Modeling and Design of Data Cube for Electricity Bill Deposit System

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ABSTRACT
Due to evolution of object-oriented technology, many of the software industries are converting old structured base database into the object oriented database. It is observed from the literature that limited research work is available for the object-oriented database and a well-known modeling language i.e. Unified Modeling Language is not much applied in the field of the object-oriented database, therefore, present work deals with the modeling of a database of a real case study of the electricity bill deposit system of electricity supply to the different houses of various localities of a city. As the size of database grows then it is very difficult to find the desired record from the database and also to keep the record for future use, therefore, a database cube designing technique is used for storing the three important fields of a database and one can get the desired information from the data cube. Sample queries are also performed for validating the designed UML class diagram for electricity billing system.

Keywords
Object-Oriented Database, UML, Class Diagram, Sequence Diagram, Data Cube, Queries.

1. INTRODUCTION
Modeling is necessary for getting the solution of the complex problem in easy way. The present work is based upon the latest a object-oriented modeling language which a platform independent language called as Unified Modeling Language (UML). It contains various kinds of diagrams used for the pictorial representation of the complex research problems. This language is not much applied for the object-oriented database, therefore, present work is an attempt in this direction. Let us first describe important research work related to this field.

In the present work a data cube approach is used, therefore, let us first define the data cube. It is a technique that records database in the form of three dimensional cubes. As data is stored inside a cube; it is easily retrievable from the database according to the user's need. Booch[1] has described object oriented analysis and design with various kinds of applications along with various types of diagrams used for the stable software designs.Rumbaugh et al[2] described about Unified Modeling Language for the original developers of the UML. Martin [3] presented UML class diagrams which allow us to denote the static contents of and the relationships between classes. Li [4] presented UML sequence diagrams which are widely used as a behavioral modeling language for interactive systems for their concise and intuitive expression, especially for a few high security systems. Samuel [5] described Sequence diagrams which one of the most widely used UML models in the software industry. Although sequence diagrams are used for modeling the dynamic aspects of the system, they can also be used for model based testing. Existing work does not encompass certain important features of UML 2.0 sequence diagrams. Nakamura et al. [6] presented UML class diagrams representing the static structure of the relations between different concepts existing in a problem are widely used in model-based software development. which no effective measures of a class diagram's understandability yet exist. We have devised quantitative measures of a class diagram's understandability and evaluated their validity. Ali [7] has described we obtained strong correlations between the domain experts' subjective evaluations of the understandability of a class diagram and the measurements of our methods. These results indicate that our measures can effectively quantify the understandability of class diagrams. Chaurasia et al. [8] presented a mobile based electricity bill deposit system through UML with a real case study of electricity department. Harinarayan et al. [9] have presented the applications of greedy algorithms to materialize the cells of data cubes. Cabibbo et al. [10] described a logical approach for the multidimensional database. Lehner et al. [11] have proposed the various normal forms for multidimensional database with key concepts in On Line Analytical Processing (OLAP) which measures the facts and data cubes. Vanea et al. [12] described aggregated data which has the potential to offer great knowledge and can helpful for decision makers in their most important activities. Xie et al. [13] presented a novel technique to reduce the data cube size by dividing the cube into chunks and using this reduced data cube to provide answers to the direct queries. Han et al [14] described mining techniques for the complex data and algorithms. Chen [15] has described a new database structure model which organizes the multimedia data in a multi-dimensional data cube. Clustered data are stored in instance table in the data cube. A corresponding leading data's are stored in dimension table. When querying, a leading data is gained from dimension table firstly, followed by a k-nearest neighbor query from the corresponding category, and then the retrieval results are returned.

The present paper deals with the modeling of a real case study and design of data cube for the power corporation department of India where a large amount of bills are generated daily and it is very difficult to keep record for future use, therefore a technique of three dimensional data is presented for storing the three important fields inside the data cubes. Sample queries are also performed for validating the UML designs and the desired information from the data cubes. For modeling purpose, UML class and sequence diagrams are designed.

2. UML MODELING FOR BILLING SYSTEM

2.1 A UML Class Diagram

The creation of table T1 in object oriented database is the first step. T1 includes four fields namely Serial Number (SNo), Name, DueDate and Amount as represented in figure 1. A group of 100 data is stored in the Table T1. Data is stored in data cube using On Line Analytical Processing (OLAP) cube software. OlAP cube software commands the object-oriented data base in Table T1. A cube must contain at least two dimensions and one measure. This results in the creation of a data cube. Though date is stored in the form of cube, the output can only be seen in the form of graphs and tables. Data cube supports the storage of millions data. Each data stored in a sequence form. OLAP database has other name which is called as Multi-dimensional database (MDDB). OLAP technology has divided in two forms. First name is Relational OLAP (ROLAP) and second name is Multidimensional OLAP (MLOAP). The main work of MLOAP is to store data directly in n-dimensional array while ROLAP stored in the form of relational database.

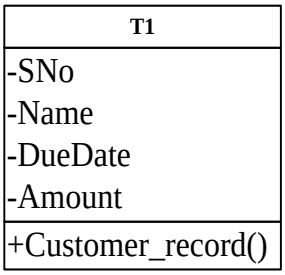

Fig 1: UML Class Definition of T1

The above class diagram shows the static behavior of system. Let us design the class diagram for billing system as shown in figure 2. The class diagram has four persistent classes Bill, Mobile, Elec_Office, Online Server and one transient class Customer. These classes are connected to each other using relationship. In this paper, Online Server sends the electric bill data on the user's mobile device. Customer is a class which has attributes like customer_id, customer_name, customer_street, customer_age, customer_city. Bill is a class of bill_no, bill_amount, person_id, deposit_date. Mobile is a class of mobile_comp, mobile_model, mobile_no, iemi_no. Elec_Office is a class of office_address, office_city, office_code and all personal record stores in electrical office. Online server sends the bill on user mobile device.

2.2 A UML Sequence Diagram

Sequence diagram is a part of UML. The work of sequence diagram is to send message to the target path. Sequence diagram finds the sender and receiver. Sender sends the message on target path then receiver shows the acknowledgement to sender. Sequence diagram shows two axis horizontal and vertical axes. Vertical line shows the lifeline and horizontal line shows the message communication.

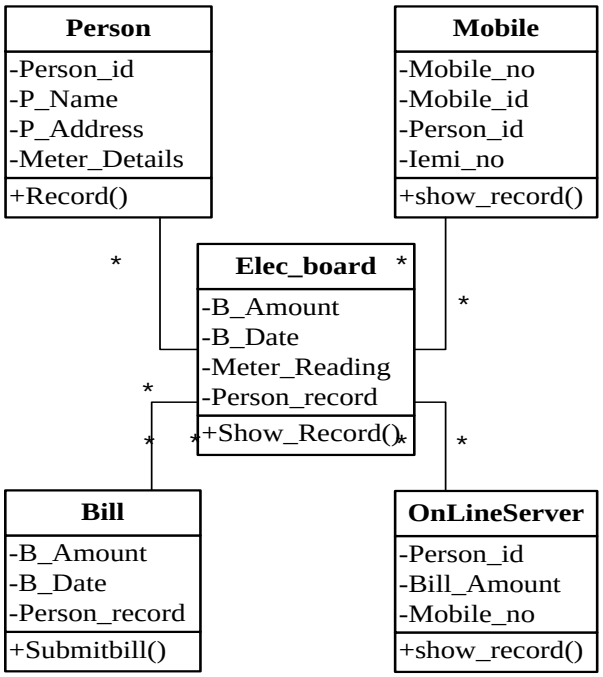

Fig 2: Class Diagram of Electrical Bill Deposit System

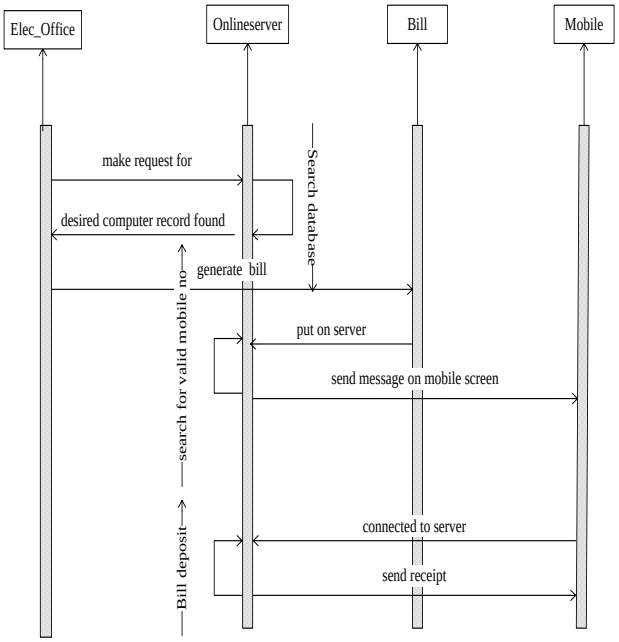

Fig 3: Sequence Diagram Electrical Bill Deposit System

Sequence diagram shows four objects Elec_office, Online server, Bill and Mobile. The diagram shows that computer sends the request to server and server passes the message on particular mobile number. Sequence diagram represents graphical symbol. In this diagram, box and attached arrow called objective lifeline. Forward arrow called the message and reverse arrow called the message return. Elec_office stores the million data in the electricity bill record. In this sequence diagram, Elec_office makes a request for desired computer and search the record inside the database. Database founds the record after generation of bill, thereafter, Bill sends on the Mobile device of customer after searching the valid

mobile number. found the valid mobile no connected to server. After connect to server bill show in mobile device

3. DESIGN OF OLAP CUBE

Online Analytical Processing (OLAP) cubes are specially designed for storing the database. OLAP cube stores million data in the form of multidimensional. OLAP cube are of two categories i.e. dimension and measure. The main advantage of designing of cube is that data is easily retrieved in comparison of other database. Data cube supports the division of data into three axes i.e. X, Y and Z. It also supports the decision support system. Though data is stored in the form of cube, the output can only be seen in the form of graphs and tables. Each data is stored in a sequence form. The other name of OLAP database is Multi-Dimensional database (MDDB). OLAP technology has divided in two forms. First name is Relational OLAP (ROLAP) and second name is Multidimensional OLAP (MLOAP). The main work of MLOAP is to store data directly inside n-dimensional array. The main work of ROLAP is to store the Relational database. OLAP cube is generally used for business purpose and for calculation of the company profit and loss for financial year. The general representation of OLAP cube is shown below in figure 4.

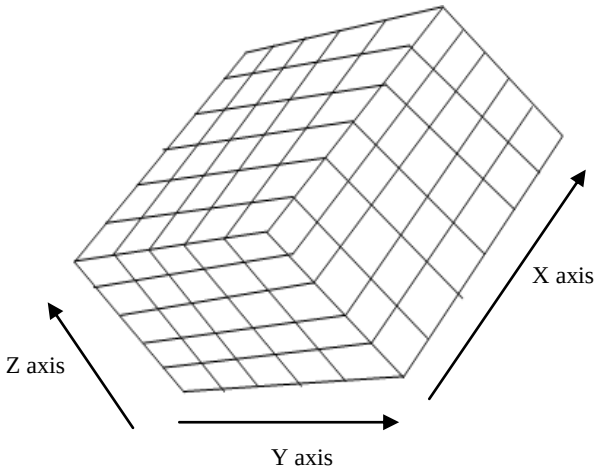

Fig 4: General Representation of OLAP Data Cube

On the basis of above, OLAP cube is created by taking three axes as Mobile_no, Person-id and Bill according to X, Y and Z axes as shown in figure 5. A sample data of 100 records of electricity bill is generated. OLAP cube software calls the table T1 and creates the data cube D1. The sample data is stored inside the data cube D1. Queries are performed on data cube D1 and results are shown below. Object-oriented database is much better than the relational database. The reason is that the object-oriented database stabilizes the relation between objects but not in the table. Data cube D1 supports decision support system. The data in data cube D1 can be easily retrieved. The different queries are given below:

Sample Query-I

This database query is performed in oracle 10G version. This table stores the person record. Person record table found the Person_id(P_id), Person_name(P_name) and Person_address (P_address).

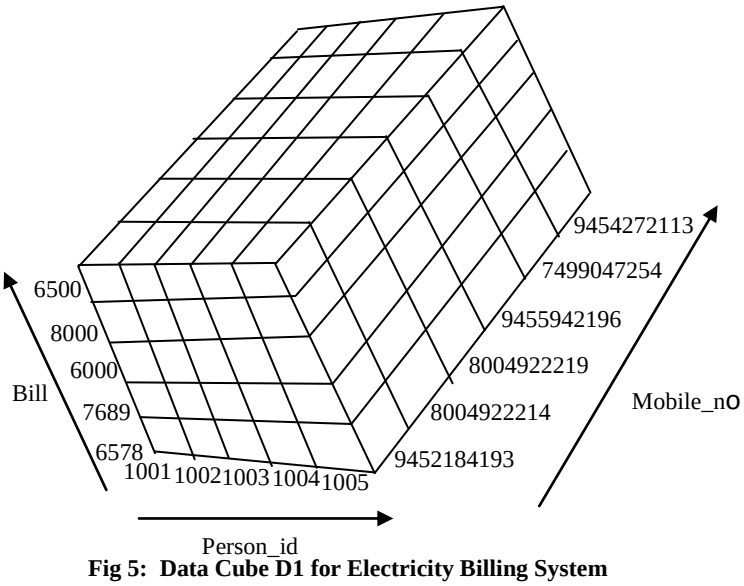

Fig 5: Data Cube D1 for Electricity Billing System

SQL>create table person (p_id number(10),p_name varchar2(15),p_address varchar2(15));

SQL>select * from person;

This table stores the person record as shown below:

P_id	P_name	P_address
1001	Singh	Lucknow
1002	Rama	Lucknow
1003	Shivendre	Lucknow
1004	Arun	Lucknow
1005	Praveen	Lucknow
1006	Sudhir	Lucknow
1007	Sanjeev	Lucknow
1008	Pranay	Lucknow

Sample Query-II

In this database query, bill_record table keeps the bill_id (b_id) and person_id (p_id) record as defined below:

SQL>create table bill_rec (b_amount number(10),b_id number(10),p_id number(10));

SQL> select * from bill_rec;

This table stores the bill_rec data as shown below:

B_Amount	B_id	P_id
6578	111	1001
6000	112	1002
7689	113	1003
8000	114	1004
6500	115	1005
7800	116	1006
8000	117	1007
8210	118	1008

Sample Query-III

Mobile database table stores the customer mobile_no and person_id(p_id). The query is given below:

SQL>create table mobile (mobile_no number (15), p_id number (10), iemi_no number (10));

Table created.

SQL> select * from mobile_rec;

This table stores the mobile_rec as shown below:

Mobile_no	P_id
9452184193	1001
8004922214	1002
8004922219	1003
9455942196	1004
9695328477	1005
7499047254	1006
9454272113	1007
930556624	1008

Sample Query-IV

This database table sends the electrical bill on the user's mobile no.

SQL>select person.p_id,mobile_rec.mobile_no,bill_rec.b_amount from person,mobile_rec,bill_rec where person. P_id=mobile_rec. P_id and person. P_id=bill_rec. P_id ;

This table sends the amount of bill on user's mobile device as shown below:

P_id	Mobile_no	B_amount
1001	9452184193	6578
1002	8004922214	6000
1003	8004922219	7689
1004	9455942196	8000
1005	7499047254	6500
1006	9454272113	7800
1007	9454272113	8000
1008	9305566124	8210

4. CONCLUDING REMARKS

In the present work, object-oriented database is created which is better than the relational database which was used in the structured approach earlier. A UML class model is designed for the execution of several sample queries and observed that model works well for designed database which was also stored inside the data cubes for the large database of electrical billing system. The desired information is shown on the mobile device so that users could deposit the bill of electricity as per specified last date of bill deposit. When the database is large, then the present work can be extended for the designing of association rules for the removal of unwanted database.

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