Behavior Analysis of Semantic Data Models

Chirag Sharma, Sandeep Kaur

Abstract— There are many traditional models of database present now a days in the form of Hierarchical model, Network Model, Relational model. Since they offer many advantages in terms of data integrity, data storage and retrieval but there is a big disadvantage as compared to latest introduced database models i.e semantic models such as Sembase, SAM, RM/T. Our paper presents many disadvantages of Conventional or Traditional Database Models as compared to Semantic models and try to find the efficient solution of these disadvantages. This paper also presents performance evaluation factors of different semantic models.

Index Terms—Database, Database models Traditional Models, Semantic Expressiveness, Abstraction, Objects, Normalization.

I. INTRODUCTION

By Database Models we mean to describe structure and operations of database. Structure defines the data types, relationships and different set of conditions. Options on data base include insertion, deletion and manipulation such as modification and performing updates. Although there are many database models such as Hierarchical model, Relational Model, Network model provide these features but there is one additional feature where these models lack and Semantic models such as SAM, Sembase has advantage over conventional model is in the feature of Semantic Expressiveness. The relational model provide simpler user interface to the database [3]. Although they provide a declarative way of representing data and queries that means it is easy to state which kind of information user wants and then allowing Database Management System handle all the queries and operations but still they offer many disadvantages. In the following section we are going to enlighten those reasons where conventional models lack in terms of efficiency compared to Semantic Models and provide best behavior analysis of semantic data models.

II. LIMITATIONS OF CONVENTIONAL DATABASE MODELS

There are many limitations of Conventional Models that are listed below

A. Poor Semantic Expressiveness

There is a lack of proper semantic expressiveness in conventional database models. The proper meaning of the Concepts such as structure and their relationships of objects is not properly understood to the user. The semantic expressiveness of the hierarchical, network, and relational models is limited; they do not provide sufficient mechanism to allow a database schema to describe the meaning of a database [4].

B. Lack of Abstraction

The lack of abstraction introduces the problem of conventional model in case of real time application for objects and their relationships. It affects data manipulation operations and increases Semantic Confusion.

C. Lack of Data Independence

There is a lack of Data Independence due to linkage records used in conventional model indicating the physical level detail. Thus this affects data management of the entities and thus affecting logical data independence.

D. Lack of Representation of Entities and Relationships

These models fail to represent entities and their relationships in real time environment.

E. Lack of Support for Complex objects

These models supports simpler objects such as Integer, Float, Character very well but there is a lack of support for complex objects such as Set, Tuple, Array, List etc.

F. No Structure to represent object hierarchy relationships

There is no facility for the structure of conventional models to represent relationships such as Aggregation, Generalization, Specialization and Classification.

G. Normalization

Due to Normalization splitting of relations to avoid anomalies may introduce some new relations that does not correspond to objects and makes database harder to use [3].

H. Lack of Semantic Integrity Constraints and application semantics

The lack of Integrity constraints and application semantics limits the application of Conventional models in the real world applications such as Sensors, Ad-hoc Real Time applications

I. Lack of Object Oriented Features

The object Oriented Features such as Encapsulation, Inheritance, and Polymorphism is missing in these models as compared to semantic models.

Due to these reasons we prefer to choose Semantic Models over conventional models. Following section will describe about the performance of Various Semantic Models.

III. PERFORMANCE OF VARIOUS SEMANTIC MODELS

Semantic Database Model is a high level database model. These are designed to provide more meaning to the database in application environment.

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An SDM specification describes a database in terms of the kinds of entities that exist in the application environment, the classifications and groupings of those entities, and the structural interconnections among them [4]. Apart from these advantages it provides usability, interoperability and effectiveness to the database systems. The various performance parameters that describes the advantages of semantic database models over conventional models are

A. Object Oriented Support

There is a proper object oriented support for Semantic Data Models in the form of Inheritance, Encapsulation and Abstraction.

B. Precise Documentation and Communication Medium

There is a support for database users in terms of precise documentation and Communication medium

C. High Level Semantic User Interfaces

It provides high level semantic user interfaces to the databases. These Interfaces serve as front end to database application. O_2 Interface provides Graphical User Interface for database applications.

D. Relativistic View

A database model must support a relativist view of the meaning of a database, And should allow alternative ways to look at the information for representation [4]. In order to accommodate multiple views of the same data and to enable the evolution of new perspectives on the data, a database model must support schemata that are flexible, potentially logically redundant and integrated [4].

E. Support for Complex Objects and Relationships

There is a proper support of abstraction for various entities in semantic database models. The complex objects such as Set, List, Array etc. Semantic database model provides the description of relevant entities in the application environment, collections of such entities, relationships (associations) among entities, and structural interconnections among the collections [4].

IV. VARIOUS SEMANTIC MODELS AND THEIR PERFORMANCE

There are various Semantic Models that provide database These models are shown in Figure1

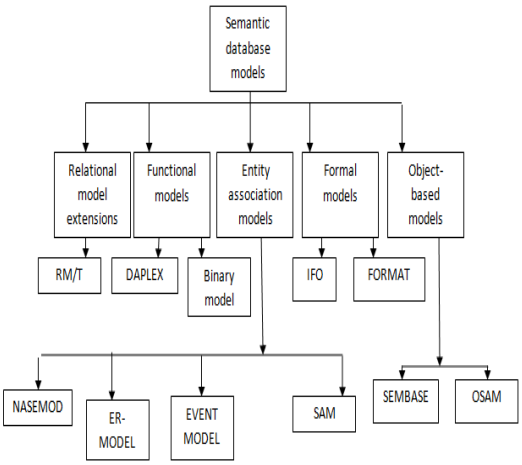

Figure1 : Semantic Database Models [3]

description and structural formulation and provide more meaning to the database. These are also known as Object Oriented Database Models. These models provide 4 architectural approaches such as Extended Relational Model Approach, The Semantic Database Approach, The Object Oriented Programming Language Extension Approach and The DBMS Generator Approach.

A. Relational Model Extension

It is a record based database model that contains semantic constructs to define more meaning to the database. It contains unique identifier for every entity. The object hierarchy such as Generalization, Aggregation, and Classification are followed in this Model. RM/T is model of this type. It contains all the features described in previous section.

B. Functional Models

It is a model that contains objects, properties of objects, their classification and their interrelationships. Functions play an important role in determining the type, properties of objects, attributes and interrelationships. Daplex Model is model that is a type of Functional Model. In Daplex Model provides a unifying construct for properties of attributes. Function represent relationships between 2 objects. Figure 2 shows Daplex Model

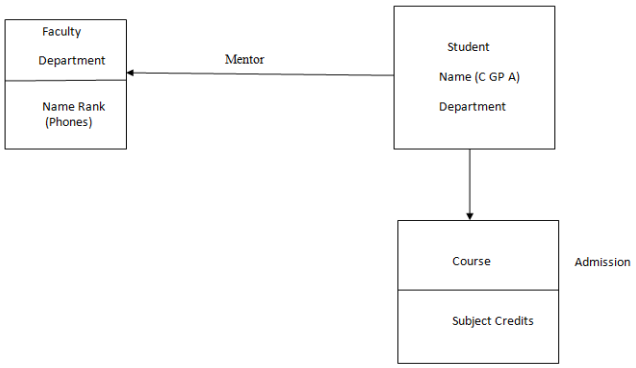

Figure 2: Daplex Model in realization of relationships between entities

C. Entity Association Models

These are the models that provide diagrammatic representation of different types of entities, their attributes and relationships between the entities. It is not suitable to represent relationships among relationships [3]. It also does not support object hierarchy such as generalization, association, aggregation and specialization that is basic disadvantage of these models. Entity Relationship Model is type of this model.

D. Object Based Models

These are the models that provide the concepts of objects along with defining the semantic expressiveness of the database. Sembase Model is an example of these models. It provides object management features.

E. Formal Models

IFO model is a type of Formal Models. It is useful in defining atomic types, constructs that are used to make complex types.

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Non atomic types are used along with functional relationships between the object types that are represented by fragments [3]. ISA relationship is useful in case of subtype-supertype hierarchy. Its basic use is in the graphical representation. It is very easy to represent more meanings to the database in application environment. Its basic disadvantage is in data manipulation operations.

V. PERFORMANCE EVALUATION OF SEMANTIC MODELS

From the study we have done so far we have to come to know about performance of various semantic models in various aspects.

A. Object Hierarchy Supported

Models such as RM/T, Daplex, Sembase, IFO supports object hierarchy (Generalization, Association, Specialization, and Aggregation) except Entity Relationship Model that does not support this function.

B. Query Defined Operations and Data Manipulation Operations

The query defined operations such as UPDATE, MODIFY operations are supported by RM/T, Daplex, Sembase, SAM Model except for IFO and ER Model that does not support this function.

C. Support for Dynamics

Dynamic data is supported by Sembase Model and Event Model in Entity Association Models.

D. Support for Extension of Relational Model

Only RM/T supports Extension of Relational model as it supports more features such as Object oriented features other than relational model features.

E. Support for Natural Language

Natural language features are supported by Semantic model named Nasemod.

F. Implementation based Applications

Implementation is performed only on few models such as Daplex Model, SDM Model and Sembase Model. Implementation is done using Object Oriented Programming Language. Such as Java Implementation is performed for Sembase and SDM. It supports fast application environment but runs slower than C++ environment

G. High level support for Semantics

Semantic Database Models have an advantage to provide high level support for semantics that means providing more meaning to the database

H. Use of Natural Designed Templates

Database Administrator uses natural designed templates to provide meaningful design of the query operations.

I. Redundancy and Derived Support

Semantic Models help in reducing the redundancy of logical data and provide derived support for various classes used in the models.

J. Proper Documentation

Semantic Models Provide ease of documentation features to the users. It saves time of the database administrators.

VI. CONCLUSION

In this paper we presented the various performance evaluation factors of Semantic models. A study was done on the different types of semantic models. We have calculated the performance of various semantic models and derived the reasons why Semantic models are preferred over Conventional Database Models. From the study w have concluded that Sembase Model is the best among Semantic Models because it supports data manipulation, dynamic and the most important feature it supports is in Implementation using High Level Programming languages for better application Environment. Sembase Models application lies in Real Time Application and Technology so it is a preferred model over other models. Although Daplex model does have an implementation part but Sembase is preferred in terms of Real Time Application.

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