3D Printed Smart Luminous Artifacts

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ADDITIVE MANUFACTURING UNIT
Information Technologies Institute
CPERI Chemical Process and Energy Resources Institute
CERTH CENTRE FOR RESEARCH & TECHNOLOGY HELLAS

Contents

WHO WE ARE

ADDITIVE MANUFACTURING UNIT

- Founded in 2019 at CERTH/ITI
- 3D Product Design and 3D Modelling
- Rapid Prototyping
- 7 Additive Manufacturing Technologies (FFF, SLA, SLS, SLM/DMLS, MultiJet, 3D BioPrinting, 3D PCB Inkjet)
- 3D Scanning/Reverse Engineering
- Quality Control Services
- Smart Applications/IoT Applications

Contents

Concept

A methodology for **Low-Cost**, **Do-It-Yourself** activities for Rapid Prototyping

Combining
- Innovative Technologies
- Cultural Heritage

Designated as a co-creation & co-design tool for **Social Manufacturing**

PCB control via the custom CERTH/ITI mobile Application

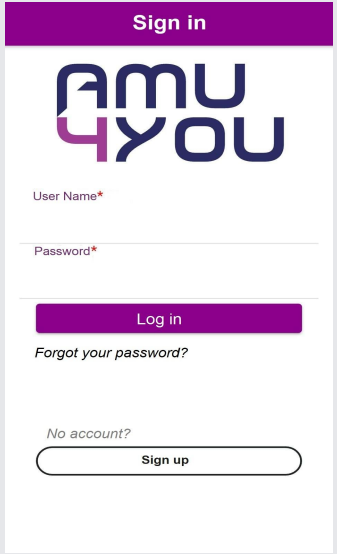
AMU4you

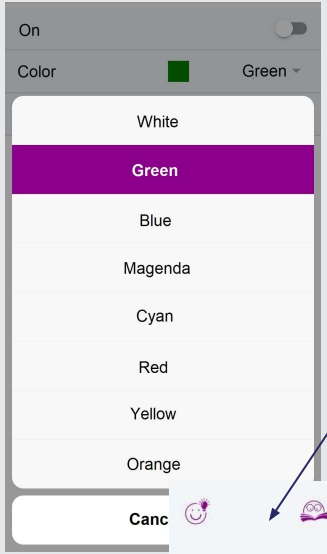
The 3D Printed Smart Luminous Artifact is connected by WiFi and Bluetooth with AMU4you:

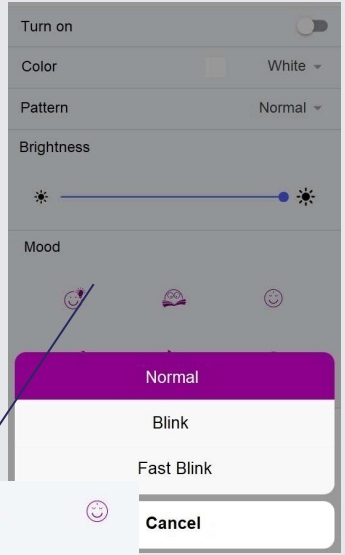
- **Semi-programmable**
- Friendly User Interface (UI)

The user can control:

- LED **colors**
- LED **patterns**
- LED **Brightness**
- **Mood** Type







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Methodology and Approach:

Steps:

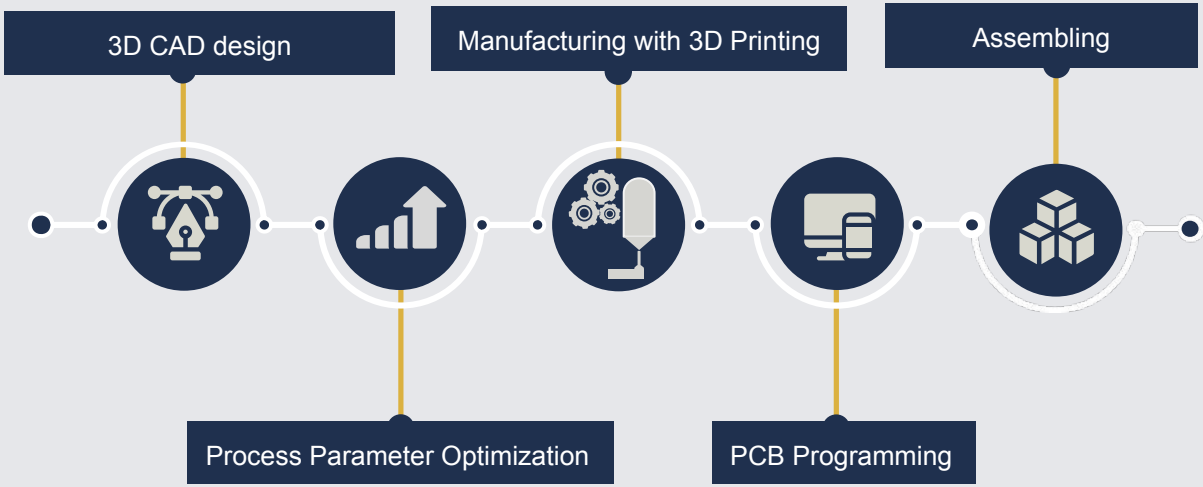
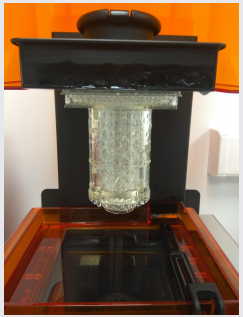
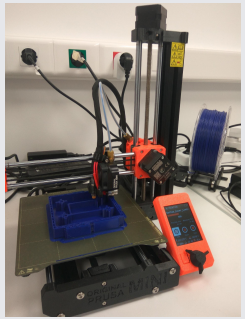


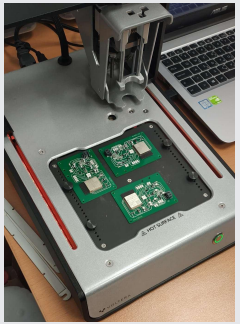
Fig. 1. Final Prototype





Methodology and Approach: Additive Manufacturing Technologies

Stereolithography (SLA)	→	Artifact Models
Fused Filament Fabrication (FFF)	→	PCB Housing
3D PCB Inkjet Printing	→	PCB



Methodology and Approach:

Parameter Optimization

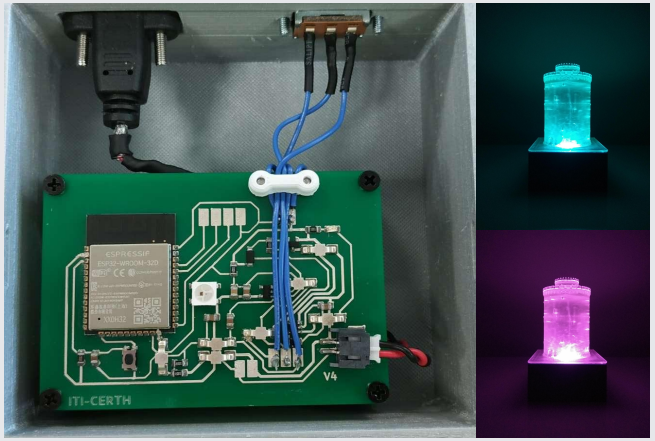


Fig. 3. Assembly Testing

- **PCB**
  - ••Design & Manufacturing of a Hybrid PCB by Multi-Functional Ink-Jet Circuit Printing
- **Housing**
  - ••Design & Manufacturing of the Electronics Housing –by Fused Filament Fabrication (FFF)
- **Prototyping & Testing**
  - ••Assembly & Programming

Methodology and Approach:

PCB Parameter Optimization

Printing

- **Layer width**
  - droplet size: 850μm
  - print height: 70μm
- **Printhead Speed**
  - 500 mm/min

Annealing

- **Temperature**
  - 180 °C
  - 200 °C
  - 220°C
- **Duration**
  - 30 mins

Fig. 4. Image from Leica DMS1000 stereo-microscope. Ag NP printed electrode with optimal process parameters at **200°C/30 min**.

- Ag NP size and shape homogeneity
- Trace continuity
- No cracks
- Smoothness

Maximum electrode conductivity

Contents

Results & Discussion

Annealing procedure Optimization

Annealing temperatures	180 °C	● ● ●
	200 °C	● ← Lower Resistance <0.1Ω
	220°C	● ● ● ●
Annealing Duration	30 mins	
Measuring methods	Stereo-microscopy	
	ViaRaman	
	SEM	

After Annealing

180°C, 220°C: **high resistance**

Ag nanoparticles size: **irregular, 10nm to 3μm**

Sample Resistance: ~ **0.2Ω**

Trace width: **57μm**

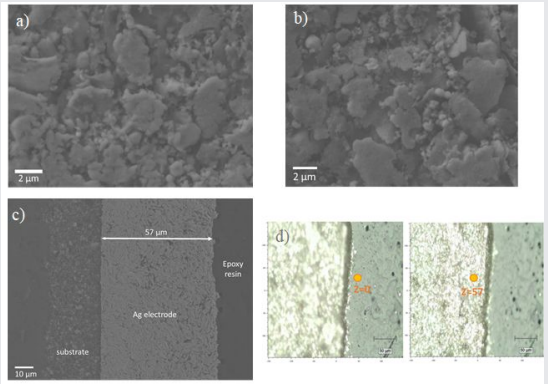


Fig. 5. ViaRaman & SEM - JEOL JSM-5600V

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Conclusions

- Promotes Additive Manufacturing in **Social Manufacturing**
- Opening the way to non-specialists to produce a devices for **customized purposes** eg. Cultural Heritage
- Empowers makers for **Low-cost**, **Do-it-yourself** Activities for Rapid Prototyping
- **Reinforces Co-design and Co-Creation** Tools for Educators to Train Students in Schools and Universities
- **Reinforces Design Thinking** and introducing the concept of Smart Manufacturing under the growing trend of personalization

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Thank you!

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