

# Computer Aided Drawing System on Archaeological Material

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**Abstract.** Drawing the material obtained from an archaeological dig is one of the hardest and longest processes, so any method or technique that allows us to work in a faster way would be a great improvement, leaving us more time to deal with other matters. Besides giving us the chance of drawing faster, this method offers several advantages such as: more accuracy, the possibility of taking as many measures as we like at any time, the quick change of scale and design without losing image quality.

Once the drawings are digitalized, we can insert them in a database, thus saving time when classifying the drawings or when just looking for them. With this method we will also be able to obtain the original volume of the item on the basis of the three-dimensional drawings, as well as have the chance of creating educational videos by means of virtual reality.

**Keywords:** CAD, 3D-measurement.

## 1 Introduction

The prospects of this kind of method of computer aided drawing are promising because they offer many advantages over traditional systems.

The method developed in this article has the advantage of being quick and easy, and what is more, it does not require large investments.

Compared with other methods of computerised drawing, this one offers the advantage of developing the whole process digitalized with the consequent saving of time, as well as giving us the chance of making as many copies of the drawings as we want and changing its scale without varying its quality. Nowadays the existence of several models of 3D scanners allows us to obtain three-dimensional drawings of objects. Unfortunately these apparatuses are relatively new so they are still expensive and rather slow. However, these scanners cannot be used to produce two-dimensional drawings, and neither can they be adapted to determined conventions nor to decide which parts of the piece must be emphasized or pointed out and which ones must not be drawn.

When it comes to viewing or creating an image in the computer we have two choices: on the one hand there are the raster images or bitmaps which are graphics formed by a series of dots. These dots are called pixels. We cannot change the scale of this kind of graphics without at the same time losing image quality or sharpness. Some of the most famous bitmaps formats are BMP, TIF, GIF, JPG and TGA.

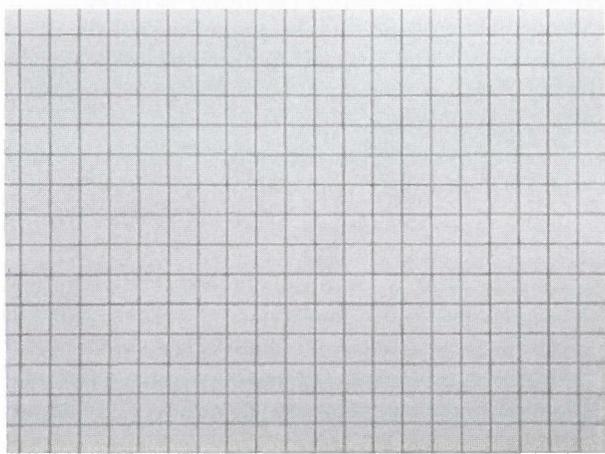
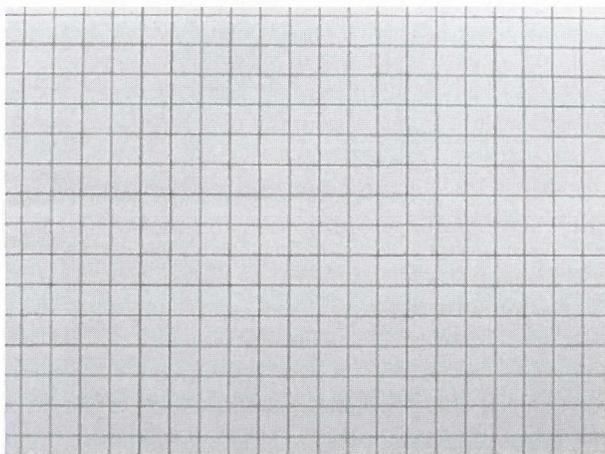
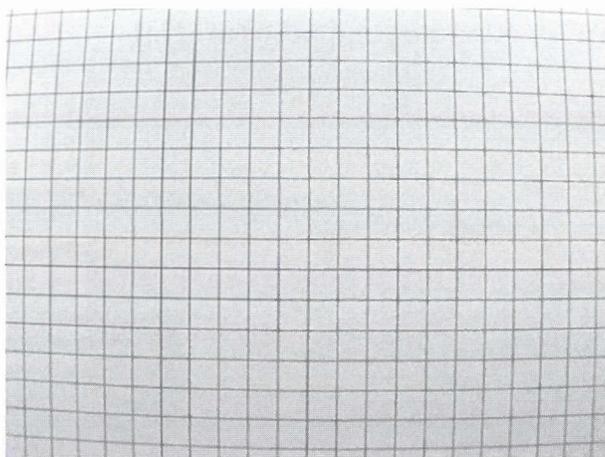
On the other hand there are the vectorial drawings. As their name indicates they are generated by means of vectors, coordinates and mathematical formulas. These kinds of graphics are understood by the computer, so we can ask at any moment how long a line is or the size, area or any other characteristic about any element. In a similar way we can easily change the scale of an object or change its position without any loss of quality. These kinds of graphics are the ones that we are going to ob-

tain as the final result. Some formats of this sort are DXF, DWG, CDR or CMX.

## 2 Image capture

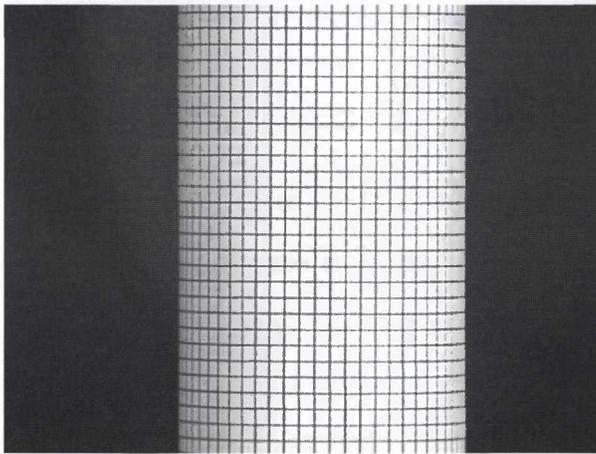
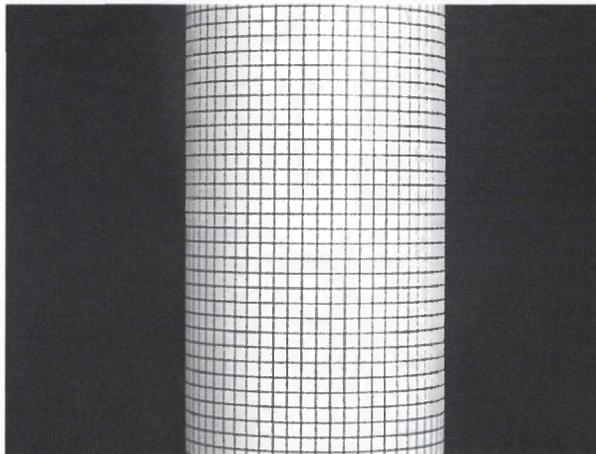
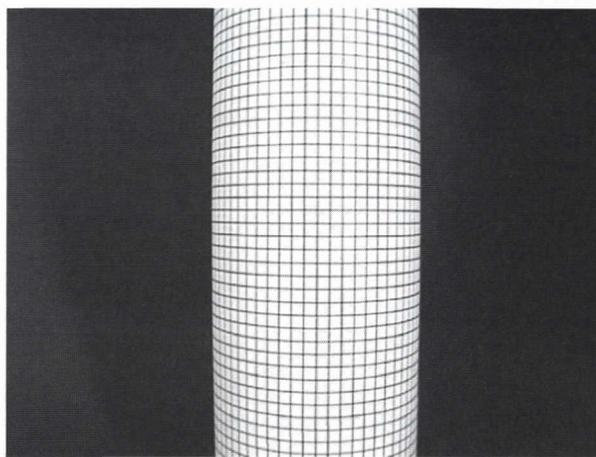
In order to capture the images I have used a camera and a video snapshot. The image captor allows me to digitalize the images obtained with the video camera. From my point of view this camera has many advantages over a digital photographic camera. And even over the scanning of the photographs taken with a conventional camera:

- The image quality of the video is higher than that obtained with a conventional digital camera. We can create images of up to 1500 x 1125 pixels. This is outside the reach of most conventional cameras.
- Although both types of camera have a similar price, this method (video camera) is cheaper because to have a large number of photographs developed is very expensive and the memory cards of digital cameras are also extremely expensive. Another advantage is that we can store many images on just one video tape.
- The tool white balance of a video camera allows us to adjust automatically the temperature of the colour, so that we can obtain very similar images with very different lighting conditions. This will work if we do not use incandescent lighting and fluorescent lamps (tube lighting) at the same time.



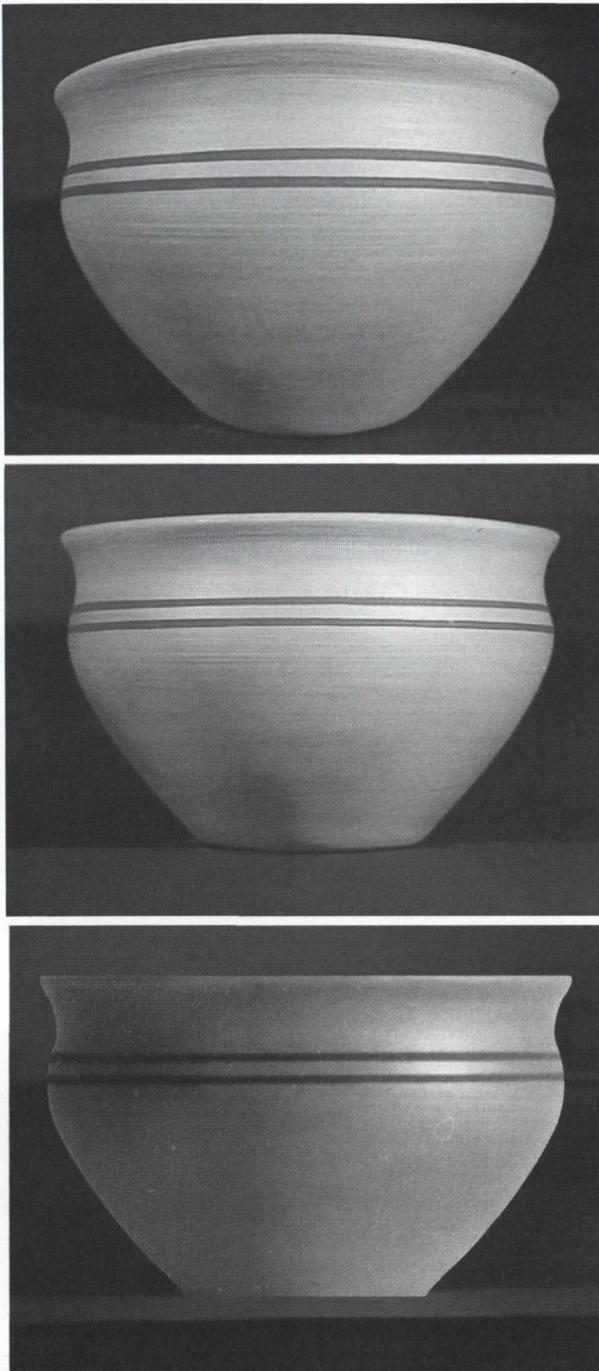
**Fig. 1.** The distortion of the lens over a plain surface forces all the lines to curve except those that go through the centre. This distortion practically disappears with a lens of 50 mm or more. Top: an image obtained with a lens of 28 mm, centre: with a lens of 50 mm, bottom: with a lens of 500 mm

- To reduce the distortion produced by the lens (Fig. 1) we will use a high zoom lens. Video cameras are perfectly equipped with these kinds of zooms and they are normally sold with lenses of up to 28 - 500 mm, plus a macro. The price of a video camera with these characteristics is similar to that of a digital camera with a 39 - 111 mm lens.



**Fig. 2.** If we use zoom lenses with long focal distances the objects are not reduced in size in spite of being further away. Top: an image obtained with a lens of 28 mm, centre: with a lens of 50 mm, bottom: with a lens of 500 mm

- In order to reduce the perspective effects (far away objects seem smaller) we will also use very high zoom lenses that can solve this problem to a great extent (Figs 2 and 3).
- A particularly useful feature is the possibility that video cameras can record sounds. In this way we will be able to insert notes about the piece we are dealing with, such as its abbreviation or acronyms.



**Fig. 3.** If we use zoom lenses with long focal distances the object is not reduced in size in spite of being further away. Top: an image obtained with a lens of 28 mm, centre: with a lens of 50 mm, bottom: with a lens of 500 mm

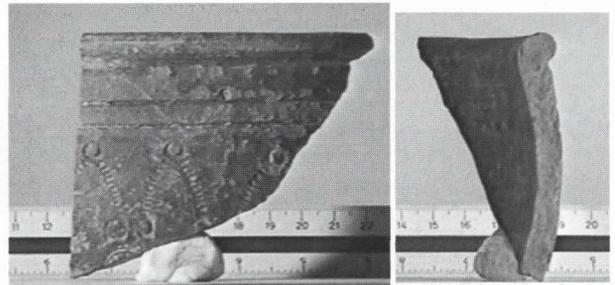
- Finally I would like to point out another advantage of the video over the conventional photograph; we can actually watch live the images that are being recorded, though digital cameras also give us this option.

When recording a piece with a video camera we must include a scale of the shot so that once it has been digitalized we can easily put the images to scale. Another aspect to bear in mind is the lighting. If we are going to make a two-dimensional object and the piece shows decoration in relief, it is advisable to light the piece

from one point only so that the shadows show this relief. If on the other hand we are going to use the image as a texture for a three-dimensional object, we must avoid any kind of shading. The computer programs will be in charge of the shading.

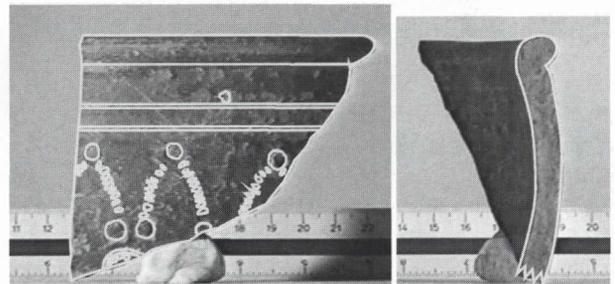
### 3 Tracing 2D

First we must import the photograph into the drawing programs in use and then put it to scale (Fig. 4). To do this we must take a measure over the scale that appears in the photograph and according to its measure and thinking about what it should be, we only have to solve a simple rule of three. The bigger the measure we take, the smaller the margin of error we will get. Once this point has been reached, we could use a comparison to describe the procedure that is left: we just have to write in ink something that was in pencil.



**Fig. 4.** The images are digitised and put to scale

The next stage will be to create a new layer and trace over it the parts of the imported image we want to take into account (Fig. 5).



**Fig. 5.** The parts we are interested in are traced, in a different layer to the previous one

Hand-made ceramics (pottery) need background texture and shading over the changes of curvature. Therefore, we should scan a convenient texture (because the textures included in the program are not usually suitable) and apply it to the drawn piece. We will obtain the shading by exporting the drawing into an image processing program. We can then shadow the drawing with the spray tool previously loaded with a suitable texture (Fig. 6).

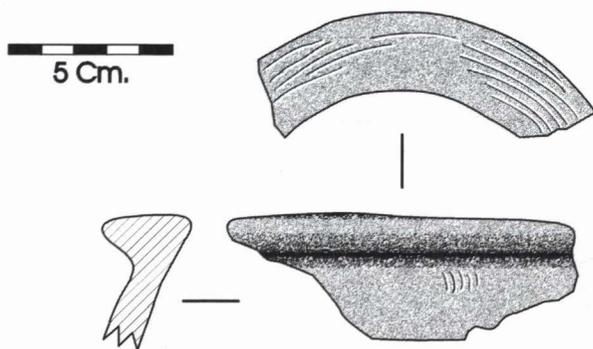


Fig. 6. We can produce shading by exporting the drawing into an image-processing program. The shadow in the drawing can be produced with the spray tool previously loaded with a suitable texture

Finally we must design the page, add a graphic scale and save the drawing, print it or export it to a database (Fig. 7).

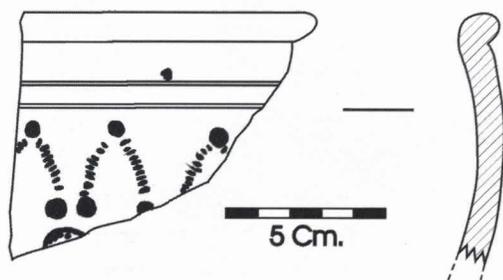


Fig. 7. We delete the layer with the photographs, and add the axis, the shading and the scale

#### 4 Tracing 3D

The final result that we have obtained now is not a drawing of an object but a virtual object. The computer treats it as an object and it can be manipulated. This object has a virtual surface, a virtual volume, virtual walls and virtual colour and texture. We can therefore observe the object from any angle, calculate its volume, find out any section or even edit a video clip.

Objects can be shaped in many ways, depending on the morphology of the original object, and the preferences of the designer. Next, I will explain two processes which in my opinion represent the fastest and easiest ways of creating ceramics and irregular objects.

##### Ceramics:

When I talk about ceramics I am only referring to objects made with a potter's wheel. To create such an object we will have to insert a photograph of a section of the piece, then trace it as a two-dimensional drawing, set the axis in its right place and rotate the section round it.

Most three-dimensional drawing programs allow us to apply textures to an object in a plain, cylindrical, spherical and cubic way. The images of the original fit to a plain projection because the image taken from a

video is also plain, so if we project again the texture of the plane over a round object each portion will return to its former place. However, this is very difficult, especially at the corners of the image because it is in these parts where the image is in profile, which means that a small portion of the image must be spread over a wide surface of the object (Fig. 8).



Fig. 8. This image clearly shows the mistakes that can arise when applying its own texture to a ceramic objects

To solve this problem we shall not apply the image to all 180 degrees, but only to the central part of the object. We will therefore not use two images (a front one and a back one) but at least three, separated 120 degrees from each other, or 90 degrees if we use four images (Fig. 9).

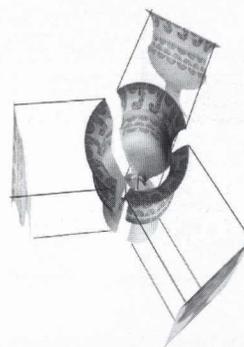


Fig. 9. To avoid deformations we apply the texture with a minimum of 3 segments of 120 degrees

In this way we will get an object with several textures at the same time or several segments with several textures (Fig. 10).

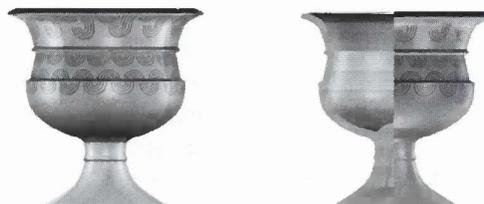


Fig. 10. Finally we join the segments to obtain the virtual reconstruction of the piece

##### Irregular objects:

I will include flint, bone and most metallic objects into this category. They will be created by tracing the profiles of the main views of the objects. We will then

extrude these profiles and the object will appear as the intersection of these profiles (Fig. 11).

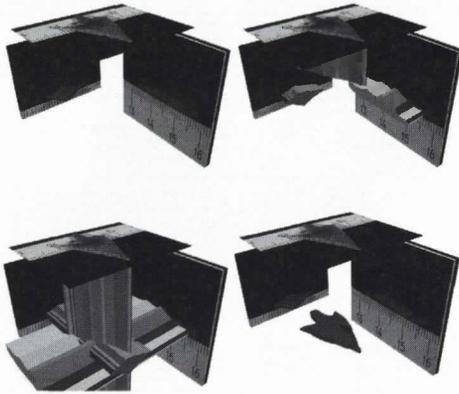


Fig. 11. The three main views of the object are extruded and then intersected

The textures will be added as described above for the ceramics. Nevertheless, we must take into account that if the objects are plain enough we will only need one image for each face (Fig. 12).

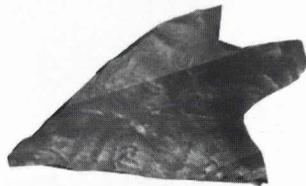


Fig. 12. With a very plain object, two textures will be enough: one for the front view and another for the reverse

## 5 Conclusions

The time spent drawing a two-dimensional object will basically depend upon its complexity and decoration. If we are dealing with three-dimensional pieces, it would be much faster to draw them in three dimensions because we do not have to reproduce all the decoration, but can merely paste the image without caring about the quantity or quality of the decoration.

Two-dimensional drawings are basically like those traditionally made by hand and they can be easily accepted. However, three-dimensional drawings, despite giving useful information about the object, are only used in video clips, web pages or for merely decorative purposes. This problem is due to a great extent to the fact that they are photorealistic graphics in full colour and are very expensive to publish. They are however perfectly suitable to be attached to a database or to any kind of distribution, such as CD-ROM, where full colour images can be added without any change in the final cost.

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<sup>1</sup> Apart from the drawings we also have the digitalized photographs which can be included in a database.