Standard Selection of Objects within a Wood Construction CAD System

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Abstract: Almost every command that can be performed within a CAD system requires the user to select one or more objects on which it will be performed. In order to simplify the process of object selection a standardization of this process was developed and is presented in this paper.

Keywords: user interface (HCI), CAD, object selection

1   Introduction

Usability is a measure of how easy it is to use a product to perform prescribed tasks.

The term "usability" in the context of creating software represents an approach that puts the user, rather than the system, at the center of the process. This philosophy, called user-centered design, incorporates user concerns and advocacy from the beginning of the design process and dictates that the needs of the user should be foremost in any design decisions.

Usability is about whether a person can use a product to perform the tasks they need to perform. The three basic aspects of usability – discovery, learning, efficiency – are strongly influenced by the nature of the task at hand and the frequency with which the user performs it [1].

When designing with a CAD system the user is required to select different entities such as an object like a wooden bar, a point, a line etc., on which his commands will be performed [2].

Optimization of the user interface is not an easy task and an exact description of its design is not possible [3]. The standardization of the object selection process must be performed both from the user's and programmer's point of view. Several situations were taken into account including:

1) When an object is selected, there is a possibility that it is not the correct one. In this case, a new object is offered to the user for selection;
2) Some commands require the selection of one or more objects or groups of objects.

All of these situations should be dealt with in a simple and uniform manner.

The solving of this problem led to the development of a single function called StandardObjectSelection whose behavior depends of its parameters.

2   Definitions Of Function Parameters

The function parameters are:
1) SelectionMode
2) ObjectSelectionPoolGroup1
3) ObjectSelectionPoolGroup2
4) Repeat
5) MessageSelectingGroup1
6) MessageSelectingGroup2
7) MessageConfirmSelectionGroup1
8) MessageConfirmSelectionGroup2
9) SelectedObjectsGroup1
10) SelectedObjectsGroup2

2.1   Selection Modes

After analyzing all the commands that require some form of object selection, four standard modes of selection have been identified:
1) SingleObject – a single object must be selected and will be returned in SelectedGroup1
2) OneGroup – several object can be selected and will be returned in SelectedGroup1
3) OnePair – two individual objects must be selected that will be returned in SelectedObjectsGroup1 and SelectedObjectsGroup2 respectively;
4) TwoGroups – two groups of objects containing one or more objects must be selected and will be returned in SelectedObjectsGroup1 and SelectedObjectsGroup2 respectively.

2.2   ObjectSelectionPoolGroup1, 2

Depending on the command that is executed, there are only certain types of objects that are valid and can be supplied as operands. These two selection pools

contain all the objects that are valid for each of the selection steps. These objects must be determined by the calling function prior to calling the StandardObjectSelection function. When the user clicks with the left mouse button (LMB) on an object, only an object that is found in the current object pool will be selected and offered for confirmation.

2.3   Restart

The selection process can be started again after the operation was performed on the selected object(s).

2.4   MessageSelectingGroup1, 2

These parameters represent messages that will be presented to the user in the status area with useful instructions for the user about how and what to select. There is a special message that will be displayed for each selection group.

2.5   MessageConfirmSelectionGroup1, 2

User confirmation of a selection is especially useful when several objects are located near or under the cursor's position, making it difficult for the user to pinpoint a certain object. After the user has made a selection, he will be required to confirm his selection. If the object highlighted by the program is not the desired one, the user can reject it with the right mouse button (RMB) and, if possible, he will be offered another one. If the user rejects all possible candidates the StandardObjectSelection function is abandoned.

2.6   SelectedObjectsGroup1, 2

The selected objects are contained in the first or both of the selected objects groups depending of the selection mode as shown in table 1.

3   FUNCTION OPERATION

If a command requires a selection, the StandardObjectSelection function is called, each parameter being filled with the appropriate information.

When implementing a command that requires object selection, the type of selection must be first determined by the developer. Next, all the valid objects

from the project database must be added to the appropriate object selection pool. Also, the selected objects lists must be emptied.

Table 1. Selection modes and the contents of selected objects groups.

Selection Mode	SelectedObjectsGroup1	SelectedObjectsGroup2
SingleObject	Selected object	Empty
OneGroup	Selected objects	Empty
OnePair	Selected object from the first group	Selected object from the second group
TwoGroups	Selected objects from the first group	Selected objects from the second group

Certain situations exist which require special handling. There is a feature of the CAD system that allows the user to just select objects without performing any operation on them. This is called activation. When a command requiring a selection is issued by the user, StandardObjectSelection automatically will assume the valid objects that are active as the input selection, but only if the selection mode is OneGroup.

The objects are selected by the user through a series of mouse button clicks. The selection process can be aborted at any stage by pressing the RMB or the Escape key. If the left mouse button is pressed and a valid object is found at the current mouse position, the user will be asked to confirm the object. If the user rejects the offered object, the application cycle through all valid objects that can be found near the cursor. If the indicated object is accepted by the user, it will be added to the appropriate selected objects group.

If only one object must be selected, the function ends. If more objects must be selected, the user is asked again to select another object and the selection steps described above are repeated.

In the case that one pair or two groups of objects must be selected, when the user clicks the RMB while selecting the first object or group the function will ask the user to select the objects for the second selection group.

For an exact and clear description of the steps performed during the selection process, several flowcharts have been developed and are presented in this paper. Figure 1 contains a flowchart describing the process of selecting the first object and the cycling through all valid objects near the mouse cursor. Figure 2 presents a flowchart describing the selection process of more objects for the first selection group. Figure 3 shows a flowchart describing the selection process of the other object or object group in the case of OnePair or TwoGroups selection modes. Finally, in Figure 4 is presented the flowchart describing the selection process for the remaining objects that will be part of the other selected objects group.

SelectedObjectsGRoup1 = empty
SelectedObjectsGRoup2 = empty
FunctionEnd = false

Restart = yes? —N→ FunctionEnd = true → End

Y

Active Elem. + OneGroup? —Y→ SelectedObjectsGRoup1 = Active Elements → End

N

MessageSelectingGroup1
RMB End

LMB + Valid Ement? ←N— RMB? ←N— Esc?

N   Y   N   Y

FunctionEnd = true → End

Y

MessageConfirmSelectionGroup1
RMB Reject

Valid Elems left? ←Y— RMB Free? ←N— LMB On? —Y→ SelectedObjectsGRoup1 = SelectedObjectsGRoup1 + Confirmed Element

Y   Y   N   N

N

Two Groups? ←N— One Pair? ←N— One Group? ←N— One Element? —Y→ End

Y   Y   Y   N
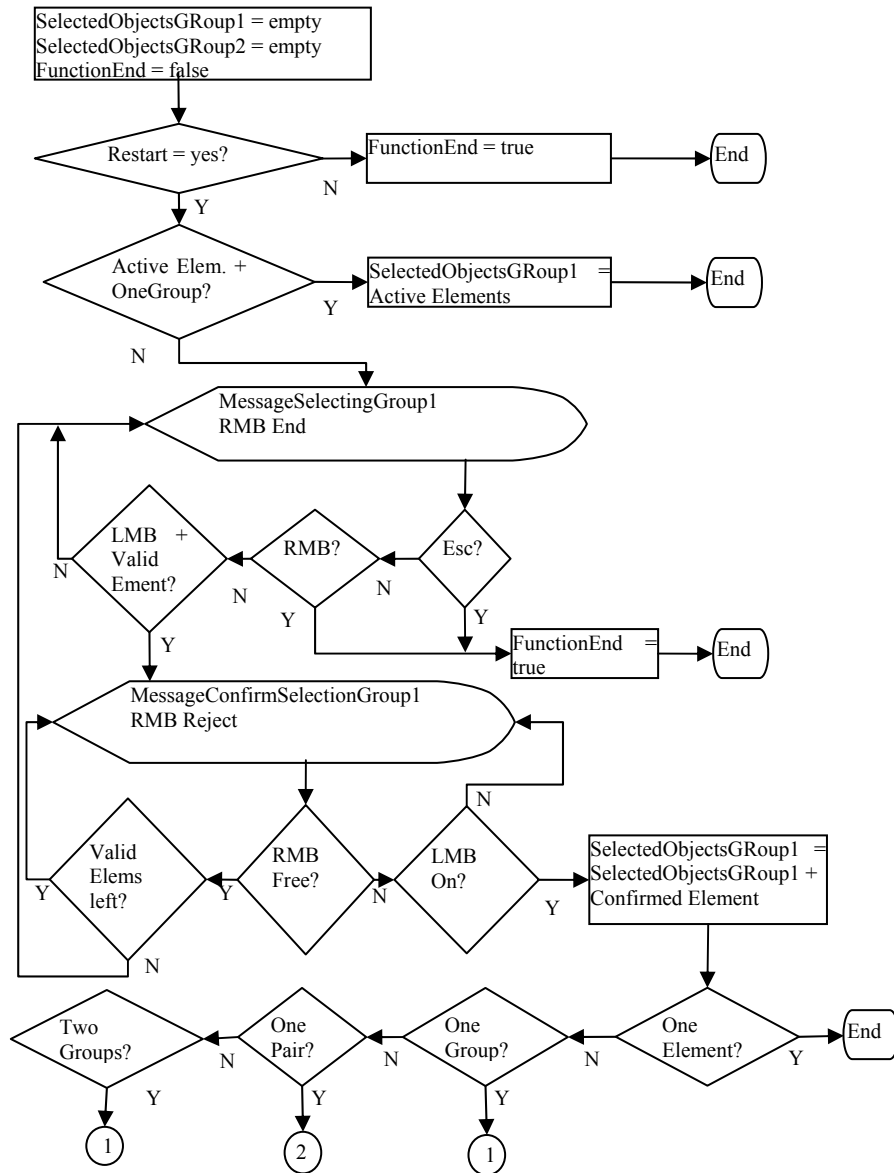
(1)   (2)   (1)

Figure 1. The process of selecting the first object and the cycling through all valid objects near the mouse
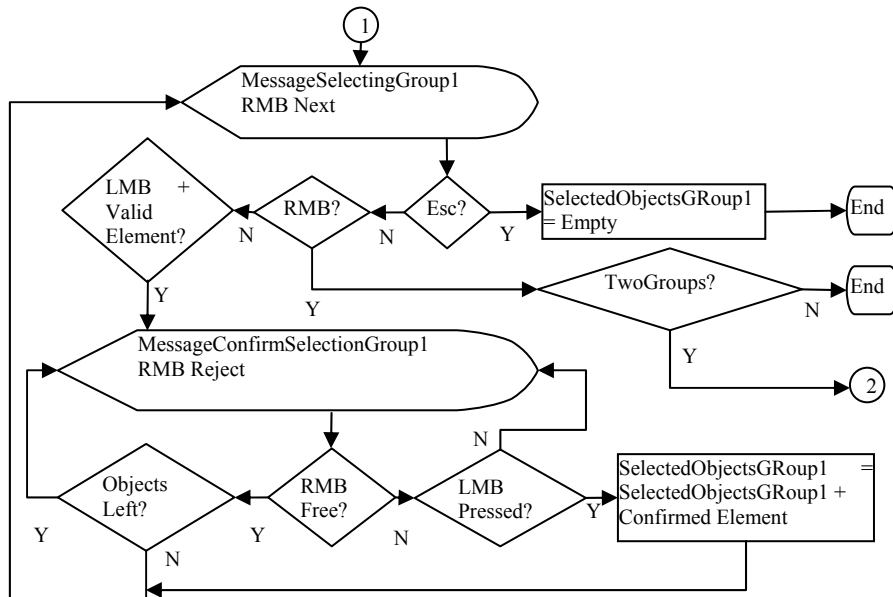
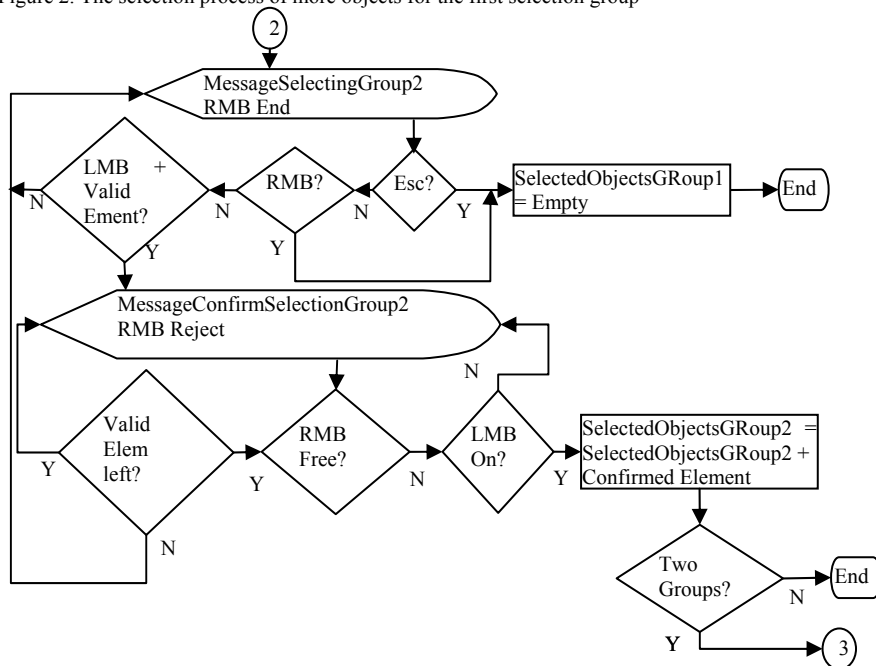Figure 2. The selection process of more objects for the first selection group

Figure 3. The selection process of the other object or object group in the case of OnePair or TwoGroups selection modes
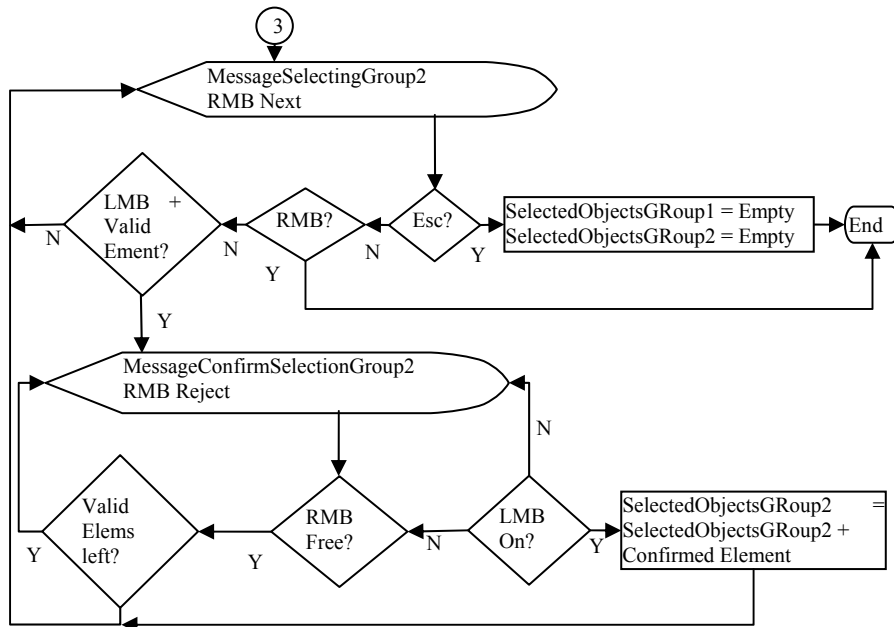
Figure 4. The selection process for the remaining objects that will be part of the other selected objects group

Conclusions

This paper presents a standardization of the object selection process performed by the user within a CAD system. The user will benefit from this solution by following the same known steps when selecting objects, focusing more on the task at hand. Also, the chosen solution enables the application developer to reuse code by calling the same function for all selection modes.

References

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