**Ortho Projection and Drawing for Archeological Artifacts of complicated form**

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**ABSTRACT**

In the compilation of archival records for archeological artifacts, true orthographic drawings of these artifacts have to be drawn by the archaeologists themselves or part-timer , expending a great deal of time, labor and skills.
This paper describes the real time orthographic drawing system for archeological artifacts with complicated form using CCD camera . Finally , it demonstrates real time orthographic drawing results for Jomon pottery by using this system instead of the manual method which requires 3-4 hours.

## 1. INTRODUCTION

Many sites are excavated yearly in Japan . For example, over 8,000 archeological sites were excavated in 1994, and an abundance of archeological artifacts such as Jomon or Yayoi pottery are uncovered from these sites. In this context, the large format still camera is expected to become a useful tool in taking orthophotos.

There are, however, still some issues which need to be solved for real time orthographic drawing, such as, developing, enlargement and tracing. From the view point of tracing, it is possible to utilize a scanner, nevertheless developing and enlargement are still subjects.

By using the orthographic drawing system with a CCD camera as proposed in this paper , an orthoimage for archeological artifacts can be acquired in real time even there are uneven parts and high quality image can be taken by using line laser beam instead of slit fluorescent light .

Furthermore the orthographic drawing can be obtained in real time via image processing procedures wherein the orthoimage is recorded as part of a rebirthable data image.

## 2. ORTHOGRAPHIC DRAWING SYSTEM

An orthophoto can easily be taken from the continuous photo which is taken with the shutter opened while the artifact is slowly moved in the dark space and slit lights are applied from both sides ( Yokoyama , etal , 1995 ).

In a general way , the Still camera is used for this purpose ( Miyatsuka , 1994 ) , nevertheless it has the weak points described above. If a CCD Camera can be utilized instead of Still camera(Fig.1), an orthoimage can be acquired in real time.

Furthermore, tracing can be done in real time by using image processing procedures since the orthoimage is digital data.

With this mind, the authors developed the orthographic drawing system using a CCD camera.

Table.1 shows the components of the orthographic drawing system and Figure 2 shows the configuration of this system.

Table.1 components of the orthographic drawing system

| | |
|---|---|
| CCD camera | XC-75 (SONY) |
| Lens | VCL-16Y-M (SONY) |
| A/D converter | FRM2-512 (PHOTORON) |
| TV monitor | PVM-1454Q (SONY) |
| PC | PC9801BX (NEC) |

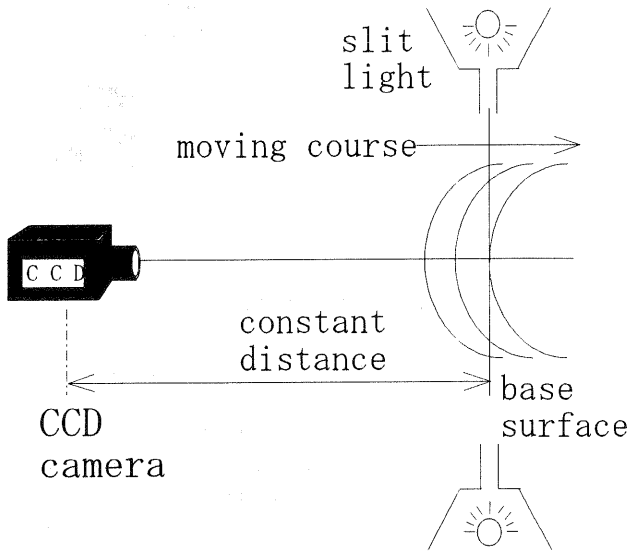


Fig.1 Ortho projection using CCD camera

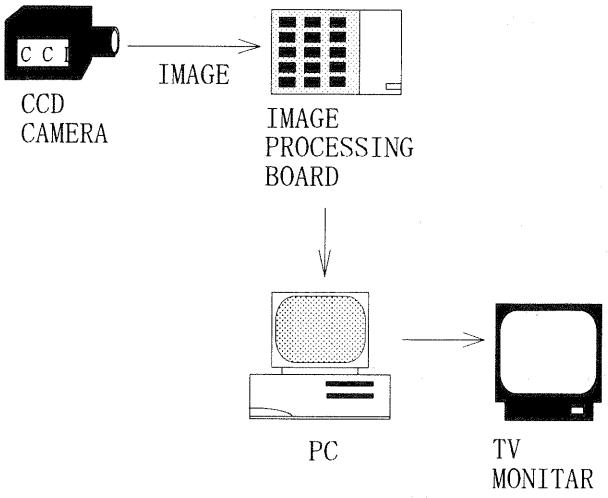


Fig.2 System configuration

In Figure3 , image A is taken by CCD camera and image B is prepared beforehand as a completely black image. By inputting brighter pixels to the new pixels on image B, brightness comparisons between image A and B are made as the orthoimage is continuously synthesized on image B. It is also possible to confirm the synthesis process of an orthoimage through the monitor.

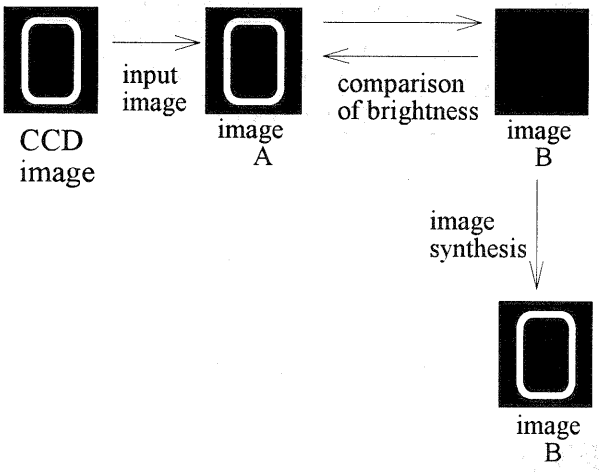


Fig.3 Image synthesis

However , if there are uneven parts on archeological artifacts , these parts are not light upped because of this system is using two source light ( fluorescent lights ) . It's a serious weak point for this system . Then , the authors adopted three light system ( up and both sides ) to improve this subject . Figure 6(a) is an ortho image which was taken by one light from up side . From this figure , it can be find that the subject on two light system (Figure 6(b) ) will be solved . Based on this result , an ortho image for an archeological artifacts with complicated form was taken by this three light system( Figure 6(c) ) . As a new subject , halation with caused by three slit lights system was occured , this subject was solved by cutting the upside parts of both slit lights ( Figure 5 ) . Figure 6(d) is the result of three slit lights system with cutting . From this figure , it's understand this system imprrove the weak point for two slit lights system .

On the other hand , Figure 7 show an ortho image which was taken by using two line laser beams instead of fluoescent slit lights under view point to gettinng fine image quality .

## 3.EDGED IMAGE

The Laplacian-Gausian filter was used in this paper to acquire the edged image for the archeological artifact since it is advantageous for both Laplacian and Gausian filter ( Marr , 1982 ) . Figure8 show the edged images produced by this filter.

## 4.CONCLUSION

This paper describes the orthographic drawing system using a CCD camera. Table 2 shows the differences between the Still camera and CCD camera system.

Table 2 Characteristic points between Still camera and CCD camera system

| | Still camera method | CCD camera method |
|---|---|---|
| Time for taking photo | 2~3 minutes | 5 minutes |
| Developing and Enlarging | Need | Not need |
| Time for tracing | 3~4 hours | 10 seconds |
| Data format | Analog | Digital |
| Image processing | Need to change into digital | Easy |
| Data saving | Photo | Disk |

Consequently, the real time orthographic drawing system using a CCD camera is expected to become a useful tool in the archeological field. The orthoimage and orthodrawing can be acquired in real time and thus recorded as part of the image date. There are, however, still some issues which need to be solved before this system can become operational, for example, image quality and the synthesizing speed of the orthoimage.

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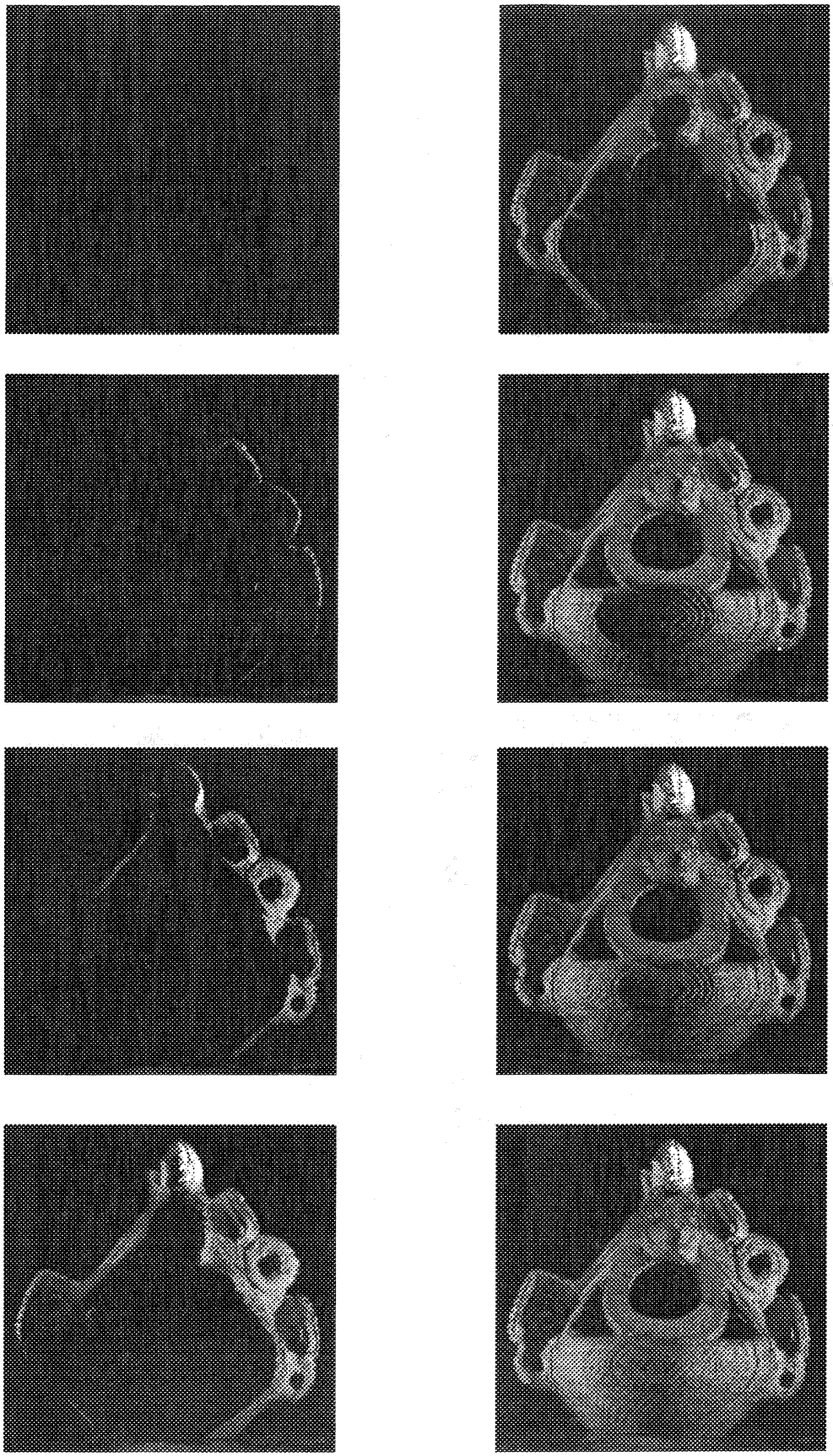

Fig.4 Synthesis process of ortho image

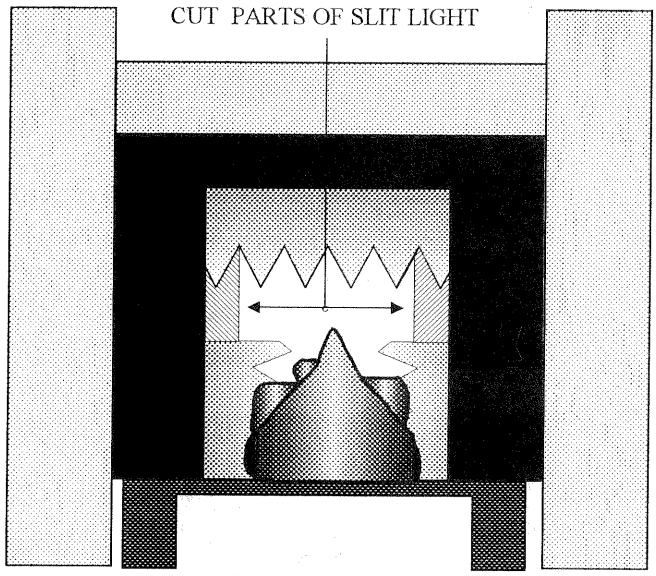


Fig.5 Three slit lights with cut system

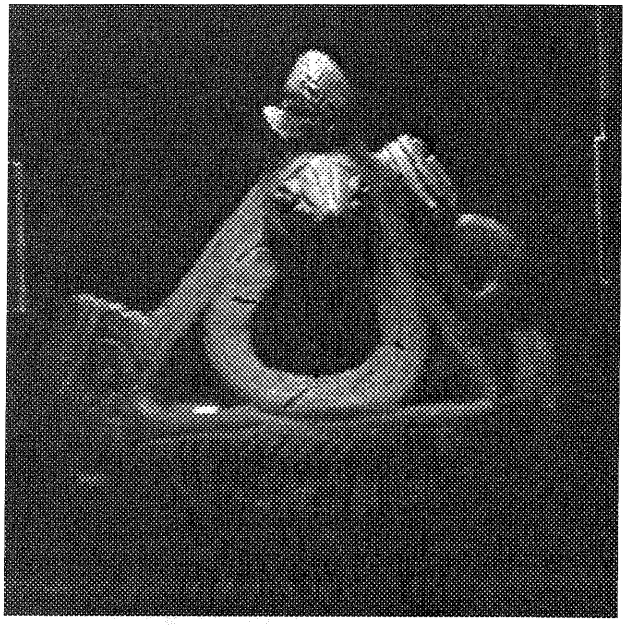

Fig.6(b) Image of light up from only upside

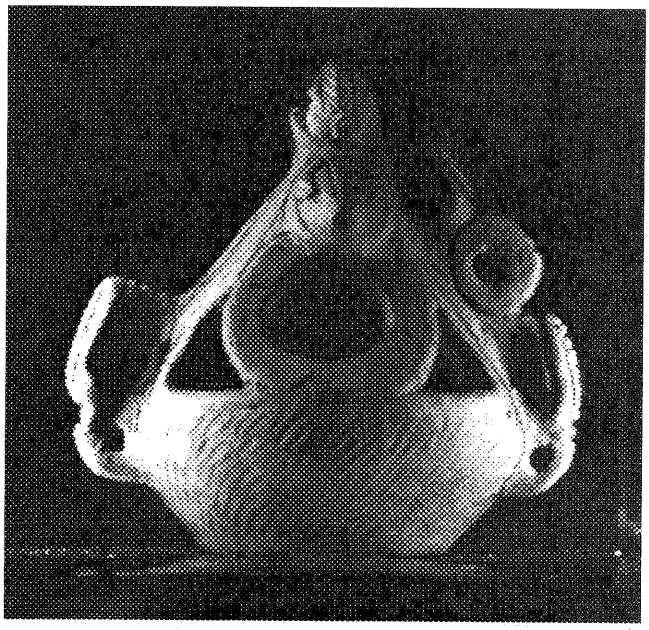

Fig.6(a) Image of two slit lights system

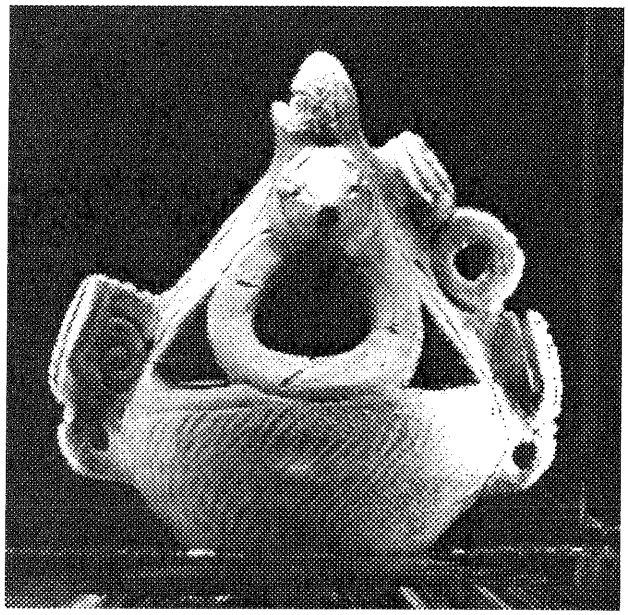

Fig.6(c) Image of three slit lights system

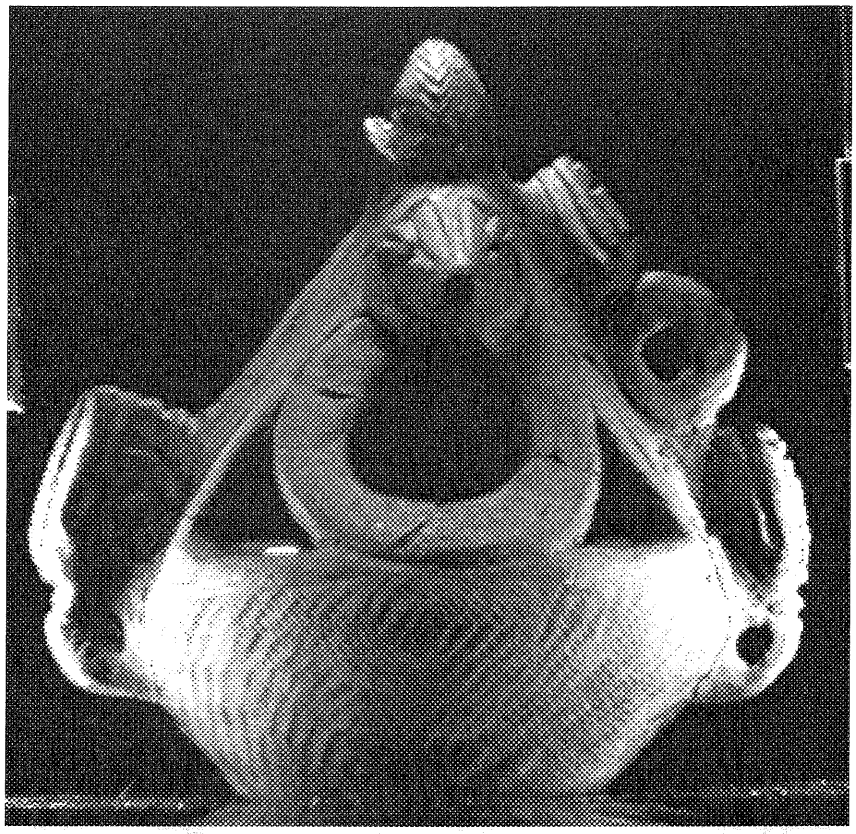

Fig.6(d) Image of three slit lights with cut system

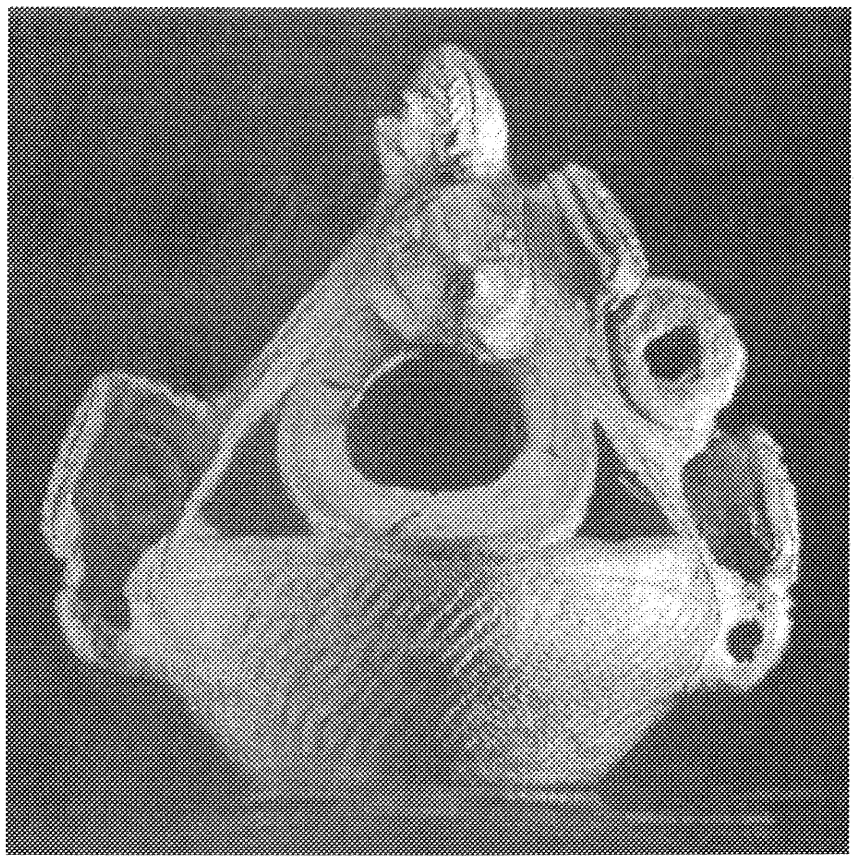

Fig.7 Image of laser beam system

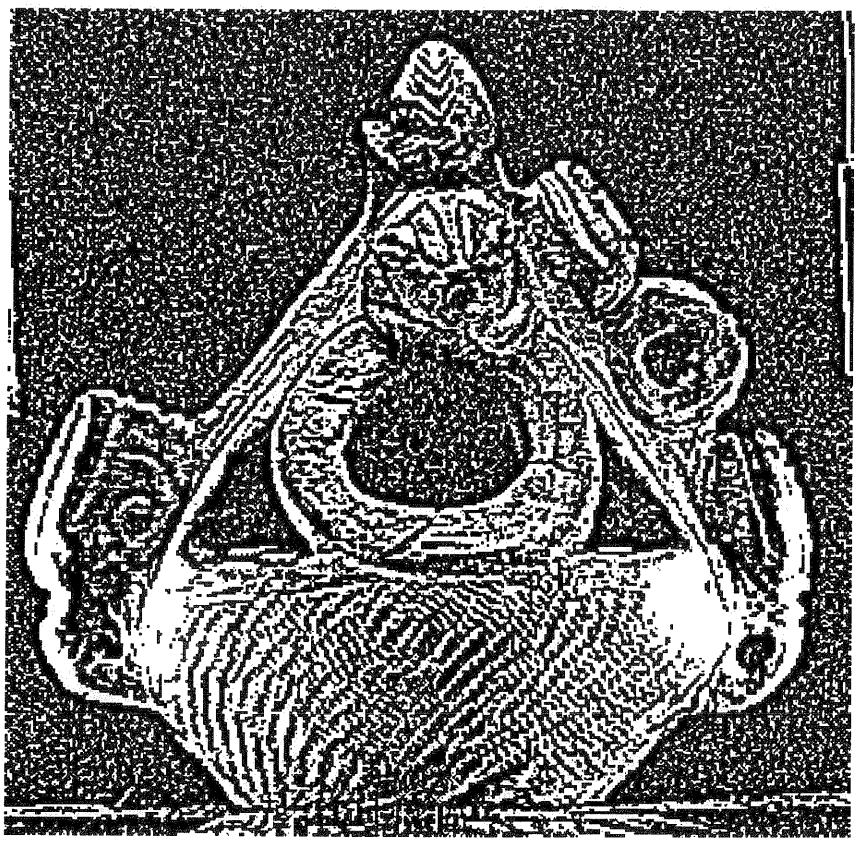

Fig.8(a) Edged result of three slit lights with cut system

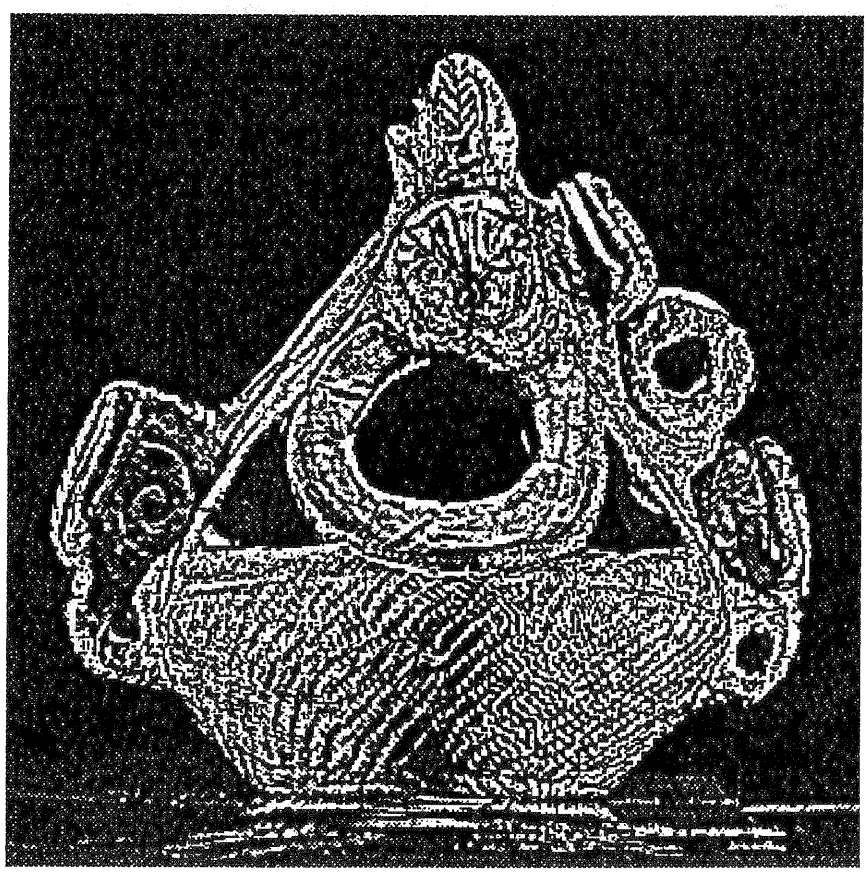

Fig.8(b) Edged result of line laser-beams system