Abstract

Sketching in 3D is a design activity that requires a new approach to user interaction and geometric modeling in an architectural context. DDDoolz is an example of such a system used for mass study and spatial design. This paper describes the basic principles and the students’ experiences in a CAAD course.

Introduction

Sketching in 3D seems to be a paradox. The sketch activity is inherently 2D since it is executed in a plane on a flat surface using some drawing device (e.g., a pencil). Three dimensional creation and manipulation of objects presumes the activity being executed in a 3D environment on spatial objects.

In this paper DDDoolz will be presented, which is a new innovative dedicated system for mass study and spatial design in the early design stage. It is a low-end user system in the sense there is almost no learning time and the software will run on standard computers. DDDoolz has been tested in a first CAAD year’s course at the Eindhoven University of Technology. Students’ results are presented and experiences are reported.

DDDoolz: a 3D Sketching tool

In the VR-DIS program [www.ds.arch.tue.nl/research] at the Eindhoven University of Technology an interactive architectural and engineering design system is developed. A series of PhD students all research a specific part of this rather ambitious system within well-defined framework. Since the VR-DIS programme focuses on the early design stage a strong need was felt to develop a dedicated tool for this purpose and not rely on existing designing and drawing packages. Communication with others packages is not our primary research goal but is very well support through the use of our design information database.

The objectives for the development of DDDoolz were:
- Minimal set of commands
- Easy creation and manipulation of masses and spaces
- Easy visual evaluation of the created model
- Moderate system demands
No distribution restrictions

In the next paragraphs a brief description will be presented of the basic principle of DDDoolz and following that all features will be briefly explained.

Basic principle
The basic principle originates from K. Strehlkes research [1] and consists of painting blocks in space. Creating new blocks is best described by a 'copy while drag' operation. For determining the copy direction the Face Orientation Method is introduced [2]. Crossing the edge of an existing block while moving the cursor of the blocks' side will result in creating a new Block adjacent to the previous selected one. This fairly simple principle gives the user a sketch-like feeling when dragging a block through space. Evidently the block must be selectable from the current viewpoint position on a side that allows for extending in the desired direction, but this prerequisite seems quite natural.

Though painting blocks in space is executed quite effectively, a new release of DDDoolz will also support creation of arrays of blocks to make the creation of (solid) planes even more efficient. As soon as DDDoolz detects that the user is drawing a closed curve, a two dimensional array of boxes will be generated instead of a single array of boxes. This function can be suppressed or stopped by undoing the last drawn block.

To support multiple viewing of the model, the user can slowly rotate the model while drawing or editing. Alternatively the user can walk or fly through the model and experience the created object or navigate to the desired viewing position.

System features
Because the basic operation can only generate orthogonal models, an additional sketching mode was introduced, namely the creation of a curve consisting of a single array of blocks. This function is established by rotating the block into the dragging direction and making the edges exactly fit, thus creating a neat curve of blocks. If blocks do not completely overlap, DDDoolz does not object to one box partially coinciding with another block. For this reason complex solid shapes can be created leaving much freedom of form to the designer.

Obviously functions like Color, Delete, Move and Orientate available. DDDoolz stores a model in its own format, which can be imported in Autocad using a VBasic macro. In Autocad all individual blocks will visible and editable, but they also can be compiled to one or more solids using the Autocad unify operation. DDDoolz can import models that are created or exported in 3DS format. The import feature allows for integration of the DDDoolz sketching functionality with 3D models that cannot be created with DDDoolz.

System implementation
DDDoolz was implemented using WorldUp (Sense8) VR development environment. The WorldUp player, which is necessary to distribute DDDoolz, is free of charge. No special additional hardware is required to maintain a reasonable performance with a model containing hundreds of blocks. Initially the system only used key pressed buttons for command invocation. In the first student release of DDDoolz the command functions were implemented as buttons using Visual Basic.

The system is distributed as a shareware application by means of our website (www.ds.arch.tue.nl / research/DDDoolz). All required software, manual pages and examples are available at the cost of a (good) response.

Student practices with DDDoolz
To test DDDoolz on its robustness but even more interesting, on its promises, we decided to use it in our first years CAD course at the Eindhoven University of Technology. The course is attended by
approximately 300 students. Notably, all students in Eindhoven have to buy a laptop computer at the beginning of their study. Standard software like the MS Office suite, Corell-Draw&Paint and Autocad are pre-installed. DDDoolz had to be installed during the course from the same location where all other course material is located. The objective of the CAD course is to give the student insight on computer usage in an architectural and design methodological context. Students practice with the drawing, painting and traditional sketching tools. DDDoolz is used to explore mass and space study in an un-traditional way.

The students’ task was to create an exhibition center using DDDoolz and to pay special attention to experiencing the model from the outside and from the inside. A web page was to be created as poster for an exhibition. Images of the design created in DDDoolz should be used in the poster. The exhibition could be of any nature and the object (e.g. a sculpture) had to be created in Autocad and then imported in DDDoolz. The official time spent on one exercise is four hours, somewhere during one week. The actual time spent depends of course heavily on the students’ experience, enthusiasm, etc.

For practical reasons the posters are not presented in this paper, but only the DDDoolz images.

Discussion and Conclusion

In spite of our thorough preparations we still had to face some technical problems. Almost all problems originated from the DirectX 3D driver that is used by the WorldUp player. Students tend to play a lot of games, which may cause overwriting the Direct 3D driver with an older unsupported version. Though software problems are almost unavoidable we hope to minimize them by pre-installing DDDoolz on the student laptops next year.

As we had hoped for, the students had no problems using DDDoolz despite the very limited time. Because the block array generation feature was not yet implemented in the student edition, most designs appear to have a quite open structure. Some students took the sketch functionality quite literal creating quite massy, though sketchy shapes. Still
a lot of student did not take advantage of the possibility to design from the inside. Here, it seems that traditional sketching and designing is obstructive to new tools like DDDoolz. The exercise allowed for post editing the screenshot image of the DDDoolz model. We were not very happy about the use of Corell-Paint. Students seemed to be more focused on the effect generated by such a bitmap package, then by functional use.

In the next years course we will use a newer version of DDDoolz that will probably increase the functionality while keeping its simplicity. In our instruction we will put more emphasis on the architectural design characteristics of the tool. After all students should be stimulated in creating mental and virtual images of interesting shapes and spaces. DDDoolz has proven to support this process and will be developed further as part of our VR-DIS research programme.

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References


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