Universitatea Tehnică "Gheorghe Asachi" din Iași
Facultatea de Știința și Ingineria Materialelor

# Raport activitate 2018

după finalizarea proiectului: Cecuri de inovare PN-III-P2-2.1-CI-2017. nr.110CI/2017, cu titlul:

***Proiectarea unui echipament pentru dezvoltarea etapei de învățare a scris- cititului***,

având perioada de derulare 25.08.2017-31.12.2017

**Participare la Salonul EUROPEAN EXHIBITION OF CREATIVITY AND INNOVATION EUROINVENT 2018**



Participare la ICIR 2018 (International Conference on Innovative Research)

## Program of EUROINVENT ICIR Conference
## POSTER PRESENTATION

*Palace of Culture Iasi - **Voievozilor Hall***

| DAY 1 – THURSDAY MAY 17 | |
|---|---|
| 14.30 | **Poster Session**<br>Chairman: Prof. Dr. Nicanor CIMPOESU<br>Prof. Dr. Mohd Arif Anuar MOHD SALLEH |
| P26. | **Ionelia VOICULESCU** - Mechanical and Microstructural Characterization of a New Corrosion Resistant Stainless Steel |
| P27. | **Aurora ANTONIAC** - Advances in biomaterials for dental applications |
| P28. | **Claudia MILEA** - Nanoencapsulated eugenol advanced compounds with addressability in dental medicine |
| P29. | **Bogdan ISTRATE** - Topical notions about in vivo analysis for degradable biomaterials with utility in human body |
| P30. | **Wen-Tsai SUNG** - Wireless Medical Care based on RFID Positioning System , |
| P31. | **Chun-Te LEE** - Simple detecting system of Sleep Apnea |
| P32. | **Andrey TYAGUNOV** - Influence of Alloying on the Thermal Stability of Model Heat Resistant Compositions |
| P33. | **Robert-Alexandru DOBRE** - Thermal and Electrical Investigation of Conductive Polylactic Acid Based Filaments |
| P34. | **Oana Rusu** - Researches on Antiphonic Characteristics of AlMg10-SiC Ultralight Composite Materials |
| P35. | **Raluca-Maria FLOREA** - Microstructure, Friction and Wear of Aluminum Matrix Composites |
| P36. | **Alin Marian CAZAC** - Influence of Nanostructuration on the Sound Velocity in Aluminum Al_99.50 |
| P37. | **Mirabela Georgiana MINCIUNA** - The effect of heat treatment and corrosion behavior of AISI420 |
| P38. | **Diana Petronela BURDUHOS NERGIȘ** - Structural analysis of carabiners materials used at personal protective equipments |
| P39. | **Ioana Corina MOGA** - Polyethylene based materials for biofilm carriers used in wastewater treatment |
| P40. | **Bogdan Florin Toma** - Researches on the Improvement of the Bioactivity of TiO2 Deposits, Obtained by Magnetron Sputtering - DC |
| P41. | **Iliana Rozemarie MANEA** - Melt electrospinning – characteristics, application areas and perspectives |
| P42. | **Dragoș Cristian Achiței** - Studies about carbo-nitriding thermochemical treatment of steel |
| P43. | **Dan-Gelu Găluşcă** - Aluminum coating influence on nitride layer performance deposited by MO-CVD in fluidized bed on stainless steel substrate |
| P44. | **Anamaria CIUBARA** - 3D Printer- Manufacturing of Complex Geometry Elements |
| P45. | **Simona Dobrița** - Preliminary Results on the Corrosion Behavior of a New Biodegradable Metallic Material Based on Zinc |
| P46. | **Cristian Tudora** - Preliminary Results on Thermal Shock Behavior of CuZnAl Shape Memory Alloy Using a Solar Furnace as Heating Source |
| P47. | **Costel Florea** - Corrosion Resistance of a Cast-Iron Material Coted with a Ceramic Layer Using Thermal Spray Method |
| P48. | **Mihai-Andrei Baciu** - Influence of Selective Laser Melting Processing Parameters of Co-Cr-W Powders on the Roughness of Exterior Surfaces |
| P49. | **Florin Gabriel Popescu** - Study of the dependence of bending resistance in corelation to temperature of a conductive material |
| P50. | **Vasile Pelin** - Assessment of hydrophobic coating on porous calcareous rocks surface exposed in urban ambient air pollution |

Lucrare publicată (ISI): **3D Printer-Manufacturing of Complex Geometry Elements**, A Ciubară[1], Ș L Burlea[2], , M Axinte[3], R Cimpoeșu[3], D L Chicet[3], V Manole[3], G Burlea[4] and N Cimpoeșu[3]

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# 3D Printer- Manufacturing of Complex Geometry Elements

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**Abstract**. In the last 5-10 years the process of 3D printing has an incredible advanced in all the fields with a tremendous number of applications. Plastic materials exhibit highly beneficial mechanical properties while delivering complex designs impossible to achieve using conventional manufacturing. In this article the printing process (filling degree, time, complications and details finesse) of few plastic elements with complicated geometry and fine details was analyzed and comment. 3D printing offers many of the thermoplastics and industrial materials found in conventional manufacturing. The advantages and disadvantages of 3D printing for plastic parts are discussed. Time of production for an element with complex geometry, from the design to final cut, was evaluated.

## 1. Introduction

Learning-reading devices that are currently on the market are rather difficult to be manipulate, do not allow the word to be correlated with a visual representation of the graphic representation of the word, and there is also the possibility of making misspelled words by wrong choice of letters, or the combination of letters is difficult for pre-school and unattractive children [1]. The technical problem solved by the patent [2, 3] consists in bringing together, in a single apparatus, both the function of viewing a letter, a word, and the graphical representation of the meaning of the word being formed, and the possibility of writing letters on a built-in tablet. With this device, the visual perception of the letter or word image is correlated with the auditory perception of the phonemes. On the basis of an invention patent [2, 4, 5] it has been proposed to provide a read-write device made up of plastic elements. In order to establish the main dimensions of the component elements for the market implementation of this product, the 3D printer was used for the design and physical realization of the component elements.

3D printing or additive manufacturing is a process of manufacturing three-dimensional solids by adding layer by layer. Physical objects are produced using the data of a digital model, a 3D model or other sources such as an additive manufacturing file (AMF) [6]. By using 3D printing, you can create products in almost any form. Several technologies and materials for 3D printing are currently being used. Recently, 3D printing equipment is available for both industrial and household users [7]. 3D printing allows the creation of complex structures and parts that cannot be produced by conventional production methods. Easy complex geometries can be created, providing great freedom in design [8-

10]. Complex models can be 3D printed as a single piece, eliminating the need to assemble component parts. 3D printing makes it very easy to customize at no additional cost. If it is necessary to change the design of an object, only the digital file needs to be modified without the need for expensive production processes or tools and additional devices [11].

The prototype of this device was made using a 3D printer to determine the optimal functional features. This article briefly presents the steps of making an element, a button with a grip and motion role in the final shape from the concept to the actual object using the 3D printing technique.

## 2. Materials and methods

For printing the plastic parts was used a Smart Rap 3D Printer. As active wire we use PLA - Verbatim (thermoplastic), 1.75 mm diameter. PLA is appreciated as the most important of all bio based polyesters at this moment. PLA it is made from sugar (sugar beets, sugarcanes, corn). Through fermentation, with the help of micro-organisms, lactic acid is produced. This is a highly efficient process. From a sugar molecule, two molecules of lactic acid are produced, without any residual products. Work temperature is 200-230 ˚C. The printing rate (wire alimentation) was of 2.5 mm/s. Beside the work temperature we have a table work temperature of 70 ˚C. The nozzle diameter was of 0.4 mm. The entire line to obtain a plastic product summarize: 3D design, 2D drawing, 3D printer program, printing process and element cleaning (post-processing) if necessary. The design plastic part is a roll with the purpose of moving a band of draws with specific dimensions and a gripping system.

## 3. Results and discussions

The results present the obtaining of a final product, a rotational button, made from the design idea to the actual product using 3D printer. The design part was realized using Catia software. The button is presented in Figure 1 a) as a part of the entire equipment proposed for the read-write learning stage. The advantages of this device are: the upper part of the device allows you to place the attention on the illuminated image, the visual perception of the image and the word, in connection with its name; the auditory perception of phoneme, together with the visual perception of the corresponding letters; the choice of letters to form syllables and word words; easy and attractive handling for children; allows users to create mobile, flexible and creative thinking; determine the formation and development of an active lexical stock [12, 13]. The device is designed for the writing-reading learning phase, used by both preschool children and those with speech deficiency.

The first step in the additive manufacturing process is the realization of the digital model. For this, Computer Aided Design (CAD) is used [14]. Reverse engineering can be used to generate a digital model through 3D scanning. After the design of the button the 2D draw was realized at real quotas using AutoCad software, Figure 1 b). Based on the 2D draw using 3D printer we realize the buttons using PLA filament.

In Figure 2 are present print screens of the Pronterface program interface (which controls the SmartRap + 3D printer) and the possibility of editing a Gcode program directly from Pronterface in a) and b) and the Cura program that makes slicing and generates the Gcode program of the printer [15, 16]. The most important parameters are visible in the left panel in (c). The elements made with 3D printer are build layer by layer. This making process present many advantages like the element density (the filling degree), useful to obtain very light pieces or very resistant pieces.

The 3D printing process is largely automatic. Depending on the size of the object, materials, and printer, the procedure may take from a few hours to a few days. It must be checked, from time to time, that there are no errors.

Many geometrical complex parts can be realized layer by layer reaching by one operation an 95% percentage of the final element. All programs used for 3D printing are open source. The 3D printing parameters are presented in Table 1. The time to obtain an element is 3 hours without using any additional elements that will increase the production costs. The filling degree was of 20% fact that will give the element a sufficient integrity and also a reduce mass [17].

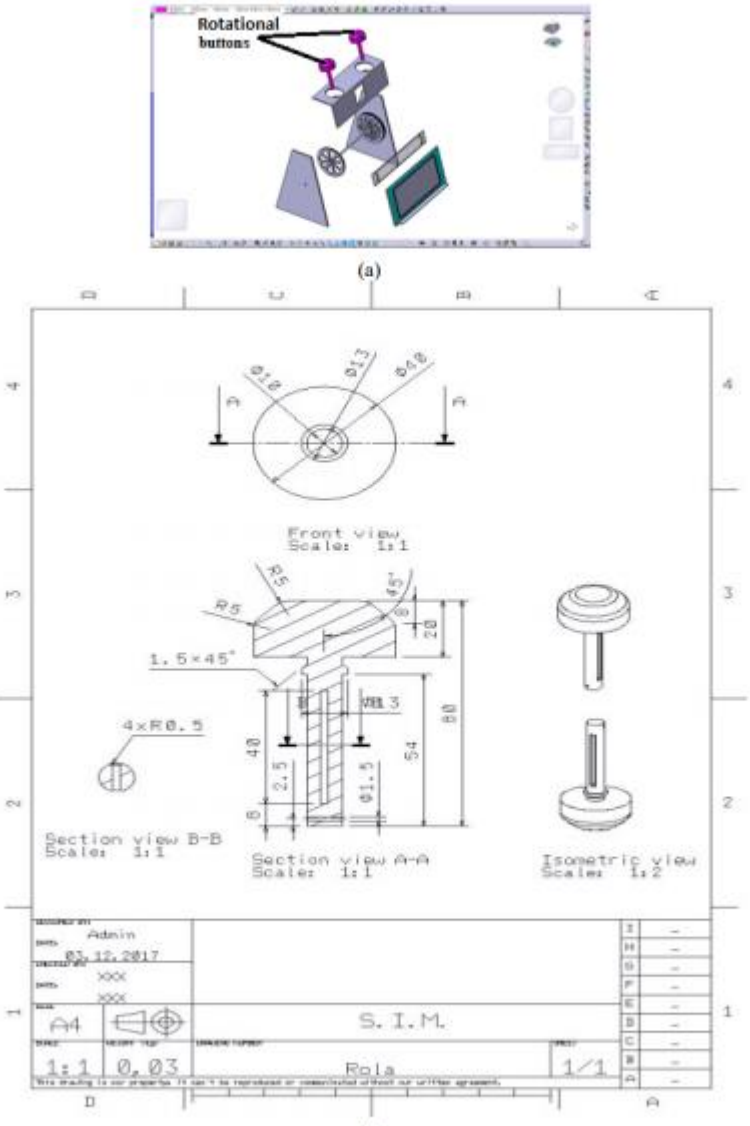


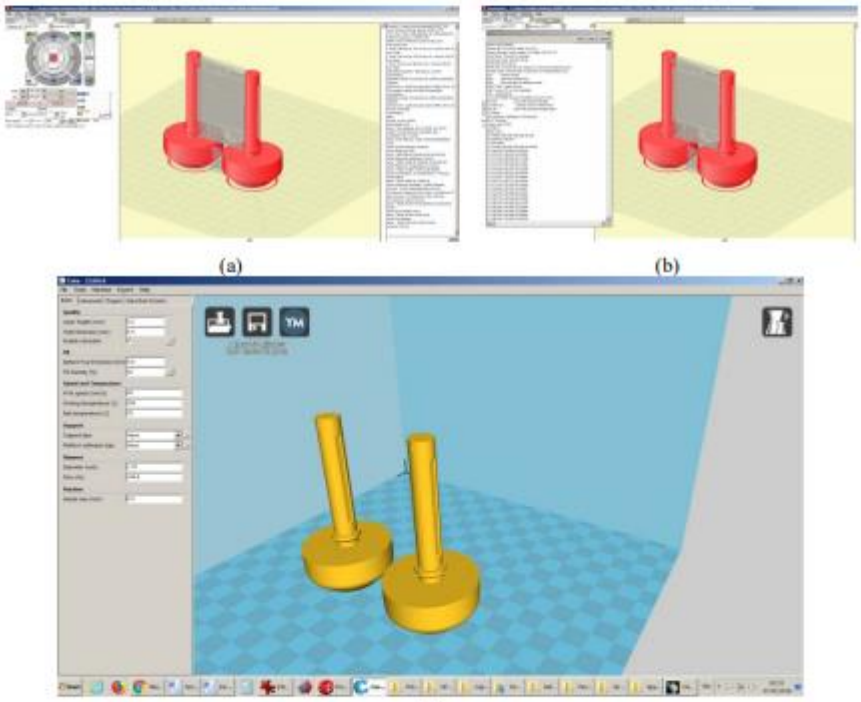

**Figure 1.** Design of the equipment (a) component parts including the rotational buttons and (b) 2D draw of the superior rotational button.

**Table 1.** Button printing parameters.

| Element | pieces | Time/piece [h] | Layer [mm] | Shell [mm] | Bottom [mm] | Infill [%] | Support [tip] | Adhesion [tip] |
|---|---|---|---|---|---|---|---|---|
| Rotational button | 2 | 3 | 0.2 | 0.4 | 0.6 | 20 | none | none |

The element is build layer by layer, each of 200 µm thick, until the element is done. In Figure 3 the final button is presented. For round parts we need for an additional stage for finishing the surface. Final product processing can include manual or compressed air cleaning, polishing, colouring and other actions that prepare the product for final use. In most cases, in 3D non-industrial printing, removing the printed object is easy - separating the piece printed on the print table, Figure 2 (a).

In the last step the equipment is ready for printing. The process requires the proper setting and control of the 3D printer, workbench cleaning and raw material loading. A routine check of all the main print settings and control panel is also required. When the machine is ready, the 3D print file can be loaded.

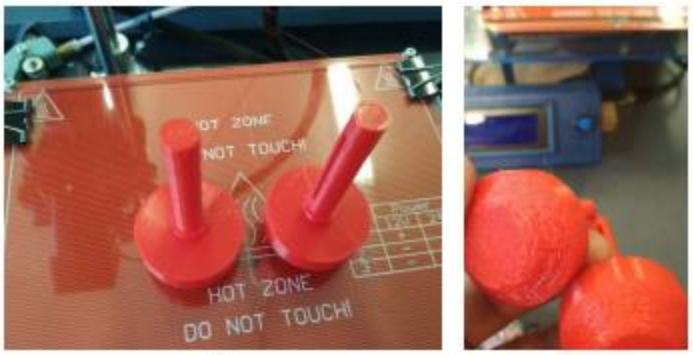


(a) (b)

(c)

**Figure 2.** (a) the Pronterface program interface (which controls the SmartRap + 3D printer) and the possibility of editing a Gcode program directly from Pronterface; (b) the Cura program that makes slicing and generates the Gcode program of the printer; (c) the most important parameters are visible in the left pane.

3D printing or layer-by-layer deposition is a process of making a three-dimensional object of any form digitally designed. The 3D object is accomplished by an additive process in which successive layers of material are deposited in different shapes. The difference between the 3D printing technique and the traditional method of making objects is that instead of eliminating the excess material, the material is deposited in the desired shape from the beginning without a special need for further processing.




(a) (b)

**Figure 3**. Button final product (a) two pieces and (b) the need for finishing the final surface of round parts.

## 4. Conclusions

Because models and parts can be produced in a short time, 3D printing is used to check and develop design ideas. It is cheaper to produce a 3D prototype than to recreate an existing one if needed. As a result, 3D printing is good for those who want to give life to a product idea, because marketing is faster and at lower risk. 3D printing can also reduce the risk of dangers associated with certain manual prototyping procedures. We use 3D printing to obtain plastic pieces with complicated geometries. The printing parameters present a 3 hours' time process with a very good final result concerning the accuracy of the details. Mechanical resistance versus the weight of the element can be choose by modifying the filling degree of the element between 5% to 100%. Round surfaces present areas that necessity a post printing processing.

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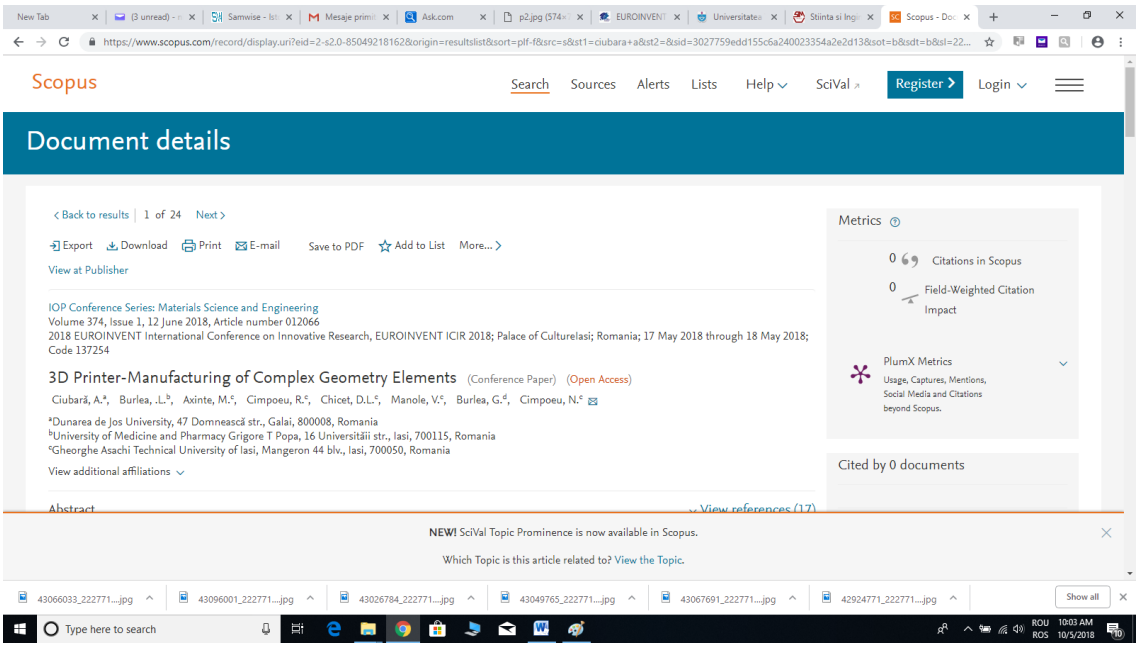
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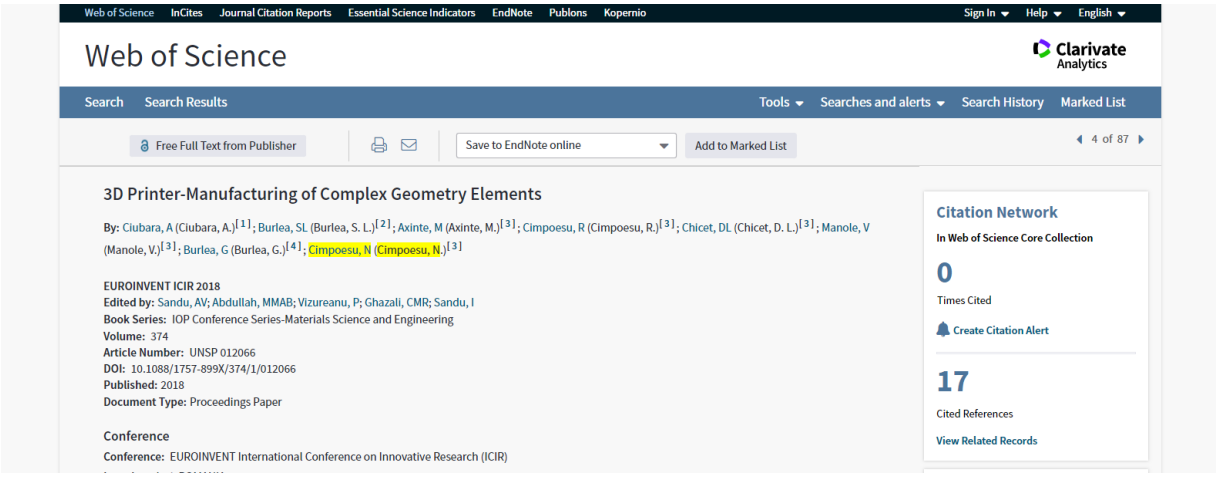
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