

A 3D LIKE REPRESENTATION OF REAL WORLD OBJECTS

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Abstract The method we present here can be used to create realistic 3d-like representations of small objects. The advantage of this method against the 3D Modeling software's is that we do not use a computer generated model in which small details can be omitted, but pictures of the real object. The rapid succession of the static pictures gives the sensation of movement.

In this paper we describe the steps required for creating the image sequence and the software application we wrote to be used to represent the objects.

Keywords: object visualization, multimedia, education, virtual reality.

1. INTRODUCTION

There are many ways to create 3D like models of objects. The state of the art methods are integrating several fields of science, like physics and computing.

A pure physical method is by taking a holographic picture of the object. This method is used successfully for instance in preserving the cuneiform tablets from the ancient Babylon[1] but it has a major back draw regarding the implementation of the method (expensive, requires special equipment and staff). Also the possibility of sharing and multiplying the image of the object. Also one holographic picture can not represent the entire object from any directions.

Another way involves the use of computers connected to a sophisticated 3D scanner. Three dimensional scanning or 'digitizing' is the process of capturing the geometry of existing physical objects through the use of digitizing machines[2]. Usually this system is requires three basic elements : 1. a laser device combined with a 2. receptor forming the scanner and a 3. computer with a 3D modeling software which has the capability of accepting data from the scanner. With this method the object can be scanned from any angles with very high accuracy followed by a computer generation of the image. The image from the computer can be rotated by any angle, the size of the image can be increased or decreased. But this method is expensive too and the computer model can not reproduce the true colors of the real object even with the use of meshes.

In the followings we would like to present a method in which we use a set of still images of the object, recorded into the computer and with the aid of a small computer software the user can rotate and see the object under different angles of view.

2. ANALYTICAL METHOD

Our goal is to represent the original object. The first and logical option is the photographic picture of the object. With this we can reproduce a perfect copy of the real object up to the smallest details. The problem is that the picture is 2D. The picture gives us a static image of the object from a single angle. Thus we can make several pictures from several representative angles but even so, details can be lost. There is a chance that a certain detail shows best from an angle which was not taken. This method is used in several products like ShapeCam from Eyetronics[3]

The next step is to record the rotating/moving object to tape, to make a movie with it. So the image is in movement and represents the object from all possible angles. For this we can proceed in the following way. The object is attached to a rotating platform (a disc). The object is recorded in a 360° rotation after Oz axis. The camera is moved on a different position after the Ox axis and the object is recorded again recorded with a 360° rotation after Oz axis. The procedure is repeated for several positive and negative angles after Ox axis. In this way a full view of the object is obtained. It is not necessary to rotate the object after the third axis because such a rotation can be obtained as a combination of rotations after the other two axis.

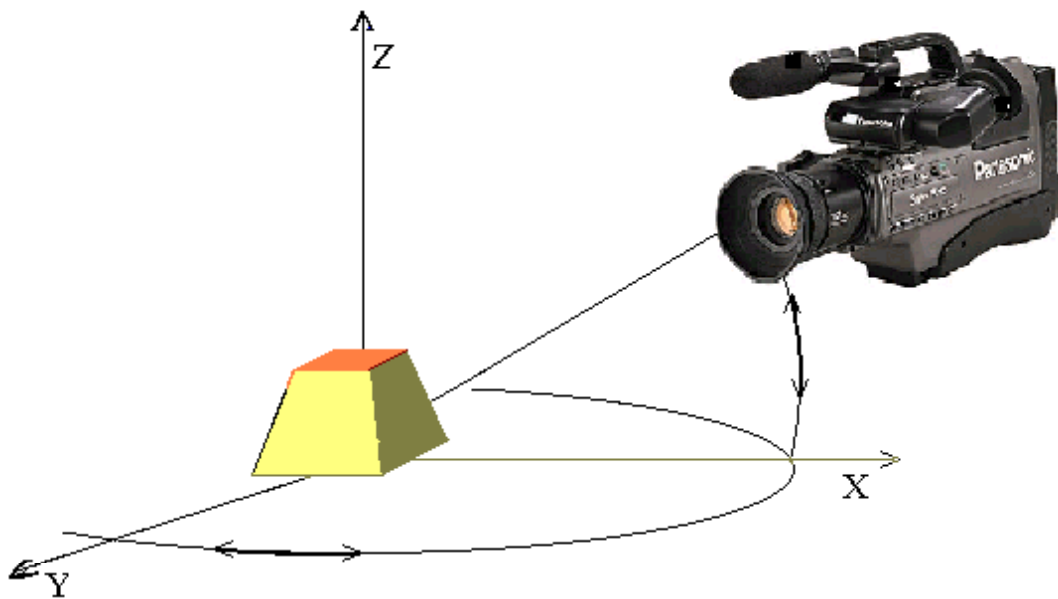


Fig. 1. Taping of the rotating object under different angles

From the point of view of the person who is studying the object, who probably would like to see the object from a certain angle at one moment and from another one after, the task of finding that angles on the tape can be frustrating. Lets suppose that we find the view in xOy plane (left- right) and we would like to see a picture right after, for the same xOy position but a different xOz angle. We are supposed to search our tape for the right image again.

A certain improvement would be to tape the different xOz positions on different tapes. By finding a good xOy position at a certain time-code or frame number we can jump on the xOz rotated tape (after changing it) at the same frame position if we agree that the object was taped with the same starting angle in xOy and the rotation has the same speed (a certain frame in different tapes, will contain a picture of the object for the same xOy angle).

If we have a single movie it is also possible to jump a certain number of frames in the movie. If for a 360° rotation in xOy plane the tape contains n frames a number which corresponds to a multiple of n will show the object for the same xOy angle but different xOz angles.

When we started this project we agreed on several conditions for the application to meet like:

- the real object to be represented, the generated images were excluded.
- the user must have the possibility to rotate the object on any desired direction
- once a project (object) is loaded the user doesn't have to "change tape" for an up-down rotation for a certain left-right angle.

3. METHODOLOGY

We started by analyzing the concept of the movie[3]. A movie is a sequence of static images changed with a certain speed. What we need is a lot of static pictures of our object and by changing them with a certain speed and "direction" we can get a movie like image. Therefore we come with the idea of an image matrix in which the images from the lines are corresponding to the rotation in xOy plane and the images in columns are the results of rotation in xOz plane for the same angle in xOy . This matrix can be covered with a step of 1 picture at the time in one of four directions: left, right, up and down from any current position.

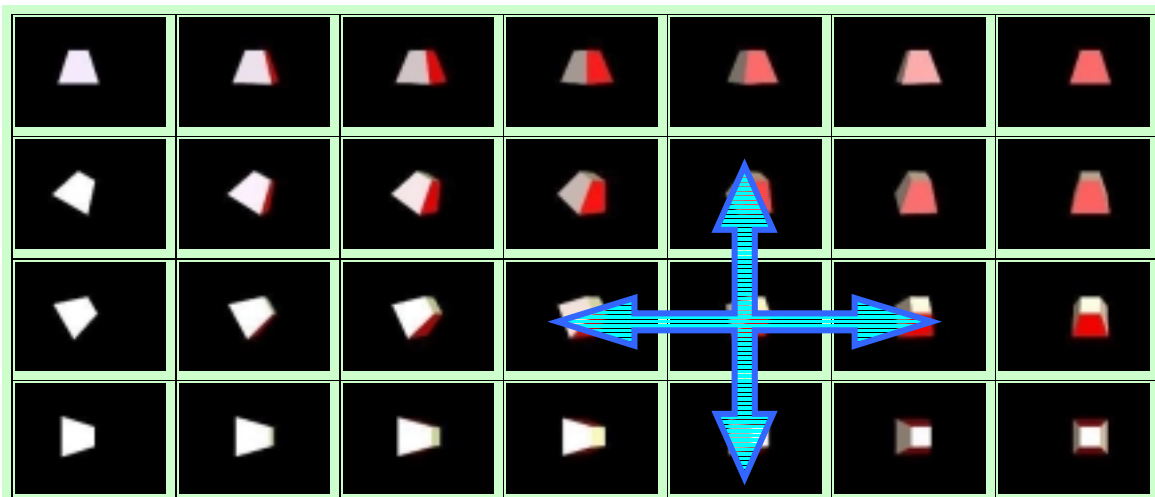


Fig. 2. The 2D image matrix

The next phase is to load the images in an application which shows 1 image at the time from this matrix. The application allows the move not only in lines but also in columns too, so the user has the possibility to load images in left – right motion sequence but also up – down motion. By loading the images with a certain speed a movie effect can also be obtained.

There are 2 major steps in creating a model of an object with this method :

- the creation of the image matrix which requires the following operations

1. taping the object in a 360° rotation in xOy plane for several angles in xOz plane, equal. Every xOy rotation must have the same duration and must begin from the same xOy position (angle 0°). For this both the disk and the platform supporting it are marked and the rotation speed is kept constant.
 2. the movies are transferred (captured) to a PC. This operation requires a PC with a capture card and a video capture/edit software.
 3. transforming the captured movie in frames corresponding to pictures taken under equal angles. The number of frames and the difference in angle between them is important for the smoothness of the transition on the application screen, smaller angle = smoother transitions but in the same time more pictures means more storage space. Satisfactory results can be obtained for a number of 25 frames for a 360° rotation. Our matrix will contain a number of $25 \times 25 = 625$ pictures.
- Next step is to add the pictures to our application.

The first step is actually the most time consuming and requires a lot of initial preparations. We have used a Pick Up player with 45 rot/min which means 1.33 sec for a complete rotation. This means that with a 25 frame/sec capture rate a full rotation will be captured in 33 frames. To transform the 33 frames in 25 we used the time compression function of the video editing software. Actually, we compressed the 1.33 seconds in 1 second.

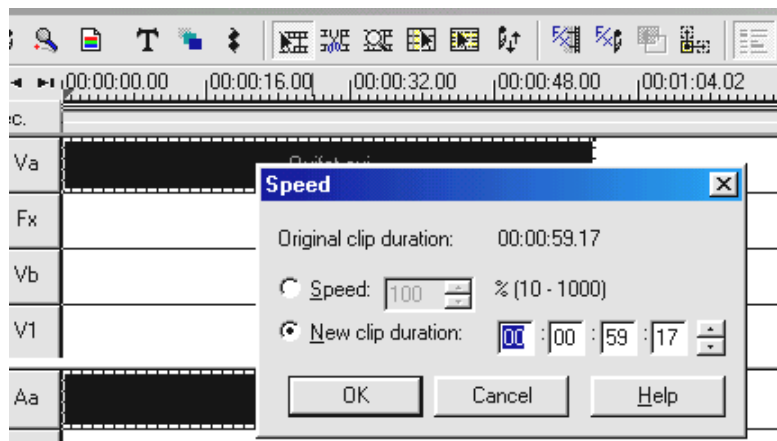


fig.3 Speed option of the video editing software

Then the 1 second movie corresponding to a full rotation was saved as a set of separate picture frames with Jasc's Animation Shop software which has an automatic avi to picture frame function. This operation is retaken for 25 xOz angles to get the full 3D picture set.

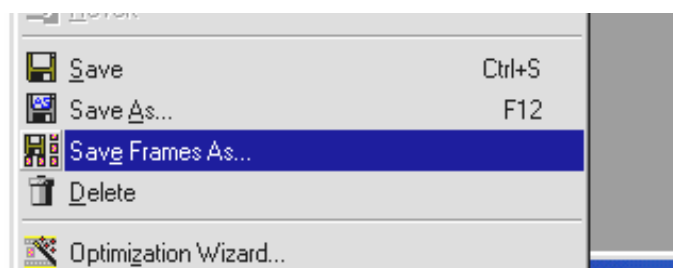


fig.4. Save as frame option

4. APPLICATION DESCRIPTION

The software was written in Visual Basic 6. It allows us to write the application with a friendly, intuitive, easy to use interface fully compatible with Windows OS.

The application interface includes the followings:

1. Directory selection box for the selection of the project (object) all the user must do is to select the
2. Edit box where descriptions of the represented objects can be read. This text is read from a doc. file situated in the same folder as the image matrix.
3. Object window where the object is shown.
4. Motion buttons to rotate the object.
5. Speed slider to change the speed of the motion.

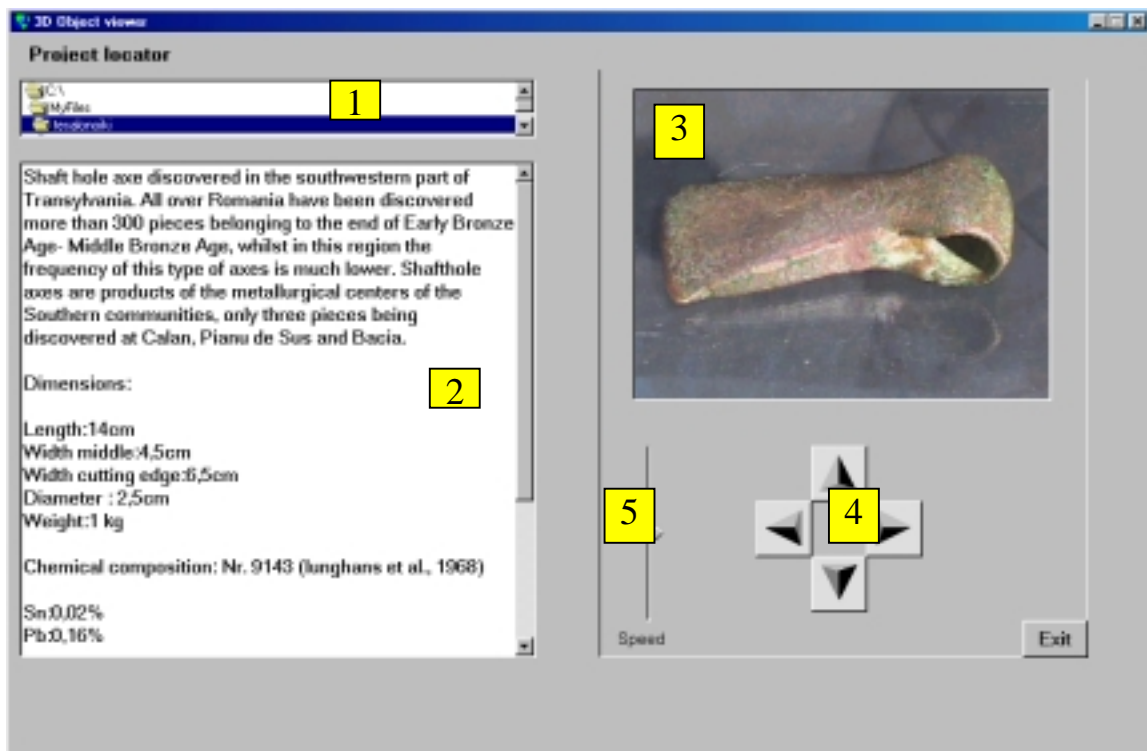


Fig. 5. Screen capture of the program with the object and its description

After the application is loaded we can select the object from the directory select box. For this all we have to do is to select the folder which contains the image matrix, the representative image and the file with the description text. Every folder contains the image files with the same name, only the name of the folders are different. After this, the information about the object is loaded in the edit box and the object window gets the first image from the image matrix of the object. Right after this, the user can study the images, he can rotate the image by clicking on the button corresponding to the desired rotation direction.

With this method we can tape objects up to a 20cm x 20cm x 20cm. The limitations are due to the dimension of the rotating platform. We are working on a device, specially designed for this operation which will have the rotation frequency of 1 rot/sec this will allow us to tape the image directly to the computer without remaking it with a separate frame rate, and the platform will be able to support bigger objects.

5. CONCLUSIONS

There is a wide applicability of this program in the instruction field, research of museological and archaeological artifacts, restoration and conservation procedures, virtual museum and data management of cultural heritage.

Further development is connected with data processing which to be achieved by the software.

A web solution which to permit online study of the object is also to be considered. Of course the quality and the size of the images in this case must be reconsidered due to de limited connection speed and the upload time of the pictures.

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