful in the case of large databases where vast amounts of data is maintained and updated regularly. In SQL, all indexes that are defined against the tables are all maintained regardless their usage. This consumes CPU time and memory I/O space. Whereas in ORACLE, indexes which are not used can be deleted. This saves time and memory. Index usage checking at

specified time intervals is not preferred as data is updated based on need. So, an alternative is proposed for this.

Partitions on tables can be used for better indexing. Partitions can be maintained by numbering like P(0), P(1) and so on. Using partitions helps in easy access and the data not required will not be retrieved. In this application, we are going for B-Tree indexing. We can sort out the data from the insurance companies table based on cost of medication in ascending order and period of medication in descending order. We can also access on multiple columns at a time.

Hashing is an important phenomenon for optimizing databases. Hashing is a technique where data is searched based on a hash field. Hashing is performed based on a hash field. For this application we go for a hash field whose value is the output of the hash function
i.e. h(k)=2mod(k).

IV. E-R DIAGRAMS

Development of Entity-relationship diagrams is the basic step in creation of a database. For a patient table, Patient is the table name, name is its key attribute and symptoms and disease are its non-key attributes. An E-R diagram exists for each table in the database.

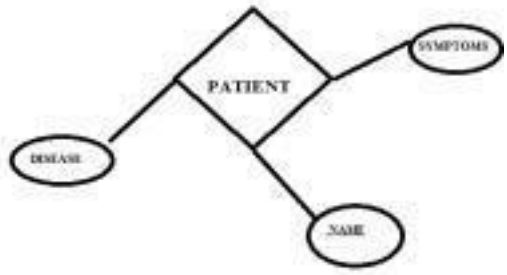

Fig 3: E-R diagram for patient table

V. SECURITY

The security for the database can be maintained by following these rules:

1. Granting only necessary privileges.
2. Revoking unnecessary privileges.
3. Restrict permission on run-time facilities.
4. Authentication of proper clients.
5. Restrict network access.
6. Restrict operating system access.

Apart from these, there must be no physical miscommunications in accessing of databases. Password encryption while connecting: Passwords are always automatically and transparently encrypted during network connections, using a modified DES (Data Encryption Standard), before sending them across the network.

VI. ARCHITECTURE

The data from various resources is maintained in the database and is used by artificial intelligence unit and user interface. The artificial intelligence unit checks the symptoms, decides the disease and prescribes the recommended medical practitioner or specialist based on intensity of the disease and the database is updated based on changes made in artificial intelligence unit. The user interface brings out the presentable look of the required information.

Fig 4: Security in database

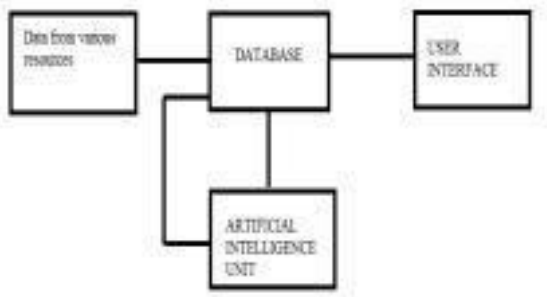

Fig 5: Architecture for remote health monitoring system

VII. CONCLUSION

Frequent monitoring of patients leads to innovative screening, i.e. detecting early signs of disease, preventing its progressions and complications. This database is designed with the assistance of doctors, patient's relatives and has a virtual collaborative environment where patient's data can be viewed in a secure environment. This data is used by doctors, medical practitioners, drug companies, insurance agents and many more to provide the finest care. A suitable architecture of the database is designed for better integration with other units which result in effective usage of data in the database. The database for this application is secure, easily accessible, informative, economical, user friendly and automatic. This database is very useful for remote places where epidemics are severe and medical facilities are scarce.

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