

GRAPHICAL OBJECTS AND INFORMATION IN ENGINEERING DESIGN

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Abstract. This article introduces some problems graphics programming in the AutoCAD environment. Using AutoLISP and Visual Basic Application programming languages prepared methods and procedures for solving these design problems: attaching, reading and performing mathematical operations with information extended data of a graphical objects. The general purpose of this paper is to contribute to a debate concerning possibility of AutoLISP and VBA graphics programming.

Key words: AutoCAD environment, AutoLISP, Visual Basic Application, graphical procedures

1 Introduction.

Engineering design is the act of creating the specifications and drawings for a product or process that satisfies the design criteria. In Lithuania most widespread computer-aided design tool is AutoCAD. Its full name is Automated Computer-Aided Drafting and Design. The first version of AutoCAD was created by John Walker and Dan Drake in 1982. AutoCAD is property of Autodesk company [2].

For a designer it is essential to draw a graphical object, but also information connected with that object is needed. Firstly, geometrical parameters; secondly, object material; thirdly, other information connected with the graphical object (cost, supplier, producer, etc.).

2 Formulation of the problem.

Prepare methods and procedures for solving these design problems: attaching information to a graphical object being drawn, reading information from certain graphical objects of a drawing, perform mathematical operations with given information.

In graphical system AutoCAD customary drawing objects are called primitives. There are fixed graphical units such as: line, circle, and arc. User himself creates needed programming graphical objects. In the AutoCAD environment we can program with C, Visual Basic or AutoLISP languages. C is computer scientists' language; possibility to program with Visual Basic appeared only recently; and every engineer can easily work with AutoLISP.

An American scientist J.McCarthy created programming language LISP in 1961. It was the first function programming language, different from operating languages such as Fortran, Pascal, and C. All calculations, orderings, and program's operations are performed by special functions or functions which a programmer writes. Language LISP is suitable for AutoCAD, to control its deep information structure. AutoLISP was originated as a result of combining LISP and AutoCAD. At the beginning it was the only one language working in the environment of AutoCAD.

Dartmouth college scientists John Kemeny and Thomas Kurtz created BASIC the first version in 1963. Language was used by beginners to learn programming. BASIC means Beginners All-purpose Symbolic Instruction Code. Young programmer Paul Allen and Harvard university first year student Bill Gates prepared first BASIC system for computer "Altair" in 1975. Later they founded "Microsoft" company.

Now Visual Basic (VB) is „Microsoft" object-oriented programming language. Visual Basic for Applications (VBA) is other Basic language version which is now included in many "Microsoft" programs such as Word, Excel, PowerPoint, Access. Since AutoCAD 14 was launched we can use VBA for graphics programming.

Computer can only produce what it has been fully instructed to do. Programming graphical objects can produce many different graphical results depending on parameters. All information about drawing in the AutoCAD system is in the drawing database (DDB). We will study it in DXF format (Drawing Interchange Format), which is included in many graphical systems [1].

Prepare two methods with AutoLISP and VBA programming languages for attaching information to a graphical object being drawn, reading information from certain graphical objects of a drawing, perform mathematical operations with read information.

We can append additional data, called extended data, to graphical entities. There is an extended data area which is found by programming method. Information is registered by name "XData". Names and values are attached with codes "1000" and "1040".

Knowing DDB structure and DXF file codes, we can create programming methods for attaching, reading and calculating with extended data.

First method: programming with AutoLisp language in the AutoCAD environment. Procedure fragment for attaching information to graphical object:

```
(setq object (entget (entlast))) (regapp "XData")
(entmod (setq object (append object (list (list -3(list "XData" (cons 1040 area)))))))
```

The next procedure selects graphical objects with extended data and calculates sum of all areas:

```
(setq rinkinys (ssget "x" '((-3 ("XData")))))
(setq skaicius (sslenght rinkinys)) (progn (setq i 0) (setq all_area 0.)
(repeat skaicius (setq narys(entget (ssname rinkinys i) ("XData")))
(setq area(cdr(cadr(cadr(assoc -3 narys))))))
(setq all_area (+ all_area area)) (setq i (1+ i)) )
```

In the first line a set of objects, which contain extended data with name " XData", is formed. In the second line the number of such objects is counted. In the next lines cyclic calculation of area is executed.

Second method: programming with VBA language for AutoCAD. Attaching extended data to drawing object procedure fragment:

```
kodas(0) = 1001 : kodas(1) = 1000 : kodas(2) = 1040
duom(0) = " XData " : duom (1) = "Plotas" : duom (2) = area
objektas.SetXData kodas, duom : objektas.Update
```

In the first two rows two vectors code and data are formed depending on extended data forming principles. In the last row information with drawn object's area is attached to a variable object and fixed in the DDB. The next procedure selects graphical objects with extended data and calculates all area:

```
kod (0) = 1001: duom (0) = " XData ": grupKodas = kod : duomKodas = duom
Set rinkinys = ThisDrawing.SelectionSets.Add(naujas)
rinkinys.SelectOnScreen grupKodas, duomKodas : area = 0#
For Each langas In rinkinys : langas.GetXData "", kod, duom
area = area + duom(2) : Next langas
```

In the first row two vectors, depending on extended data forming principles, are formed. In the next two rows a set of objects, which have extended data with name "XData", is formed. In the next rows cyclic calculation of area is executed.

3 Example.

Specification of windows in a house design. For an engineer drawing a house plan is an often done work. This work is done faster if special programming procedures for visualizing graphical objects are used. Lets fulfill house plan drawing and prepare windows specifications for a house plan with program written in VBA language.

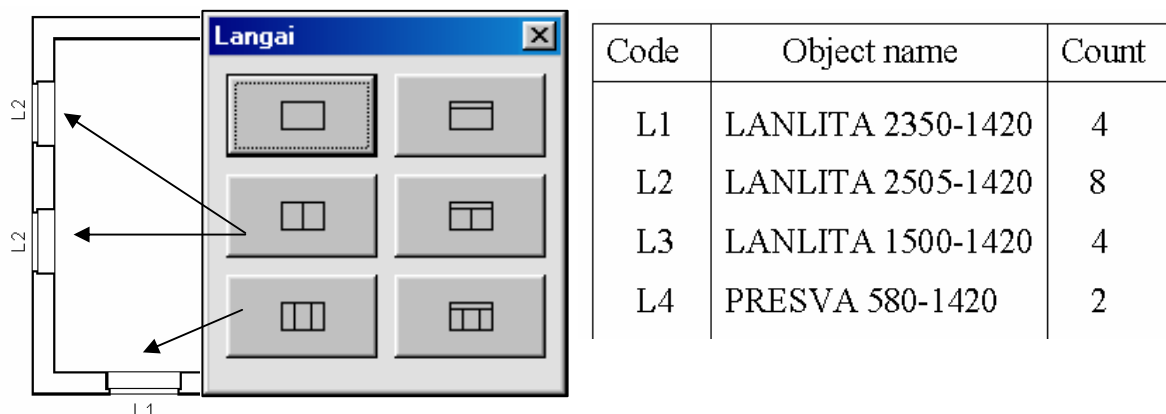


Fig.1. Specification of windows in a plan of a house

In the house plan we have a few different windows in rooms; their properties describe program's procedures and can be selected from the menu (Fig.1). We will solve only problems dealing with automation formation specification of windows (Fig.1) according to results of a drawn plan of a house.

4 Conclusions.

Knowing DDB structure and DXF file codes, we can create programming methods for attaching, reading and calculating with extended data.

Prepare methods and procedures for attaching information to a graphical object being drawn, reading information from certain graphical objects of a drawing. Prepare model specification of windows in a house plan.

Bibliography

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