TAKING ADVANTAGE OF INTEGRATED SOFTWARE ENVIRONMENT IN NEW IOS THREE-COORDINATE MEASURING MACHINES SOFTWARE SYSTEM DESIGNING

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Abstract:
The paper presens the concept of new software system of three-coordinate measuring machines produced by IOS based on integrated software environment techniques. System manages a relational database, organised for collection of all necessary data and information in measuring process. The basic architecture and its implementation are discussed. New perspectives for cooperation of the system with another program environments are also shown.

1. INTRODUCTION

Development of measuring techniques actually is very close connected with development in computer industry and growing possibilities of computer aided designing of measuring systems by new software tools type RAD (Rapid Application Development). Modern measuring instruments are equipped in graphic user interfaces allowing for their full operation. These types of instruments are often called virtual instruments. According to National Instruments definition: "virtual instrument it is software layer and / or hardware (layer) added to general purpose computer in this way, that user can work on computer as on traditionally designed measuring instrument.

Basic functions of virtual instrument are data acquisition, proceeding of measured data and functions realised by graphic interface, it means control of measuring process and presentation of results.

Under the circumstances the properties such like: converting hardware modules for data acquisition to the main purpose computer for data processing, using graphite user's interface, functional flexibility and many others allowed the three- coordinate measuring machines to be considered as a virtual instruments.

The newest IOS software for three- coordinate measuring machines is Windows based software system. System was developed using graphic tools of Delphi 5 (Borland). In development of new system much possibilities of software surrounding were used: object – events programming style, construction of graphic panel by graphic objects possibility of using sophisticated data processing libraries, using RS interfaces for communication with machine hardware, multitask realisation, using of database and so on. All these tools allowed elimination of time consumed programming of functions by using Delphi systems mechanism. Process of application creating was done in such way:

− the analysis of problem with specification of all functions, machine system parameters and their relations;
− the designing of system's graphic panels;
− the designing of operation's program;
− the designing of measured data form presentation.

Designing, debugging and testing of system was done in IDE (Integrated Development Environment) consisting of code editor, debugger, graphic editor and tools for database management.

2. THE SOFTWARE SYSTEM STRUCTURE

Structure of software system of measuring machines is based on three cooperating with themselves functional blocks (fig. 1).
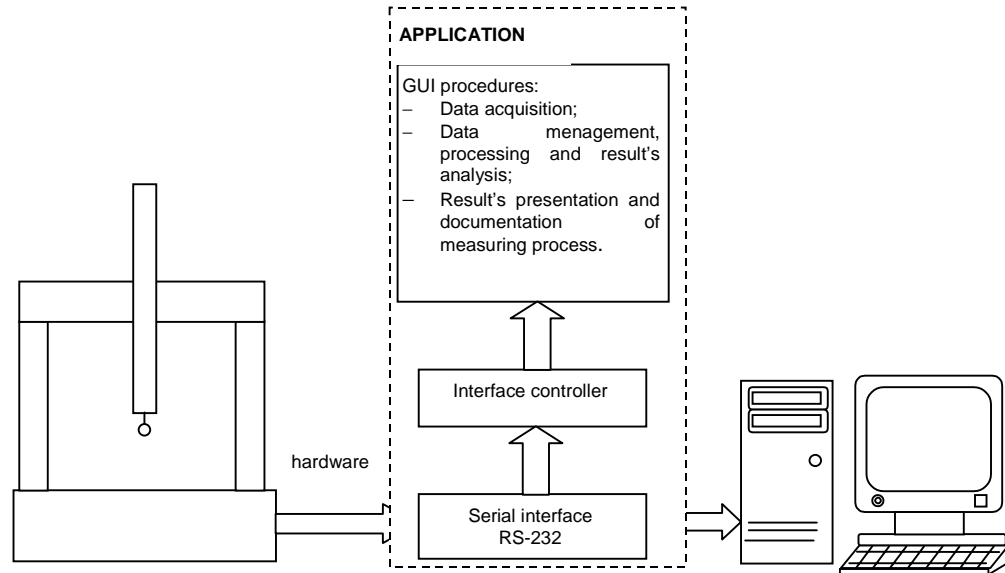

Figure 1. The software system structure

Realised accordingly to this way software was based on object–events programming conception. It includes graphic components section and implementation section with language code of event's operations of designed graphic objects and procedures performing basic tasks of application inside GUI. Superior task of application which was gathered data processing and data visualisation was achieved by development of own libraries of numeric, geometric and visualisation procedures. Among them such categories of GUI operations can be specified:
– procedures of calculation of basic geometrical elements;
– set of procedures for connecting elements from existing ones (ones already probed or calculated);
– set of procedures of data transfiguration according to declared projected plane;
– procedures of building affinic conversion matrix for creation of alignment; data transformation between defined part systems;
– procedures setting the coordinate system origin;
– procedures of results analysis;
– procedures of controlling of inspection reports;
– data management procedures, data export and import.
Existing of event belonging to any described category caused creation of necessary event's protocol, which can be needed in next steps of application operating.

3. THE RELATIONAL DATABASE MODEL

Storing of the protocols was done by connection of application with relational database. Kernel of access to database is driver of database BDE (Borland Database Engine) supplied by Borland Company, which is communicating with application according to scheme shown on fig.2. Access to data is possible by using BDE API (Application Programming Interface).

Database entities create measured data and event's protocols. This partition was done under the circumstances of access of speed to information and assurance of avoidance of redundant data. In both cases a uniform data model was considered. Adjusting architectonic database model for the application needs a basic data structure was defined, consisting of fields allowing the universal coding of different information categories.
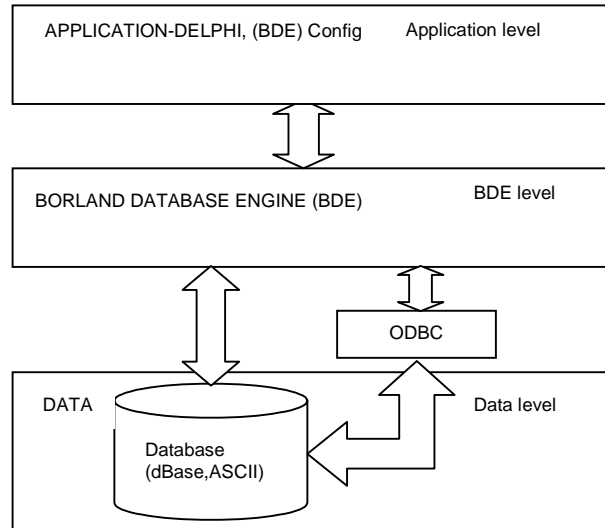

Figure 2. The connections of database

Data model's realisation is relied on assigning actual values of parameters of collected probed points or accruing event to particular model fields, assigning next value to identification field and storing element in database. Discriminant of category of element from data set is a field with name type_element, which is an identifier for entity instant. Value assigned to other attributes can have a various meaning according to the value of type_element field e.g. the main elements groups have attributes such as:

− type_element=element: calculated parameter's values of measured geometrical element;
− type_element=function: calculated values of geometric relations as well as the identifiers of elements, used in calculations;
− type_element=system: calculated values of defined coordinate system and identifier of reference element;
− type_element=path: current values of coordinates of vector for head movements.

In the case when element is not applicable to any field its value is assigned to "null"

Database usage is easier due to using SQL for asking questions or issuing commands. It is possible to get data fulfilling criteria determined with SQL question, searching, filtering, and flexible using of data in database e.g. for calculations, coordinate system orientation etc.

Database generates parts program, which can be executed in CNC cycle of machine work. Application uses cursor rewinding to make in accordance to its present position appropriate operations in the entity. Type_element field allows verification of element association with appropriate group. Updating functions are released at this moment, which data model's realisation for current element amounts to field's data modification. Choosing of database format (dBase) was caused due to broad usage of its standard. Parameters of database are quite enough for technical limits of the measuring machine (maximal number of records: 1 milliard, maximal number of characters in the field: 256). Data from database can be exported in ASCII delimited format using special procedure. Data importing from text delimited ASCII format is possible using ASCII driver included in BDE. This allows using DMIS code (the Dimensional Measurement Industry Standard) for generating of parts program having formalised notation of basic operations performed by machines software system and included in system database.

4. CONCLUSION

Higher and higher requirements and broadening of operations tasks of three-coordinates measuring machines forces using of new concepts and modern means for preparing of more perfect, faster and effective software. Replacement of classical tools, having no problem oriented languages features with high procedural languages of fourth generation (4GL) with object programming philosophy provides high effectiveness of application work and allows using of visual technique (panels generators). Object structure of software causes that application may be adjusted very fast for changing requirements, which influence on ease of its distribution and configuration.

Performed tests and measurements prove that database appended to machine software is enough efficient, e.g. the result of searching of record (using index) for 1000 records domain, in which searched number was in last record, on Pentium 300 was almost immediate. Further optimisation should be considered parallel to the system development by using more effective strategies of movement in the database and to analyse security system.

An SQL database server (Structured Query Language) using ODBC driver (Open Database Connectivity) allows cooperation of machine software system with other type of databases (e.g. MS Access). Other profits resulting from accepted database structure are possibilities of introductory measurement data processing and transfer them to other analysing environments (CAD environments).

5. REFERENCES

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