

OBJECT-ORIENTED AND RELATIONAL APPROACHES IN DATABASE MANAGEMENT SYSTEMS (DBMSS): DESIGN, IMPLEMENTATION AND INDUSTRIAL MARKETS

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Abstract—Design of databases began as an art and has been converted through the years to a methodology that basically makes database applications easier to use (Teorey ,1990). Consequently, the Database Management Systems (DBMSs) is now one of the essential subjects in computer science. To end up with a strong database system, the designers should choose a powerful approach in order to design their database. It is clear that Object Oriented approach is commonly preferred by the database programmers and designers due to its useful principles that find the solutions of the logical and technical problems generated by earlier approaches. Conversely, several researchers state that Object Oriented approach has its individual issues in database designing and implementation. The aim of this research is to investigate the usage of Object-Oriented approach in physical and logical database design. This research will be divided into five parts. First, I will cover the design background of the trendiest database approaches, Object Oriented and Relational approaches. Then, I will discuss rising opinions about choosing one approach over the other. Later on, I will introduce the industrial trends in database markets. After that, I will explore the future of DBMSs. Finally, I will conclude my research with an effective conclusion.
Keywords—Object-Oriented , Rational , database , management database ,design , implement , Rational-object, OROCAL.

I. INTRODUCTION

Between 1960 and 1969, electronic files were used by most of the people to save their important data on any computer. Then and after few years, database technologies have replaced the file systems. Databases' design began as a simple art and has been converted by many developers to a methodology that basically makes database applications easier to use (Teorey ,1990). Consequently, Database Management Systems (DBMSs) is now one of the essential subjects in computer science. Teorey (1990) defines DBMS as a system that manages and controls all the data in a database. To build a strong database system, the designers should choose a powerful approach in order to design their database. It is an evident that Object Oriented approach is commonly preferred by the database programmers and designers due to its practical and useful concepts that find the solutions of the logical and technical problems caused by earlier approaches. Conversely, number of researchers state that Object Oriented approach has its individual issues in database designing and implementation.

II. BACKGROUND

A. Object-Oriented Approach

It is believed that database designers mostly prefer to use Object-Oriented approach while designing a database. Essentially, Object Oriented databases are identified by classes where the methods and the values are saved. General behaviors and properties are described by classes (Blaha&Premerlani, 1998). AlRashdi (2011) indicates that the values are the properties or the data associated with the class whereas the methods are described as pieces of code that apply functions or the behaviors within the class. On the other hand, the object is a concept that inherits the

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meaning of the class as instance. In the Object-Oriented databases, each instance is identified by the object identifier which is a unique attribute associated with the object.

The graphic Object-Oriented databases diagram includes classes linked by different types of relationships as shown in figure 1 where Ahmed has a medical file and a number of appointments and every class has a unique attribute (Jones & Monk, 1997).

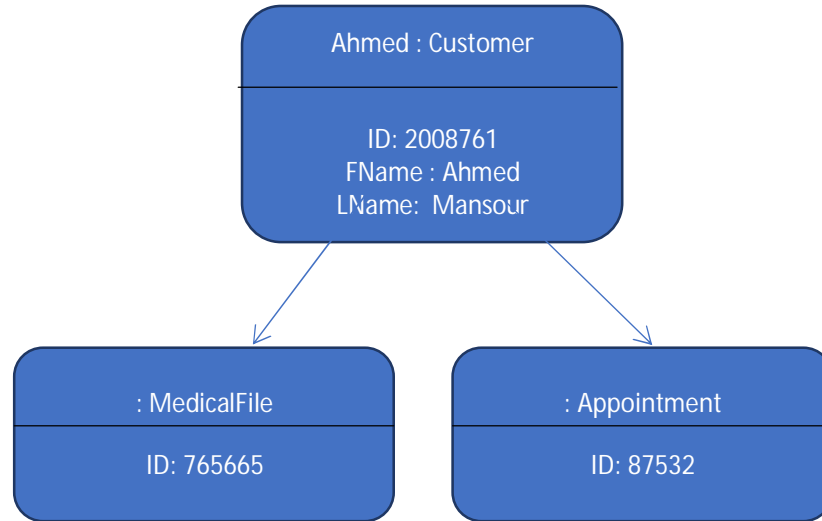


Figure 1. Example of Object-Oriented data model

In addition, Object-Oriented languages like Java and C++ are mostly used to implement the Object-Oriented databases (Blaha and Premerlani 1998). Additionally, the Object-Oriented Database Management System (DBMS) is the system that improves the functionality of the classes by managing the data within the Object Oriented databases.

B. Rational Approach

On the other hand, Relational databases are clarified by tables where the data is kept and saved (Jones & Monk, 1997). Because of its mathematical basic, Relational database systems refer to the relationships between the tables (Fong, 1997). Jones and Monk (1997) state that Relational databases include various instructions which express the database components. As an example, every record in a table within the database should be identified by a unique value, primary key or candidate key, to recognize the record. Moreover and according to AlRashdi (2011), foreign keys which are related to primary keys logical express the relationships between the tables in the logical design while Joins create them in the physical design as shown in figure 2 where Ahmed has a medical file and a number of appointments and every table has a forging attribute that links it to the other tables.

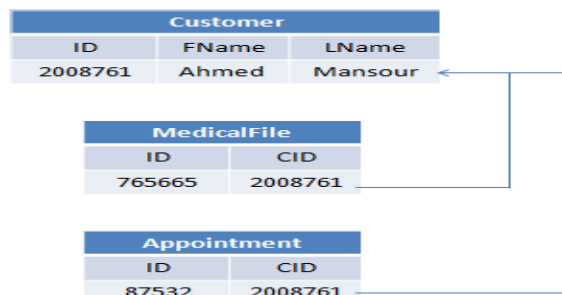


Figure 2. Example of Rational data model

Moreover, Structured Query Language (SQL) standard has a range of good tools like data control, data manipulation and data control that help the users in designing databases (Behm , Dittrich&Geppert, 1997).As a result, Relational databases are widely implemented by a specific language, SQL. Furthermore, Blaha and Premerlani (1998) state that in order to enhance the database functionality, Relational Database Management Systems (RDMSs) play a basic role in managing linked tables. It is obvious that the RDMSs place levels of user privileges which vary from one user to another to control the accessibility of the database.

III. DISCUSSION

A. *Logical Design of Databases*

It is commonly known that database's designers are widely use Object Oriented approach to logically design a database because of its strong properties and features. According to Behm, Dittrich and Geppert (1997), concepts of Object-Oriented approach are very helpful where the relationships can be generated by aggregation and inheritance like complex and generalization/specialization relationships. Accordingly, user-defined data types are supported by object-oriented model. Therefore, the user gets the opportunity to create a built-in data type, dynamic data type, from the existing data types inside any database. Because of its properties, Fong (1997) stat that in cases of saving data and assessing the pre-implemented database, Object Oriented approach is more suitable than other approaches. In addition, applications designed by this approach has a high level of security due to its hidden properties and methods which are built to be unseen by the user (Fong, 1997).

In contrast with Object Oriented databases, Thalheim (2000) indicates that Relational model is more comprehensible and clearer than Object Oriented model especially that the first one is based on mathematical principles. He believes that Relational approach is very understandable in designing a database because it depends on the relations within the database and between the tables. Consequently, Relational approach is usually used in the databases' logical design by the designers with limited knowledge in database technology. In addition, Thalheim (2000) claims that there is no serious problem that cannot be solved in the Relational database's logical design. He thinks that an extended new model of the Relational approach will be the new dominator in database's design in the following few years.

B. *Physical Design of Databases*

Generally, it is believed that Object Oriented principles are very useful in databases' physical design. There is no doubts that the essential programming code to design a Relational database is more than the essential programming code to design an Object Oriented database (Smith &Zdonik, 1987). Hence, the programmers use Object Oriented approach are more likely to save cost, memory space, effort and mainly time. Moreover, illegal data can be added by the user in Relational databases without getting rejected from the RDBMSs while in Object Oriented database it is not acceptable to enter such data. Therefore, it is evident that Object Oriented approach is very powerful in discovering the programming bugs. In addition, it is obvious that in Object Oriented databases the user can reuse the code by modifying the class's methods and properties without replacing the whole database (Smith &Zdonik, 1987).

However, Relational databases are executed by SQL. SQL is an incredible database language where the user inserts, insert, deletes, creates and modifies records and tables from/in any database. In addition, SQL increases the functionality of the database by providing numerous remarkable tools to the designers to such as web development tools and administrative tools (Leavitt, 2000). Furthermore, Bloom and Zdonik (1987) indicate that Relational approach has an independent powerful database language, SQL, where Object Oriented approach has no specific database programming language. As a result, database's programmers can implement a database without being worried about any programming bugs may be generated by the main code.

C. *Industrial Trends in Database Markets*

The industrial trends in the database markets over the recent years show a great increase in the sales of the software applications that applied the principles of the Relational approach. Undoubtedly, the Relational database management systems such as Microsoft SQL Server, MySQL and ORACLE have become leaders in the database

markets even with the existence of NoSQL raising sales with the revolution of Big Data in data science (AlRashdi, 2011). NoSQL is a non-Rational database management system that dramatically spread after the remarkable increase of unstructured data in application industry. Currently, 40% paid database markets have been dominated by OROCLE, a Rational database management system, with a cost of more than \$400 billion. In 2016, Rational database management systems lead the global database markets by holding the first three positions as shown in figure 3(Asay, 2016).

303 systems in ranking, April 2016

Rank			DBMS	Database Model	Score		
Apr 2016	Mar 2016	Apr 2015			Apr 2016	Mar 2016	Apr 2015
1.	1.	1.	Oracle	Relational DBMS	1467.53	-4.48	+21.40
2.	2.	2.	MySQL	Relational DBMS	1370.11	+22.39	+85.53
3.	3.	3.	Microsoft SQL Server	Relational DBMS	1135.05	-1.45	-14.07
4.	4.	4.	MongoDB	Document store	312.44	+7.11	+33.85
5.	5.	5.	PostgreSQL	Relational DBMS	303.73	+4.10	+35.41
6.	6.	6.	DB2	Relational DBMS	184.08	-3.85	-13.56
7.	7.	7.	Microsoft Access	Relational DBMS	131.97	-3.06	-10.22
8.	8.	8.	Cassandra	Wide column store	129.67	-0.66	+24.78
9.	9.	10.	Redis	Key-value store	111.24	+5.02	+16.69
10.	10.	9.	SQLite	Relational DBMS	107.96	+2.19	+5.67

Figure 3. Database management systems (DBMS) market ranking on April 2016

Although the researchers forecasted in the early time of Object Oriented database that it will dominate the databases markets, Object Oriented databases sales currently are very disappointed comparing with the Relational databases sales. One reason behind this result is that Object Oriented database applications requires a high level of database technology knowledge from the general user. On the other hand, the Relational database applications are enormously user-friendly, clear and mostly comprehensible in its performance (Leavitt, 2000). In addition, Asay (2016) indicates that Rational database management systems seems to be the best solution for specific problems.

Lately, many researches have been published to examine a new approach that combines the two approaches (Object-Oriented and Relational approaches). Obviously, the new databases, Object-Relational databases, have been established and industrialized to create a combination between good principles, user and markets requirements. Object-Relational databases can be logically modeled by classes connected via relationships. Also, the new database can be implemented by an extended SQL standard that applies the class-behavior principles like instances. It is clear that the Object-Relational databases solves the drawbacks of the two approaches and expresses the valuable concepts of them both (Devarakonda ,2001).

IV. CONCLUSION

To conclude, it is a controversial subject to decide which approach is better in designing and implementing databases. It is believed that Object Oriented approach is the top approach regarding physical and logical design and implementation of databases. Accordingly, a large number of database programmers and designers has supported that in their papers. However, users with no database background are widely using Relational databases. In the meantime, Rational approach has achieved a huge number of sales while Object Oriented approach sales were very disappointed. Although Object-Relational approach has merged both approaches and has gained their outstanding principles, the problems that have been addressed from them are still solvable. Obviously, future researches need to be conducted to achieve an unquestionable approach. It can be an improved version of Relational approach, as Thalheim (2000) recommends, or an extension of Object-Relational or Object-Oriented approaches. This will be a huge challenge for the present and the upcoming generations of database’s programmers and designers.

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