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A method of inserting symbol matrix on the workpiece sketch and assembling a device

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A method of inserting symbol matrix on the workpiece sketch and assembling a device

A Babă[1,*] and M Bâldea[1]

[1] University of Pitesti, Manufacturing and Industrial Management Department, Târgul din Vale Street No.1, Romania

Email: alexandru.baba@upit.ro

Abstract. In the process of designing the technological devices for orientation and fastening for semifinished parts, there is a close connection between the technological device designer and the process technologist, the one representing on the operating plans, for each operation, the orientation and fixing of the piece in the device by means of the symbols information. The work comes in support of the process technologist because all this activity becomes fully automated. Each symbol in the information symbol matrix (SI), specific for the design of technological devices, also contains information (name, number of degrees of freedom taken over, type of surface, etc.), which can be extracted by the Excel-AutoCAD link, for processing them. This paper presents concretely, inserting symbols on the surfaces of the loose piece as an example and how to form a control device using Tool Palettes.

1. Introduction
In the process of designing computer technology devices, there is a close collaboration between the process designer and the device designer.

The process engineer is the one who draws the sketch of the operation in a graphical environment, then precisely and completely accurately places the suggestion and symbolic representation schema, which does not allow for different interpretations of the device designers.

In synthesis, two phases are used for the design of technological devices:
- Elaboration of the orientation and fixation scheme (SOF) symbolically represented by the technologist in the operations plan;
- Constructing the constructive principle scheme, the overall drawing and the details made by the device designer.

In this paper we aim to automatically create, using the AutoCAD and VBA environment, the location of the SI on the sketch of the operation and an example of a control device configuration with the functional building blocks.

2. The essence of informational symbol
For the development of Orientation and Fastening Schemes (SOF), the technologist uses a set of information symbols (SI) that he places on the work shield of the workpiece, taking into account the specific directions of certain surfaces. In figure 1, there are given some examples of information symbols used in the drawing of the guideline and fixing schemes of the worckpiece.
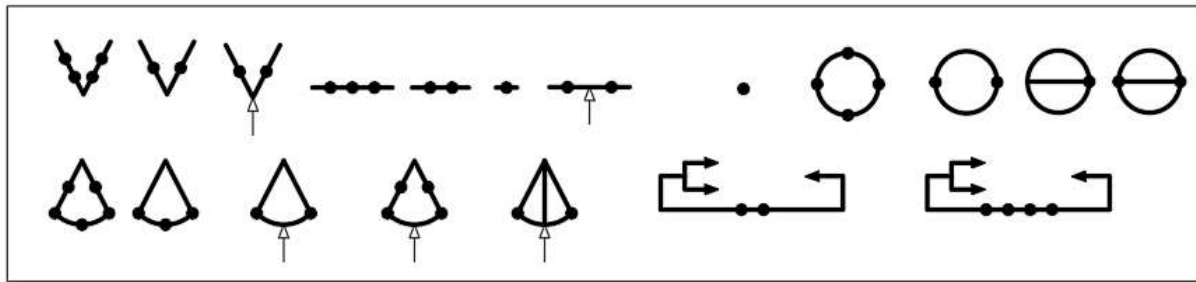
Figure 1. Examples of information symbols.

Information symbolisation (SI) must provide information [1 - 5] such as:
- Functional-cinematic information (F - C), (linked to the number and nature of the related degrees of freedom);
- Functional-technological information (F-T), related to the relative position of the generating bases, orientation, quotation from the worckpiece and the active ones on the support.
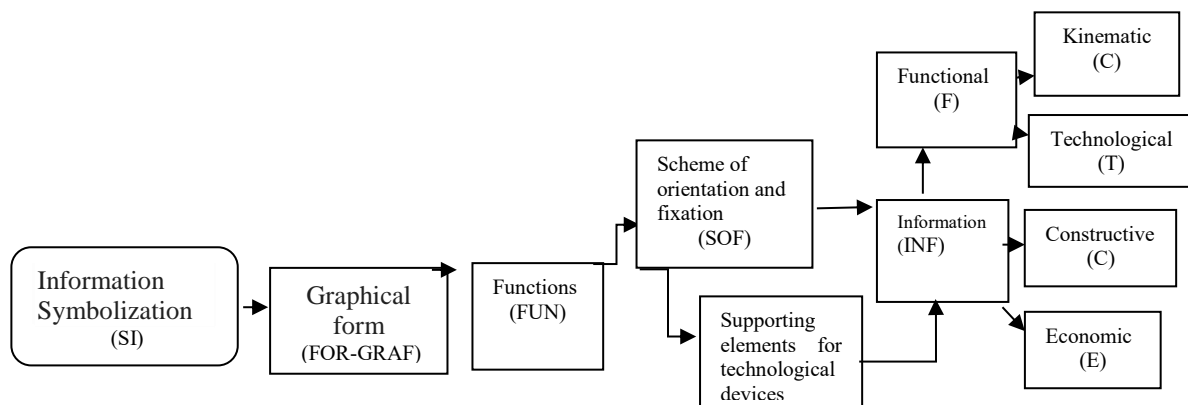

Figure 2. The essence of symbols.

Figure 2 illustrates the essence of the symbolization, the informational symbol (SI) has a specific graphic form (FOR-GRAF), fulfilling the function of defining the orientation and fixation state (SOF) and the function of correspondence with the physical support element used in the selection or designing stage and besides these two functions, the symbol provides functional information - cinematic (FC), functional - technological information (FT); constructive information (C) and economic (E) are related to symbol architecture [1, 2, 6].

The essence of the symbols states that SI provides information on the number, nature (rotation, translation), meanings and axes of reporting the degrees of freedom associated with the symbolic support.

One must emphases that the number of degrees of freedom is given by the number of circles (full or empty) placed on the base shape of the symbol, indicating a main (full circle) or auxiliary (empty circle) bearing. The number of circles on the same base form gives information on the dimensional aspect of the orientation surfaces of the PSF and the active surfaces on the support (R) in the joint area of the contact (long prism, short prism etc.).

3. Creating Dynamic Blocks of SI and Functional Building Blocks (BCF) using AutoCAD and the VBA Programming Environment

Dynamic blocks of SI / BCF are bidirectional parametric objects with a set of configurable properties, which allows us to program in any language, so VBA.

Steps to achieve the Visual Basic for Applications program:

- Creation of the SI / BCF drawing in the AutoCAD work environment;
- Attachment of specific SI attribute (names, rotations, translations etc.) and functional constructive blocks;
- Creation of dynamic blocks;
- SI / BCF insertion;
- Rescue dynamic blocks.

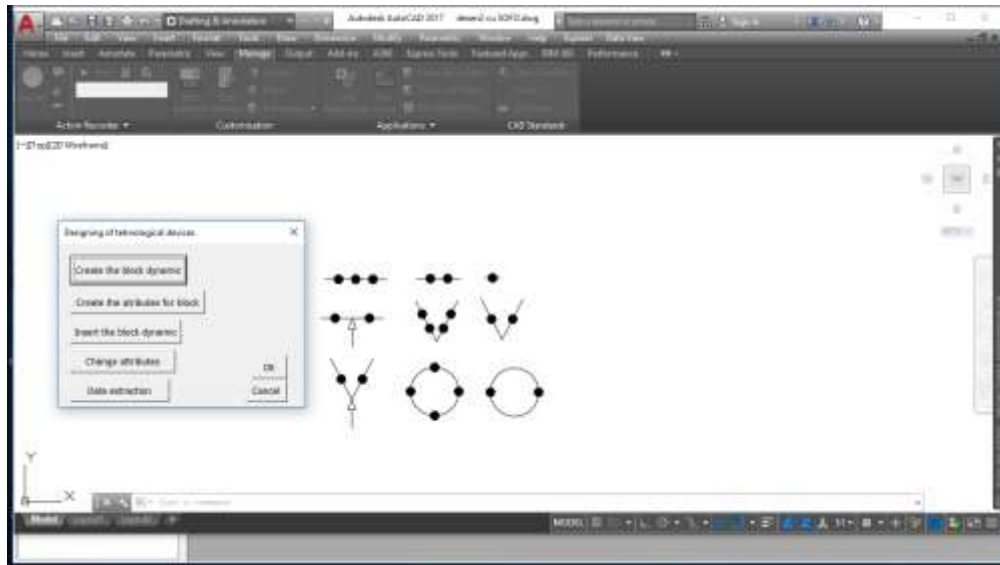The user interface of the VBA code is shown in figure 3.

Figure 3. The program interface.

Specifications:
- The GetDynamicBlockProperties property of a block reference was used to obtain the dynamic properties of predefined lengths;
- The TagString property contains the tag for the attribute reference;
- The TextString property contains the value of the attribute reference;
- The Explode method performs a block reference expansion, allowing the block to be edited;
- GetAttributes and GetConstantAttributes are used to extract information about attributes in a block, for example in an Excel spreadsheet, for further processing.

The Visual Basic for Applications code has the ability to create dynamic blocks, attach attributes, insert blocks into drawings, and extract data from a drawing into an Excel spreadsheet. This program also has an important property, attach new attributes, or modify attributes to already created blocks.

4. Creating Palettes "Simboluri Informaționale"
The custom palette creation scheme in the Tool Palettes window for organizing the SI dynamic blocks is shown in figure 4.

The operating principle is as follows:
- The symbols are drawn in the AutoCad environment, then with the help of the created software, each SI drawing is selected one to which the specific attributes are attached, after which they are transformed into dynamic blocks;
- SI dynamic blocks are slid in the created palette window;
- The symbol in the palette window is specific to the shape of the surface on which it is placed, and draws it from the window to the desired location.

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For example, figure 4, the possibility of placing SI on the surfaces of the test piece, regardless of their orientation, due to the fact that the scaling, rotation, shifting properties were taken into account at the cross-section of each dynamic block.
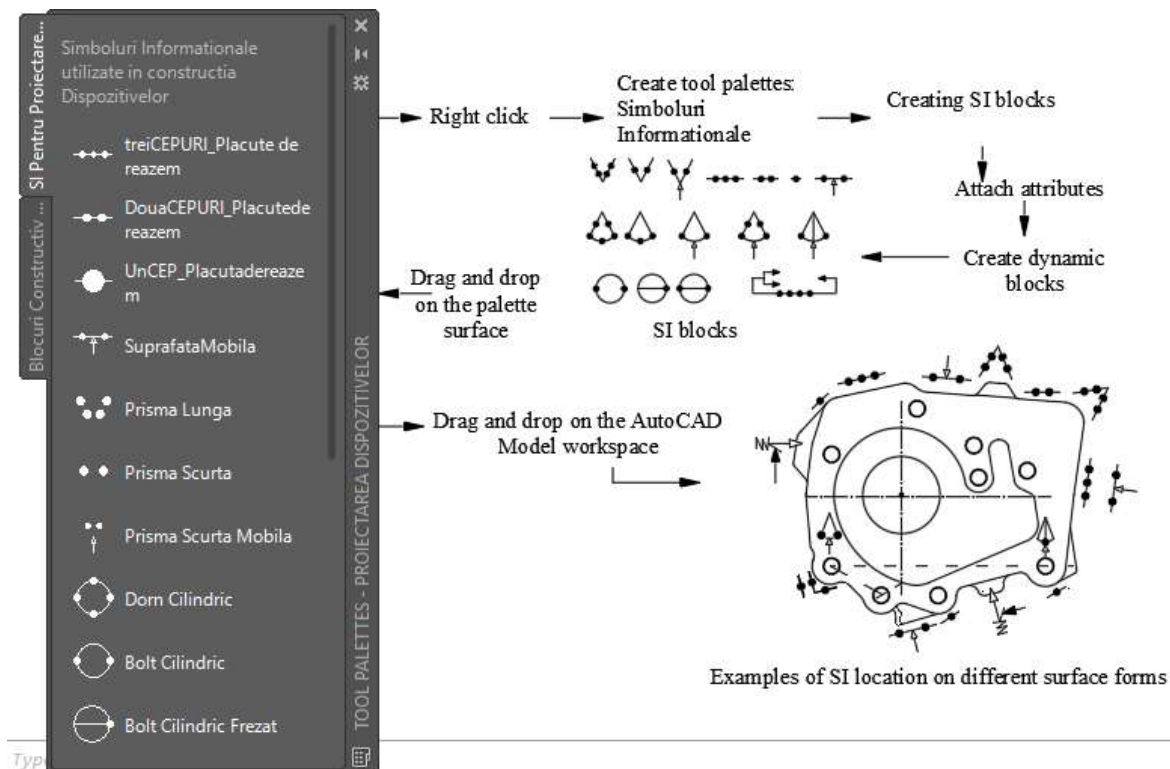

Figure 4. Informational Symbols palette for Device Construction.

5. Creating Palettes Control Device

Any technological device consists of a reunion of functional building blocks, blocks that can be used successfully for the construction of new devices or technological equipment.

Then we consider that our research in the computer approach is justified, which aims at transforming functional constructive blocks into modular structures as typo-dimensions and transferring them into a computerized database in the form of dynamic blocks.

In the sense of productivity, a customized palette called Functional Building Blocks has been created, which contains a collection of modular structures of control devices in the form of dynamic blocks with specific characteristics (scaling, rotation, visibility, etc.).

The organization of dynamic blocks in the Constructv Functional Blocks palette is an efficient way to quickly build a technological equipment (Control Device) by simply dragging them from this window into the workspace to the desired location.

The custom palette creation scheme in the Tool Palettes window for organizing the dynamic blocks of the functional building blocks is shown in figure 5.

The operating principle is as follows:
- AutoCad draws functional constructive blocks or modular device structures, then selects one drawing to which each specific attribute is attached, then transforms into dynamic blocks;
- Dynamic blocks of functional building blocks or modular device structures are dragged into the created palette window;
- Choose from the palette window, the functional constructive block or the modular device structure and draw from this window into the desired location.
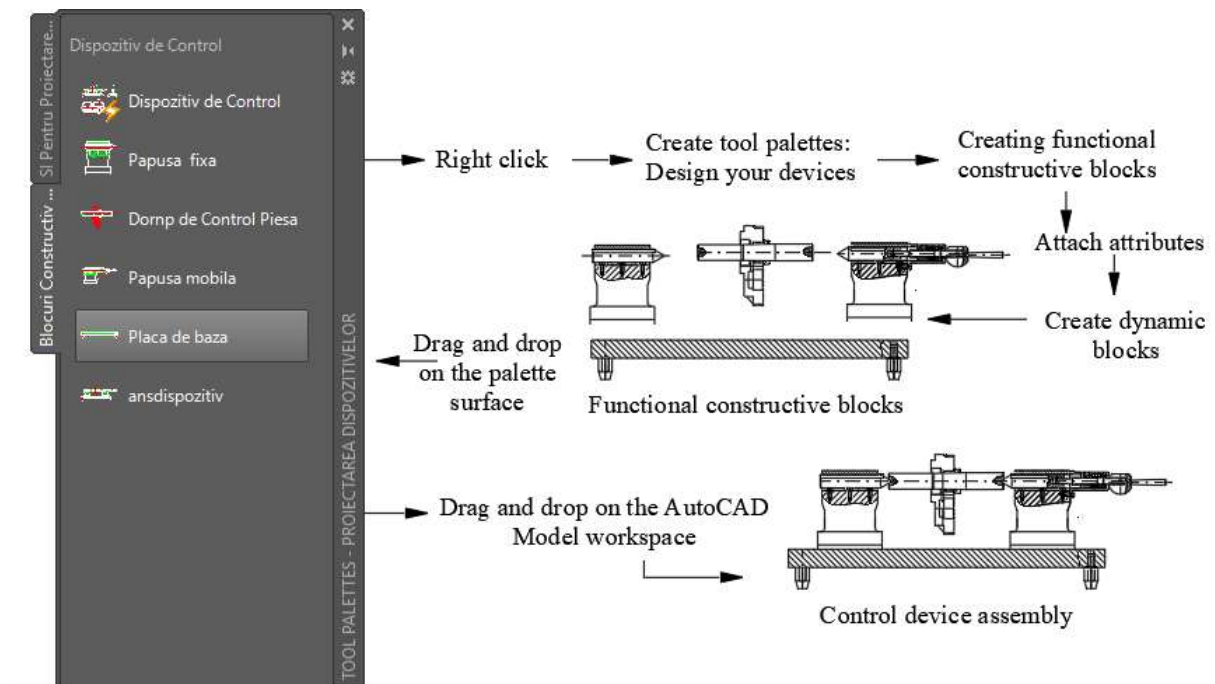
Figure 5. Functional Constructive Block Palette.

As an example, in figure 6 and figure 7, it is presented the stepwise configuration sequences of a control device consisting of the modular subassemblies as dynamic blocks made with the software described above.
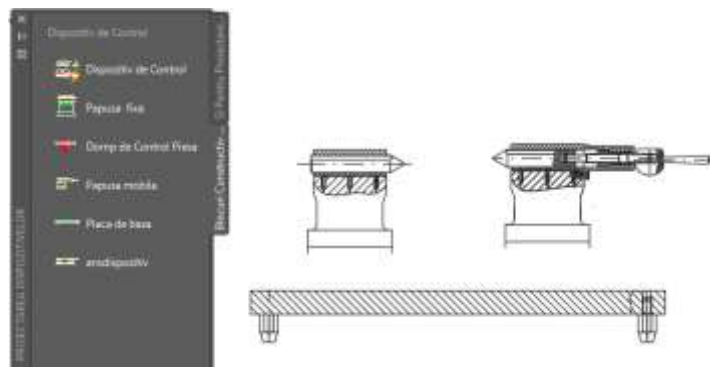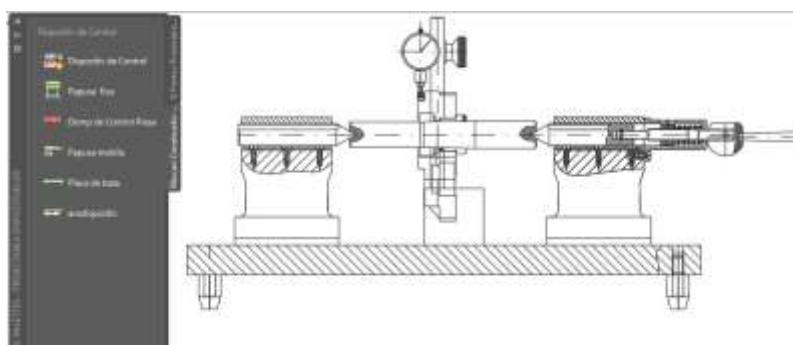

Figure 6. Modular structures in the control device.

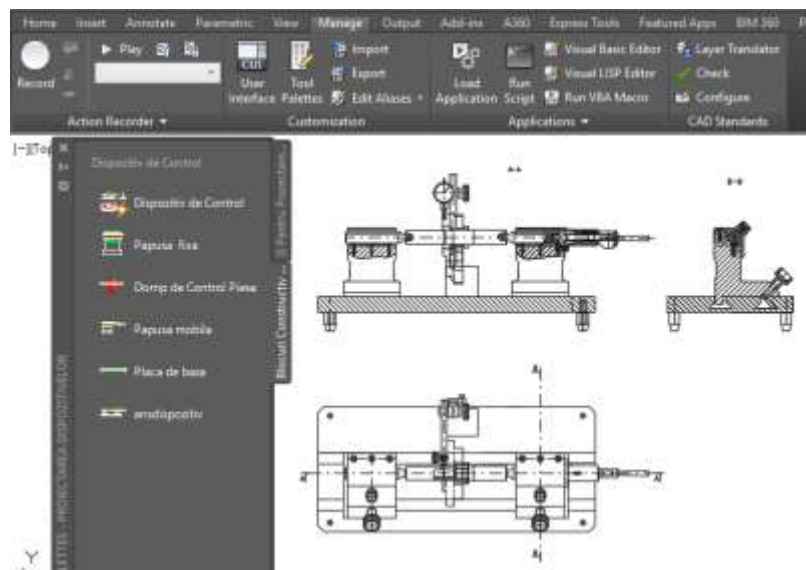**Figure 7.** Front view of the control device.

Figure 8. Control device assembly.

In figure 8 it is presented the device assembly. If we call the Dynamic Block visibility property, we can display the views we want.

6. Conclusions
In this paper, our research has focused on automating, using AutoCAD and Visual Basic for Applications, the placement of information symbols on the sketch of the operation, and the configuration of a control device using functional building blocks.

Our research and contributions have as main objectives the development of new modular structures of technological devices and control with industrial applications.

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