



MAKING ART REPLICAS MODELS USING 3D SCAN AND ELECTRODEPOSITING

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ABSTRACT

This paper presents a modern fast and efficient way, of faithfully reproduction works of art by implementing modern technology of 3D scanning and printing processes combined harmoniously with metallic coating made by electro deposition.

KEYWORDS: electrodepositing, reproduction, 3D scanning

1. Introduction

A replica is a copy, which is intended to be a faithful reproduction of the original and the reproduction is defined as a copy of an original artwork (drawing, painting, sculpture etc.).

Reproductions used for historical purposes, by their exposure into museums, do not contribute only to increase of artistic and historical knowledge of a large segment of the contemporary civilized world.

Making replicas of art objects without moving them or coming in direct contact with them, especially for those whose integrity may suffer, is a real advantage.

The proposed method allows the production of replicas of art objects at different scales, depending on needs, which are made without direct physical contact between an original object and the various stages of making his reply.

Not always it is necessary for life-size reproduction of an art objects made by means of a mould directly executed on the object. Sometimes it is preferred a perfect copy, but on a smaller scale, this way a museum is able to have in a relatively small space a large number of artefacts (replicas) of art objects.

2. The principle of the method

Modern technique allows today implementation in practice the ideas above presented. With a high-resolution 3D scanner, we get high fidelity reproduction of the details.

Backing besides can be made at any distance towards the original location. In this way any museum in the world can have any replica of an art object, regardless of its original size and location.

As a principle, the procedure of making replicas of art models by 3D scan and electrodepositing is the following:

1. 3D scanning of art objects.
2. Software processing of obtained information.
3. Streaming of information in electronic form to the new location (museums, exhibitions, art galleries etc.).
4. 3D printing on a scale which can be different from 1:1.
5. Preparing model by painting with electro-conductive solutions.
6. Electrodepositing metallic material on art objects reply (gives increasing strength and appearance as close to reality - see bronze, copper).
7. Any subsequent processing (touches, coating decorative organic layer).

This film is presented in the scheme from Figure 1.

If reading the data requires a portable 3D scanner and a laptop, for practical realization of replicas, the entire installation (computer, 3D printer, painting and drying installations, electrodepositing installations with all annexes) can be embedded in a mobile container.

That container will be connected to water and electricity.

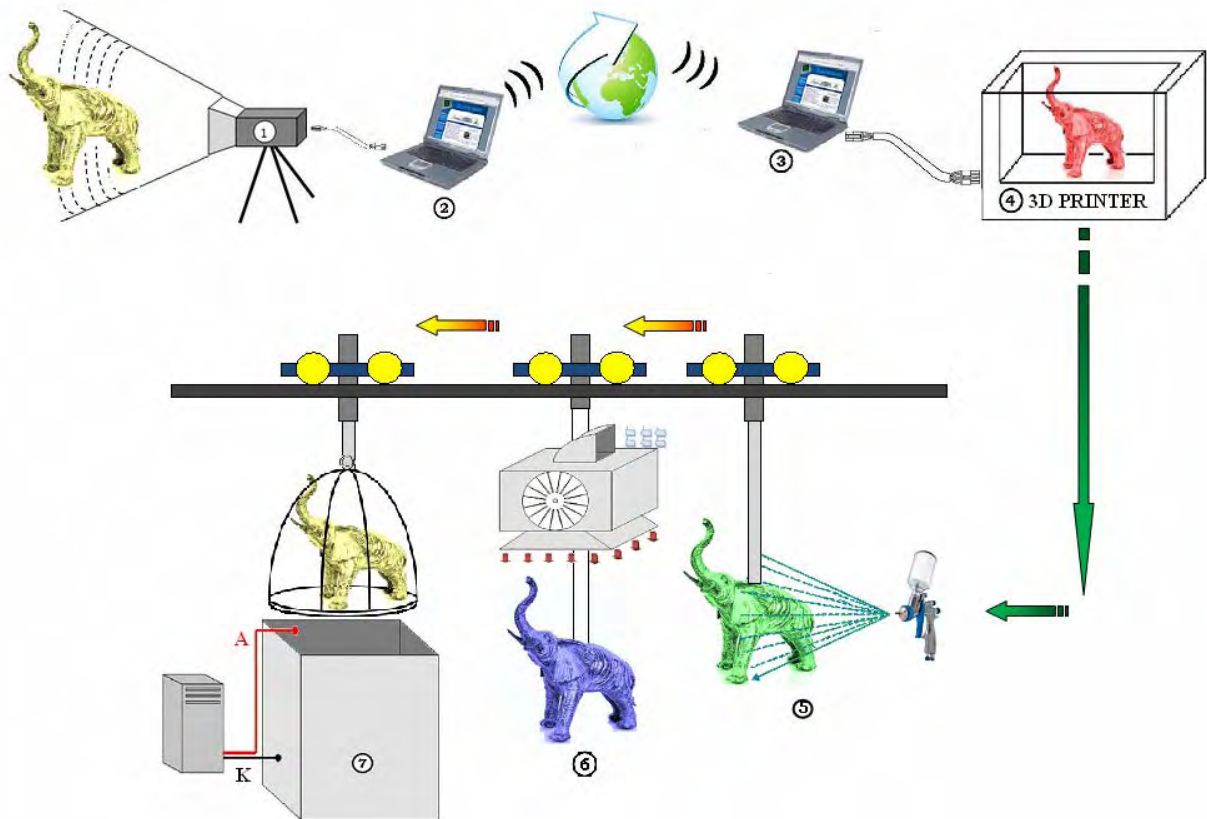


Fig.1. Progress operations for the realisation replicas of models art by 3D scan and printing and electrodepositing: 1 – 3D scanner (portable); 2 – processing and information storage unit (laptop); 3 – laptop whit corresponding software; 4 – 3D printer; 5 – painting installation; 6 – drying installation; 7 – electrodepositing vat.

3. The procedure of art models replicas made by 3D scanning patterns and electrodepositing

Large field work of current 3D scanner allows that a scanned object can have dimension size of a few centimetres (the different religious items, ornaments, jewellery, amulets, statues) to tens of meters (historic buildings, architectural complex etc.). The information obtained can be sent further as such or processed.

For large models a trick can be used. Based on calculations of resistance, it can drop some volume of material from the inner mass of the art object, without affecting the structure of resistance and without having repercussions on the details, however small these may be.

We get such a monolithic piece, but with an inner cavity like a scab. Once completed this stage, digital saved information will be electronically transmitted to the new location where, through a 3D printer, a copy of the real object will be made.

The process makes us think of teleportation.

In case it wants to get a reply whose size can't be made from a single printing, pieces will be executed which will be assembled finally like a puzzle. As noted above, the development of cavities leads to reduced materials consumption, reduced energy consumption and of course achieving a reply with a lightweight (a major advantage in case it needs repositioning or movement to a new location).

After any possible finishing and the critical visual inspection of the model obtained, this will be covered with a fine film of electrical conductive paint. Thus prepared, the obtained replica fixed to a metal carriage is placed in a vat of electrodepositing to be covered with a metallic layer so that it will provide the necessary hardness and look as close to as possible real.

The control of the electrodepositing process was realized based on WinCC software version 6.2., a program called "control program of electrodepositing process", (PCPE); with it we can view, modify and control the process parameters.

It enables communication with field elements of input/output type from PLC that manages the process. In addition to input signals corresponding to values of external variables, it also allowed the definition and use of internal tags running but only on local computer. In accord with current regulations about the noxious, the operator will be completely isolated from the area where the electrodepositing process develops.

He will introduce the process parameter values based on synopsis, displayed on the monitor, according to the data set for a given technological flux.

On this synopsis are marked positions parts during the process and state level solutions in vats.

When launched in execution, the PCPE will appear synoptic from Figure 2 with fields **Timp** (Time) and **Temp** (temperature) set to zero. Having prepared these fields, the operator will enter data starting from the right side, which corresponds to the area **SETARE PARAMETRI**.

In the **ELECTRODEPUNERE** field will enter the type of metallic material to be electrodeposited, the values of the surface to be covered in [mm²] and the value which must thickness have, in [μm]. In the program, the name at the metallic material is associated with the values for density, valence and atomic mass. In that way it will reduce the time to introduce the initial data and eliminate the error of human factor.

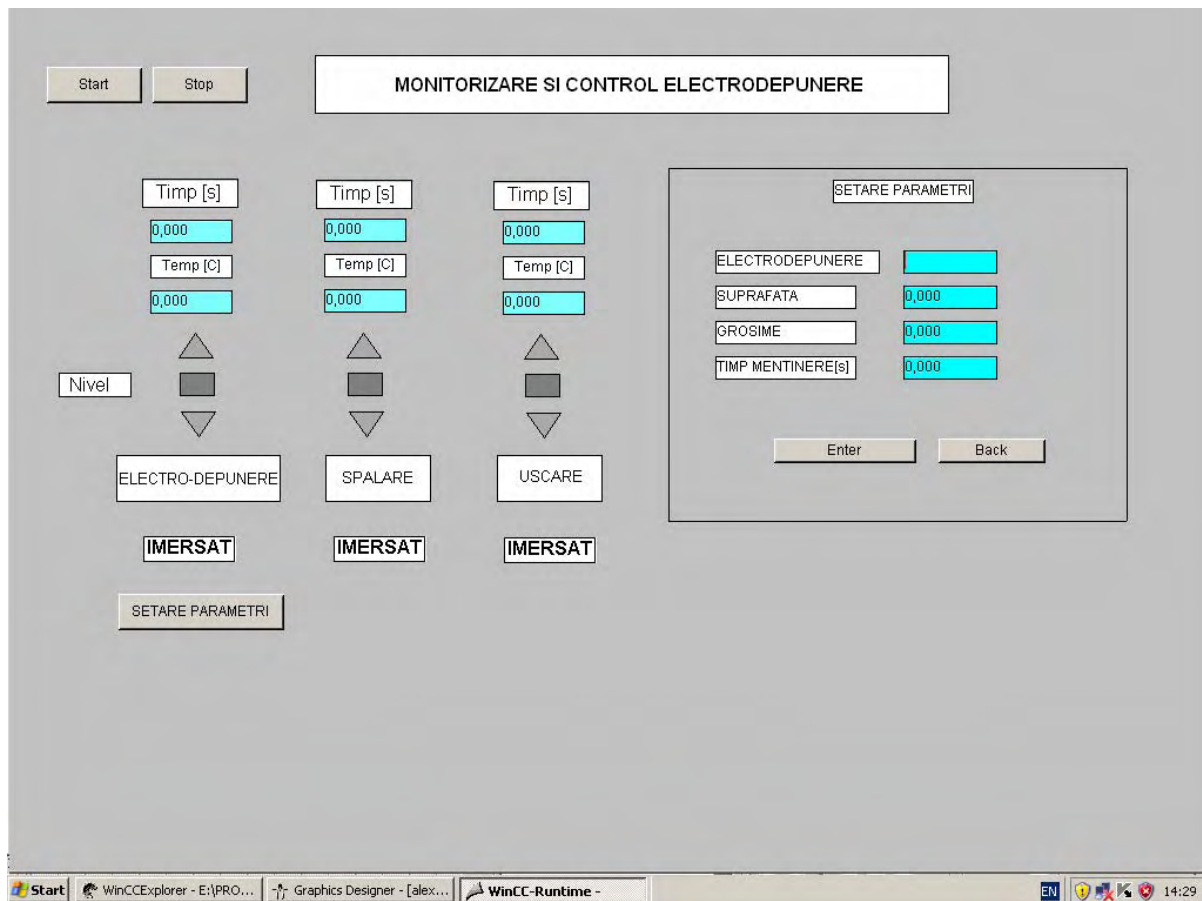


Fig. 2. Synoptic 1 – Monitoring and control electrodepositing.

Once these data entered, the **Enter** key will be press and in the field corresponding to maintenance time its value will be shown in seconds, calculated using the program, based on mathematical relations, according to the formula:

$$t = \frac{S \cdot \delta \cdot \rho \cdot z \cdot F \cdot \eta}{A \cdot I} \text{ [s]} \quad (1)$$

The same value will appear in the field corresponding to electrodepositing time.

The program operates with material constants for chromium, nickel, copper, zinc, gold and silver. It can be used for other metallic materials by adding their specific constants. Values for current intensity and efficiency will be updated for each process and are specific to each installation.



Having calculated the value for maintaining time in electrodepositing vat we will go back in the left field **Monitorizare și control electrodepunere (Back key)**, but which has now set all values for time and temperature. At this stage, a synopsis that monitors the whole process must have all the fields values completed.

With all these parameters set, it will start the process by enabling key **START**. Above each cell, it is shown the maintenance set time properly calculated and the temperature of vats solution. Pieces position in the area of certain tanks will be indicated by changes of colour field of corresponding vat in green, by correspondence with the associated tags and that the pieces are immersed in the solution will be flagged by the green colour field with inscription **IMERSAT**.

Indication of these positions is made on the received PLC signal from optical position sensors. PLC sends digital signal to the computer which through software will change the colour of the respective field.

Still with the help of synopsis is made indication of the level solutions in vats.

Based on the digital signal received from the sensors, the level will light one of those three indicators.

Normal is when the rectangle becomes green. Activating one of the two red triangles means exceeding or declining to maximum or minimum the rates required. Level adjustment is made by PLC which transmits simultaneously signal to the pump and solenoid (digital outputs).

The operator is able to manually break operation process by activating the **STOP** key.

This is necessary when damage occurs in the process or when process parameters need modification in order to obtain different thickness of coating.

4. Conclusions

The method enables the realization of replicas of art objects without direct physical contact made between an original object and the various stages of making its reply. The fact that reproduction is not accomplished through a matrix directly executed on the object allows the obtaining of replicas at different scales of art objects, depending on the needs. Also is not affected the integrity of the original. A museum can condense into a relatively small space a large number of artefacts (replicas) of art objects, made from a small-scale. On this way we have a very good control of the electrodepositing process for obtaining the best quality of the metallic material deposited layer. It also minimizes the negative impact of the noxious wastes that they may have on the environment.

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