

Data Cube Representation of Patient Registration System through UML

Dr. Vipin Saxena[†], Gufran Ahmad Ansari[†] and Krishna Kumar^{††}

[†]Department of Computer Science, Babasaheb Bhimrao Ambedkar University, (A Central University), Vidya Vihar, Raebareli Road, Lucknow, 226 025 INDIA

^{††}Department of Computer Applications, IFTM, Lodhipur Rajput, Delhi Road, Moradabad-244001, U.P. INDIA

Summary

In the present paper, a Unified Modeling Language (UML) model is proposed for the Patient Registration System (PRS). The three dimensional Data Cubes are also designed for faster searching & sorting of Patient Registration database. The proposed model is also validated by performing several queries on the Patient database. UML Activity, Class & Sequence diagram are designed.

Key words

UML, Activity Diagram, Class Diagram, Sequence Diagram, Data Cube.

1. Introduction

The Unified Modeling Language (UML) is a well known recognized, powerful and leading diagrammatic modeling language which is used to model the software research problems [1]. UML is a collection of best engineering practices that have successfully proven in the modeling for a software design of complex systems. Modeling is very helpful to understand the process of the input and output of the system [2]. Unified Modeling Language is not a technique of designing system, but the (mainly graphical) notations that process to represent the designs [3]. Now days a number of tools are available to model of a domain based system and then implemented into the active data based management system. The implementation of model is defined in [4]. UML is very popular for analysis of the research problems and easily compatible to the programming language [5]. By the use of UML, several database systems are proposed by researchers in which specific attributes are taken according to the values of interest. The attributes are selected as dimensions or functional attributes. The Optimization queries on the various databases are available in [6-7]. The queries are also performed on data cube to fetch the data from data cube and take the decision according to the need and also use the nested query applied on the data cube [8]. The design of data cubes through various cases of the database systems are

explained in [9]. Data validation is the beginning state to get the quality of data. Getting the quality data it is important to use certain rules & these rules are well defined in [11]. Recently, Saxena & Ansari [12] proposed a well secure UML model for domain based system. In this paper a domain of the credit card is considered.

In the present paper, a validated UML model is proposed for the Patient Registration System (PRS) & this model is suitable for solving day to day problems of patients. A real case study of *Sanjay Gandhi Post Graduate Institute of Medical Sciences (SGPGIMS), India* is considered alongwith the huge amount of real database of Patients. Data Cubes are also designed for the Patient & validation is performed through secure SQL queries. The UML activity, class and sequence diagrams are proposed for the PRS.

2. UML Model for PRS

The Modeling of software is an essential part for optimizing the queries applied on domain based system. The designed of the software should be very clear, efficient and performance oriented, therefore a UML design is proposed for a complete PRS system. The UML activity, class and sequence diagram are described below:

(A) Activity Diagram

The activities of PRS system is represented by the UML activity diagram which is given below in Fig.1.

Fig.1 shows the complete Patient Registration System activities for the outdoor patients of the hospital. In the activity diagram the patient arrives for the registrations & the people sitting on the OPD chair first checks whether the patient is referred by a doctor or not and also check that department is available for patient treatment if patient fulfill all these conditions, then patient has right to fill the registration form & to pay registration amount otherwise not. An identity card is issued to the patient & his personnel registration file is created and this file is forwarded to the Master of Social Work (MSW) section. This section will screen the file and send to the concerned doctor available in the department. This report goes to

patient file after seeing the patient report file, if the doctor recommends for admission then the patient will be admitted through MSW after depositing the admission fees for the treatment. Now a ward is allotted to the patient for further treatment. But if doctor is not recommending for the admission then doctor will give prescription to the patient & patient will follow doctor's prescription. After successful result in both the cases, the activity diagram is terminated.

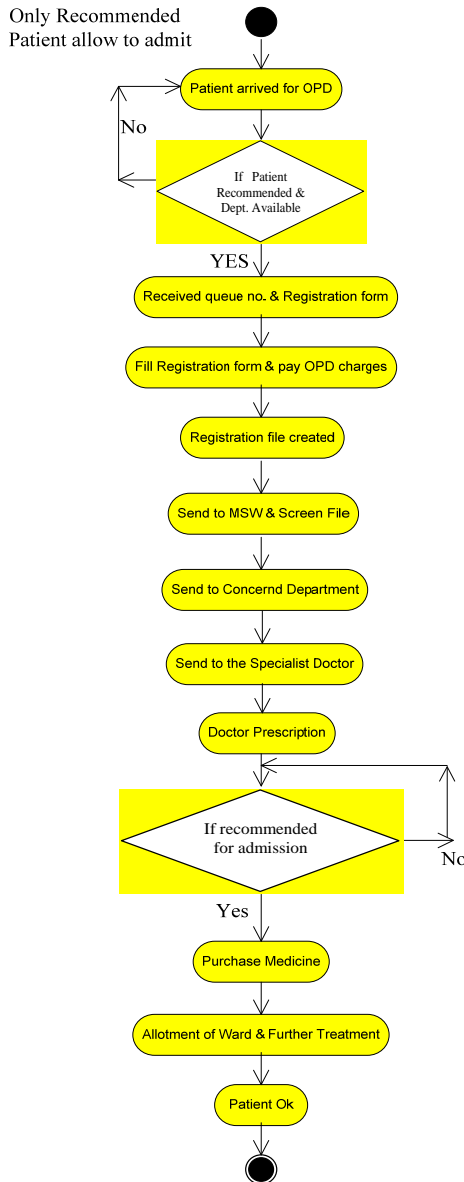


Fig.1 UML Activity Diagram for PRS

Fig.1 shows the complete Patient Registration System activities for the outdoor patients of the hospital. In the activity diagram the patient arrives for the registrations & the people sitting on the OPD chair first checks whether the patient is referred by a doctor or not and also check that department is available for patient treatment if patient fulfill all these conditions, then patient has right to fill the registration form & to pay registration amount otherwise not. An identity card is issued to the patient & his personnel registration file is created and this file is forwarded to the Master of Social Work (MSW) section. This section will screen the file and send to the concerned doctor available in the department. This report goes to patient file after seeing the patient report file, if the doctor recommends for admission then the patient will be admitted through MSW after depositing the admission fees for the treatment. Now a ward is allotted to the patient for further treatment. But if doctor is not recommending for the admission then doctor will give prescription to the patient & patient will follow doctor's prescription. After successful result in both the cases, the activity diagram is terminated.

(B) Class Diagram

PRS system is modeled with the help of UML class concepts & shown below in Fig.2. The PRS

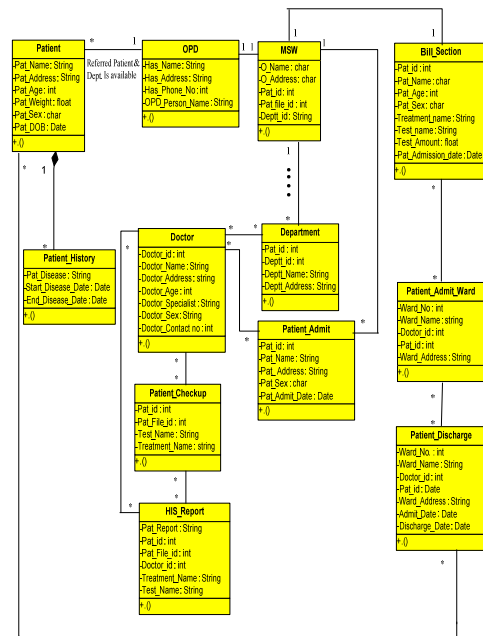


Fig.2 UML Class Diagram for PRS

model contains twelve major classes these major classes along with attributes. The Patient class has a single association with the OPD (Out Dour Patient) class and the OPD has multiple association with the Patient class and single association with Master of Social Work (MSW) class. MSW class has also a single association with the Patient_Admit class and also has a multiple association with Department and Bill_Section. The Department class has a multiple association with the Doctor class and single association with MSW class. The Doctor class, Patient_Checkup and Hospital Information System (HIS) HIS_Report class have multiple association with each other. Bill_Section, Patient_Admit_Ward and Patient_Discharge classes have also multiple association with each other and Patient_History has a multiple association with Patient class. According to the model the referred Patients may arrive for the registration & treatment of their diseases. Only the recommended patient can get the registration if the department is available. If the patient is recommended and department is available then get the form for registration and after filling the registration form patient get the registration card alongwith Patient identification number and Patient file is forwarded for the screening for diseases. This screening is done by the MSW section, after screening the file patient meets the concern doctor and if doctor recommended for admission then patient will pay the admission charges. After paying the admission charges treatment patient will move to the ward and admit. The above diagram shows the attributes & their relationship along the attributes in the form of class diagram.

(C) Sequence Diagram

The sequence diagram shows the sequences of movement of the Patient from one object to another object. The sequence diagram is shown below in Fig.3. In the diagram, life line for the corresponding object is shown & the five major objects are selected & these are Patient, OPD, MSW, Doctor & Bill_Section. The communication of the information between two objects represented by an arrow & message on that arrow; the vertical lines show the life of the objects.

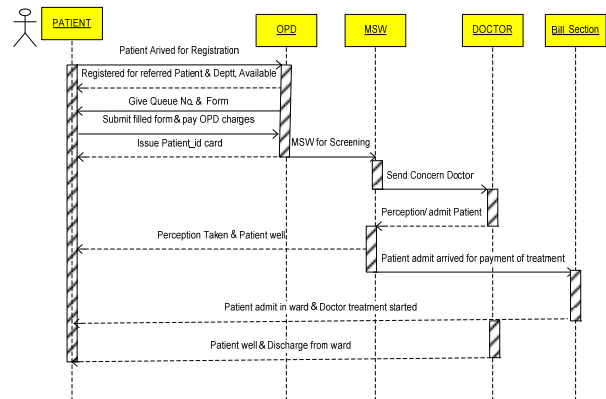


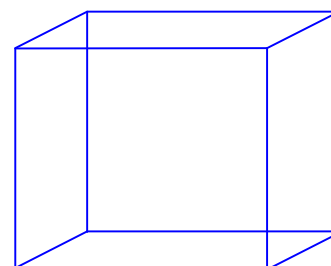
Fig.3 UML Sequence Diagram for PRS

3. Data Cube Representation for PRS

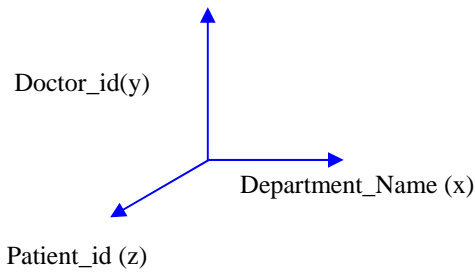
Let us consider each Patient is examined & evaluated to meet the following two conditions for the registration, OPD treatment and also for the admission in the hospital. The conditions are

- (i) Patient should be referred by any outside doctor for registration in the hospital.
- (ii) Consulting department should be available in the hospital.

The UML class model has implemented through the design of Data Cube for the three dimensional representation of Data Cube of PRS model as shown in Fig. 4. The three major attributes are considered i.e. Department (x), Doctor_id(y) & Patient_id(z). A 3D representation of Cube along with attributes is shown below in Fig. 4 (a) & (b).



(a) A 3D Cube



(b) 3-D Cube with Attributes

Fig. 4 (a) & (b) A Three Dimensional Cube Representation

Let us consider the following sample domain as per the 3D cube representation for the PRS system these values may go upto the N record. The sample domain is shown below in Table 1.

Table 1: Sample Domain of Patient Registration System

Department_Name(x)	Doctor_id(y)	Patient_id(z)
Endocrinology	1111	1001
Genetics	2115	2002
Cardiology	3112	3003
Nephrology	4111	4004
Urology	5113	5005
Radiotherapy	6114	6006
Gastro medicine	7111	7007
Endocrinology	1112	1003
Genetics	2112	2004
Nephrology	4115	4005
Urology	5118	5007
Radiotherapy	6119	6008
Gastro medicine	7114	7009

The data bank of Doctor(Y) and Patient (Z) arranged in anomalies table shown at Table 1 & this table can be contented for the N patients.

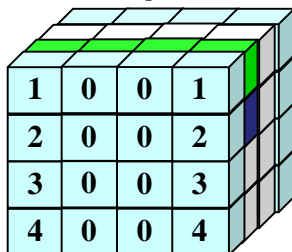


Fig.5.A Front View of Sample Data Cube

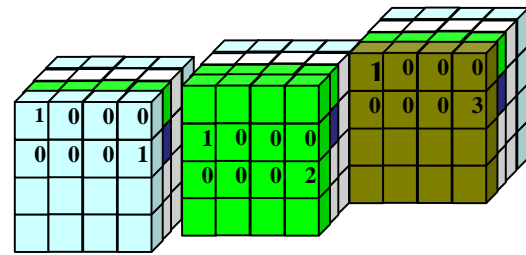


Fig.6.Entire View of Sample Data Cube

The Data Cube formed from the data bank is a 3-dimensional representation, which each cell (x, y, z) of the cube representing a combination of attributes as shown in Table 1. A sample data cube for the front view of data cube attribute is shown in Fig. 5. The content of the each cell is the count of the number of times that specific values come collectively in the database. Cells that show blank basically they have zero value. The cube can be used to retrieve information from the databank of patient registered in the hospital & one can also search data from databank. The main aim of this design is to retrieve the decision support information from the data cube in a very easiest & faster way. Several queries have performed on the given domain of data cube to retrieve necessary information. The entire view of data cube of sample data is shown below in Fig. 6.

Query 1:

```
SELECT      Department_Name, Patient_id,
FROM        Table Name
CUBE BY     Department_Name, Patient_id,
HAVING      Patient_id='2002' WHERE
            Department_Name= "Genetics"
```

The output of the above query is shows the record having the Patient_id = '2002' and the department is Genetics.

Query 2:

```
SELECT      Department_Name, Doctor_id,
            Patient_id,
FROM        Table Name
CUBE BY     Department_Name, Doctor_id,
            Patient_id,
HAVING      Doctor_id='Urology 3003'
```

The output of the above query is shows the record having the Patient_id "3003".

Query 3:

```

SELECT      Department_Name, Doctor_id,
            Patient_id,
FROM        Table Name
CUBE BY    Deparement_Name, Doctor_id,
            Patient_id,
HAVING     Doctor_id='5113' WHERE
            Department_Name= "Urology"

```

The output of the above query is shows the record having the Doctor_id "5113" and department Urology.

4. Concluding Remarks

From the above proposed PRS model, it is concluded that UML modeling is a very efficient modeling language to represent the software domain problems visually. The proposed PRS model through UML is an efficient model & on the basis of this design data cubes are designed for faster & secure search of the patient records. One can perform several queries within the fraction of time. In the above paper, only data mining concepts are used through UML, however this work can further be extended in the form of text mining for searching the address record of patients/doctors, etc.

Acknowledgement

Authors are grateful to Prof. B. Hanumaiah, Vice-Chancellor, B.B. Ambedkar University (A Central University) Lucknow for providing the excellent facility in the computing lab. Thanks are also due to University Grant Commission, India for financial support to the University.

References

- [1] Kovacevic, S. UML and User Interface Design, in UML'98. 1998. Mulhouse – France, Year.
- [2] Lieberherr, K., Holland, I., and Rie, Al, 1998 "Object-oriented programming: An objective sense of style", Proc. OOPSLA'88 as ACM SIGPLAN 23, 11, pp.323–334.
- [3] Craig Larman: "Applying UML and Pattern". Prentice Hall, 1998.
- [4] H-E. Eriksson, M. Penker. Business Modelling with UML: Business Patterns at Work. J. Willy & Sons, ISBN 0-471-29551-5, 2000.
- [5] W. Shen, K. Compton, J. K. Huggins. A Toolset for Supporting UML Static and Dynamic Model Checking. In proceeding of the 26th International Computer Software and Applications Conference (COMPSAC 2002), Proceeding Software Life: Development and Redevelopment, Oxford, England, IEEE Computer Society, pp 147-152, 2002.
- [6] Kim W. "On Optimizing a SQL-like Nested Query" ACM TODS, Sep 1982.
- [7] Ganski, R, Wong H.K.T., "Optimization of Nested SQL Queries Revisited" Proc. of SIGMOD Conf., 1987.
- [8] Dayal, U., "Of Nests and Trees: A Unified Approach to Processing Queries that Contain Nested Subqueries, Aggregates and Quantifiers" *Proc. VLDB Conf.*, 1987.
- [9] Agarwal S., R. Agrawal, P. Deshpande, On the Computation of Multidimensional Aggregates, Proceedings of the 22nd International Conference on Very Large Databases, 506-521, Mumbai (Bombay), 1996.
- [10] Molina, H., J. Ullman, J. Windom, Database Systems: The Complete Book, Prentice Hall, 2002, 1119p.
- [11] O. Vasilecas and E. Lebedys "Application of business rules for data validation" Journal of Information Technology and Control Vol.36, No.3, pp.273-277, 2007.
- [12] V. Saxena and G. A. Ansari "UML Modeling & Protection of Domain Based System", International Journal of Computer Science and Network Security (IJCSNS), Vol. 8, No. 7, pp.338-344, July 2008.



Dr. Vipin Saxena: He is a Reader and Department of Computer Science, Babasaheb Bhimrao Ambedkar University, Lucknow, India. He got his M.Phil. Degree in Computer Application in 1991 & Ph.D. Degree work on Scientific Computing from University of Roorkee (renamed as Indian Institute of Technology, India) in

1997. He has more than 12 years teaching experience and 16 years research experience in the field of Scientific Computing & Software Engineering. Currently he is proposing software designs by the use of Unified Modeling Language for the various research problems related to the Software Domains & Advanced Computer Architecture. He has published more than 55 International and National publications.



Mr. Gufran Ahmad Ansari is a research student in the Department of Computer Science, Babasaheb Bhimrao Ambedkar University, Lucknow, India. He has got his Master Degree in Computer Applications in 1997 from Dr. B.R. Ambedkar University, Agra, U.P., India in 2002. Currently he is actively engaged in the research work on domain based of real-time system modeling through the

Unified Modeling Language (UML). He has produced several outstanding publications on various research problems related to the domain based UML modeling & Security.



Mr. Krishna Kumar is a Assistant Professor in Department of Computer Applications, I.F.T.M. Moradabad, India. He has got his Master Degree in Computer Applications in 1999 from Madan Mohan Malaviya Engg. College, Gorakhpur, University of Gorakhpur, India. Currently he is engaged in the research work Web Technology and Software Engineering. He has produced

several outstanding publications on various research problems related to web technology.