VIRTUAL MANUFACTURING SYSTEM BASED ON RELATIONAL OBJECTUAL DATABASE FOR MECHANICAL OBJECTS USED IN MEDICINE

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KEY WORDS: Object relational databases, objects, model, implants, class, virtual.

ABSTRACT
Today is the great diversity in the way information is accessed, manipulated and presented. Object orientation is proving to be an technology that makes it easy to construct and maintain complex system from individual components. The paper identifies, assesses and categorizes research and applications relevant to key aspects of Virtual Manufacturing (VM). The Object-Relational technology may provide a powerful representation and classification tools for virtual manufacturing. Object-Relational technology may also provide a common platform for the information sharing between VM centers.

1. INTRODUCTION

The object-oriented model is richer than the relational one. It offers features such as object identity, definition of abstract types, type and class hierarchies, not present in the relational one[1]. However, this richness also generates new problems in the definition of derived classes and makes the definition of object schemas more difficult. The development of an OODB object schema definition mechanism entails the development of a derived class definition mechanism, the integration of the derived classes, the selection of a definition semantic, the definition of syntax to define object schemas, and the development of object schemas generation algorithms. Object schemas must be organized in a hierarchical structure similar to the conceptual schema [2]. This entails the integration of derived classes in the class hierarchy.
The databases of this mechanical system are represented in figure 1

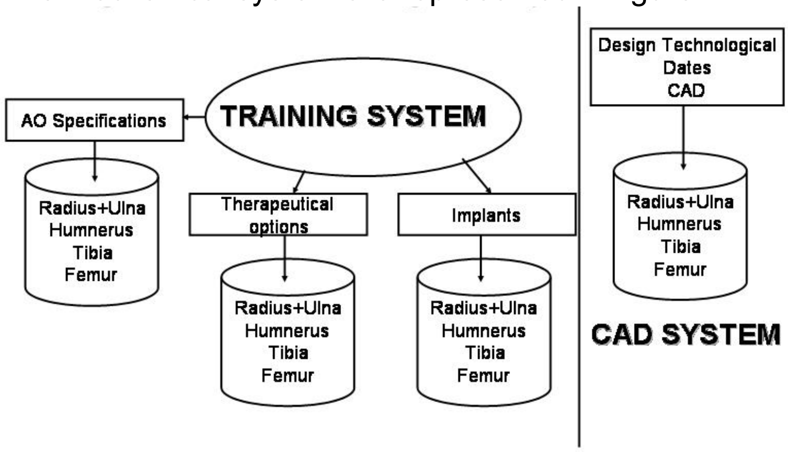

Figure 1. Virtual Manufacture System

2. OBJECTUAL RELATIONAL DATABASES

The programming and database concepts have come together to provide what we now call object-oriented databases [3]. Perhaps the most significant characteristic of object-oriented database technology is that it combines object-oriented programming with database technology to provide an integrated application development system. There are many advantages to including the definition of operations with the definition of data:

- The defined operations apply ubiquitously and are not dependent on the particular database application running at the moment.
- The data types can be extended to support complex data such as multi-media by defining new object classes that have operations to support the new kinds of information.

Other strengths of object-oriented modeling are well known.

- **Inheritance** allows one to develop solutions to complex problems incrementally by defining new objects in terms of previously defined objects;
- **Polymorphism** and dynamic binding allow one to define operations for one object and then to share the specification of the operation with other objects. These objects can further extend this operation to provide behaviours that are unique to those objects.
- **Dynamic binding** determines at runtime, which of these operations is actually executed, depending on the class of the object requested to perform the operation.

Polymorphism and dynamic binding are powerful object-oriented features that allow to compose objects, to provide solutions without having, to write code that is specific to each object. All of these capabilities come together synergistically to provide significant productivity advantages to database application developers[4]. Object/relational database management systems (ORDBMSs) add new object storage capabilities to the relational systems at the core of modern information systems.

Defining the databases is a process which tries to maintain the preservation of the relational characteristics of the databases in an object medium[3]. That is why the relations defined as classes of a predefined type (cursor) are preserved; the database of relational medium is defined as a class data environment. To this class will be attached types of class objects from relational database. The existing relations between the tables inside the database are defined as predefined type classes named cursor. The views are defined as cursor class, figure 2.

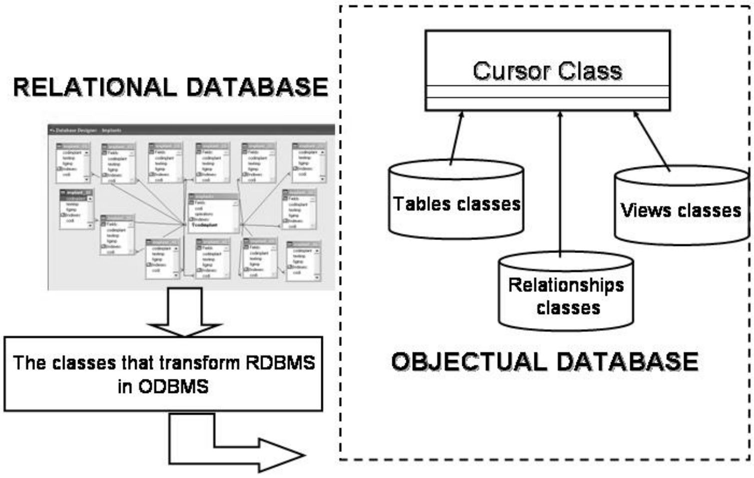

Figure 2. The Relational and Object Database

All the relations and views will be cursor type classes and inside the data environment class will exist objects of these type classes. The concepts of derived class, partial derived class, external schemes etc., will be applied in order to get the object database. A particular approach is the producing of object database corresponding to each tool type with the help of specific classes, which aim at generating the source code for each object database[6].

3 Medical implant characteristics

The standard material for AO implants is stainless steel. AO introduced in 1965 a brand of stainless steel specially designed for implants and this contributed decisively to the international standardization of this kind of material used in bone synthesis. But nowadays Titanium is a material that will be used in future medical implants.
This Automatic System sets to develop a software program meant to allow, based on the X-ray fracture image, according to AO standardization, to classify the fracture within a certain group. Thus, depending on the chosen group and the type of bone the group of standardized implants and the desired implant will be chosen. The entire documentation necessary[6] for the implant designing technology as well as the technology necessary for the manufacturing of the implants will be developed by this automatic system.
The figures below show two types of fractures (fig. 2) with the necessary implants and the obtained results

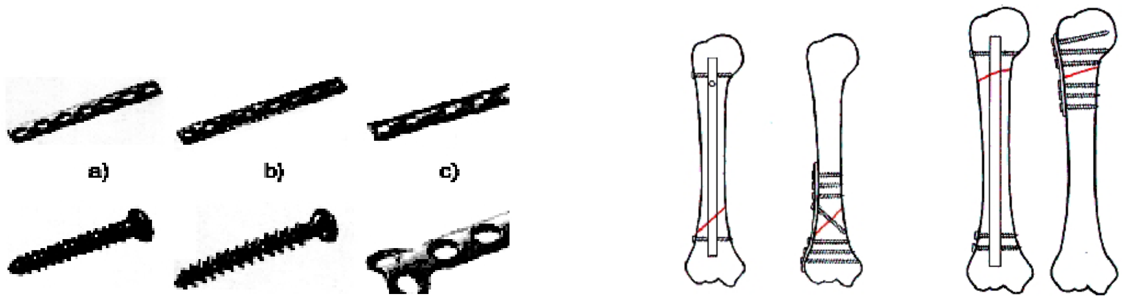

Figure 3 Medical Implants

4. Virtual Manufacturing

Manufacturing systems and processes are being combined with simulation technology, computer hardware, and operating systems to reduce costs and increase company profitability. Perhaps one of the most interesting and important of these recent developments is called "Virtual Manufacturing." Often termed "The Next Revolution in Global Manufacturing," virtual manufacturing involves the simulation of a product and the processes involved in its fabrication.

Simulation technology enables companies to optimize key factors directly affecting the profitability of their manufactured products. These include manufacturability, final shape, residual stress levels, and product durability. They directly affect profitability by reducing the cost of production, material usage, and warranty liabilities. In addition, virtual manufacturing also reduces the cost of tooling, eliminates the need for multiple physical prototypes, and reduces material waste. Small improvements in manufacturing have dramatic and profound effects in terms of cost and quality. Return on Investment calculations have shown that small savings in material usage deliver enormous returns in a manufacturing environment.

Once the geometry has been established, the software's machining "expert system" evaluates each design for manufacturability. One of the major technology innovations involved incorporating a huge amount of machining knowledge in the system says . For example, the system can currently flag issues related to milling, bending, part finish, and more. Next, the software then gives a price quote.

In manufacturability evaluation techniques, there is a trade off between computational requirements and accuracy. Some approaches examine the design directly: these are less computationally intensive, but in some domains it is difficult for them to give good results. Other approaches generate and evaluate manufacturing plans: these can produce accurate results in cases where direct approaches have problems, but can require large amounts of computing time. As the cost of computing power continues to decrease, we anticipate that the computational requirements will become less of a limitation, and thus plan-based approaches will become increasingly attractive

With current technology, manufacturability ratings are often not tied to any specific aspect of the part being rated and hence it can be difficult for designers to determine exactly what is causing manufacturing problems. Ratings schemes are needed that will enable the designers in identifying and eliminating the manufacturing bottlenecks and to move beyond rudimentary cost estimation and rating schemes it is necessary to develop algorithms that help to automate the redesign task.

Designers rarely start conceptualizing a product as geometry. A true assessment of manufacturability includes some aggregation of the ratings for cost, schedule and quality over the entire product and at each level of abstraction. Creating tools that can intelligently assess the trade offs between conflicting design requirements and manufacturing constraints and produce an informed and useful rating of manufacturability is a great challenge in bringing about the Virtual Manufacturing workplace.

Starting from the relational database “IMPLANTS” with the help of classes for database object generating, we reach the object code generating for the desired database class. This relational database contains a lot of tables and views. The process of transforming is composed by the appealing source program that transforming tables and views in classes and after this, the generated source program which contains tables and views transformed in object classes. External schema in design phase for classes that are under control all dates is presented in figure 4. The principals parts of mechanical system are represented by classes. The ”Humerus Implants” class is presented in figure 5.

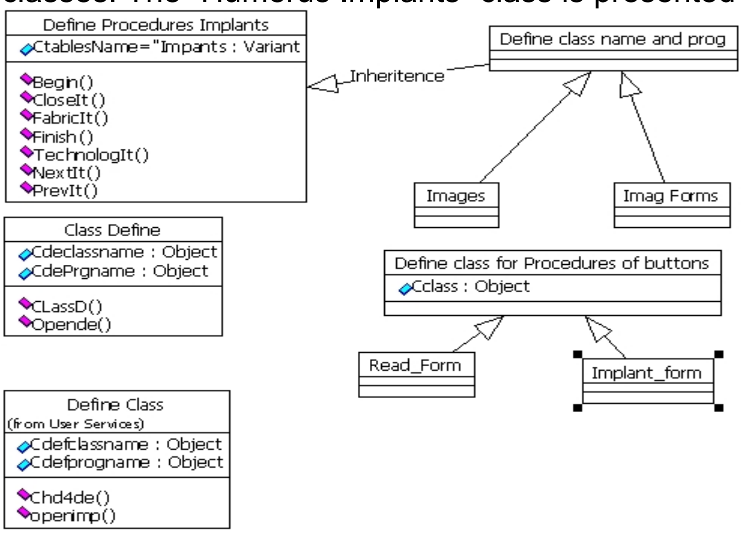

Figure 4 External schema for database class

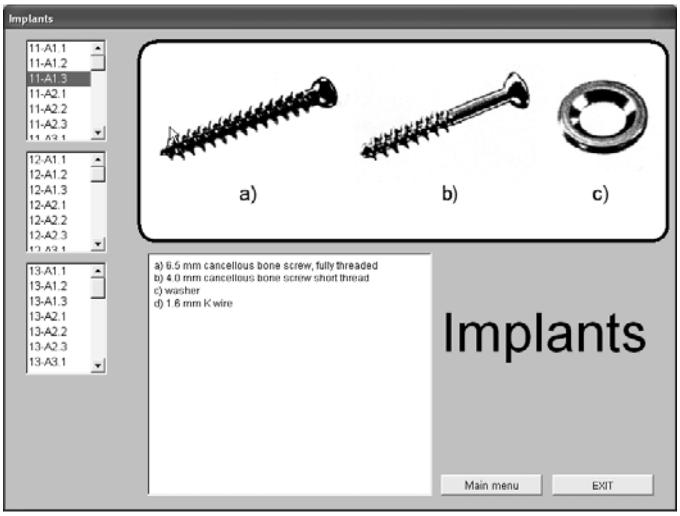

Figure 5 The "Humerus Implants"

The paper aims to create a data base refering to the computation of the optimum cutting rates for implants processing the designed parts by turning and milling in order to obtain an optimal cost that can be very easy calculated and increase the productivity for estimation costs of the manufacturing process virtual and also real. Once created the database, can be accesed by a powerfull machining soft for establishing the optimal rates of the cutting proces that enables the manufacturer to offer a real cost of the parts.

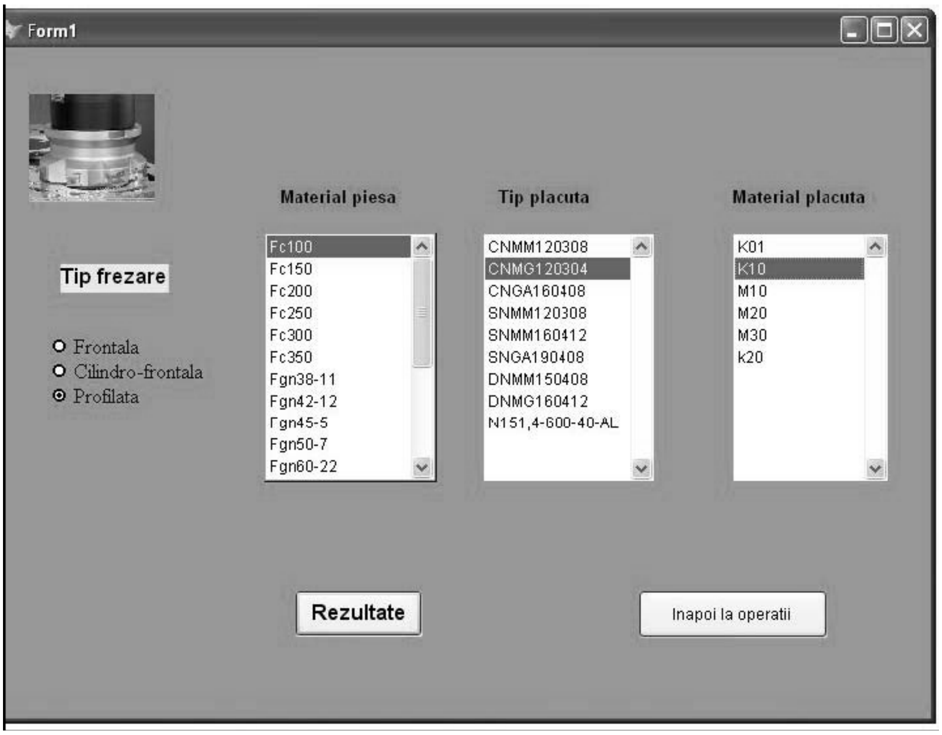

Figure 6 The Interface of software part one

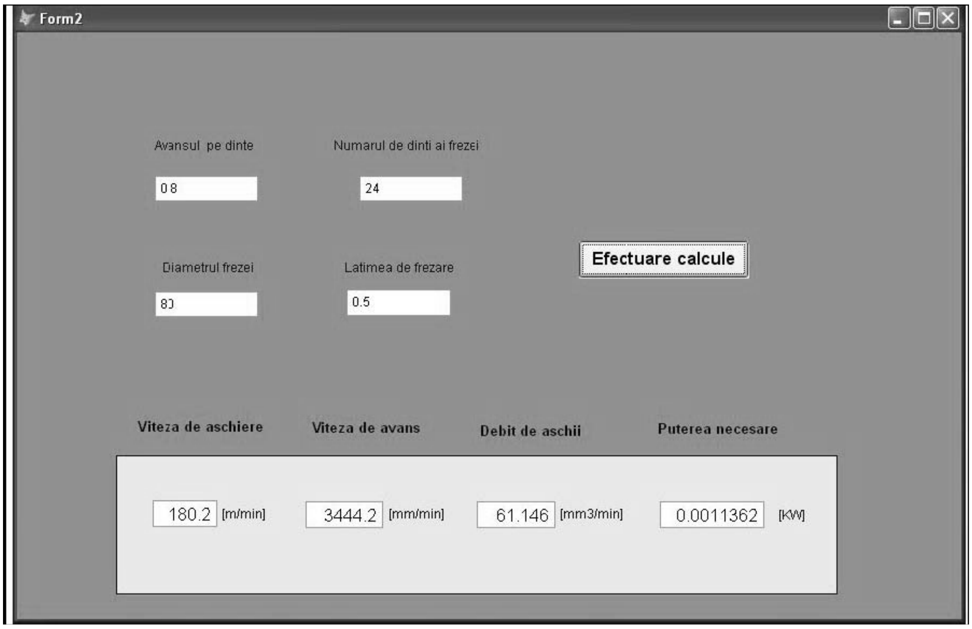

Figure 7 The Interface of software part one

Conclusions

This paper describes a part of virtual manufacturing system, how the relational database is transformed into object database. The transformation is realized with the object concepts and the help of the "Generating_class_turning" class. Also is presented the way of realizing an object application.

All the procedures necessary to the administration of data can be found in a specific class. From the viewpoint of conceptual and programming aspects there are a lot of differences between the object designer and relational designer, but the execution time of the object programs is exactly like the relational programs' one. This paper demonstrates that in ORDBMS software it's possible to respect object concepts for the programming language and also for the storage medium.

The software can be used independently or linked with a CAM system for a quick analyse of the estimated costs and setting of the optimal parameters in the cutting process in simulation of the manufacturing of different machine parts. The created soft aims to make a link between the geometric conception of the parts and the technological environment.

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