Hands-On 3D Printed Electronics

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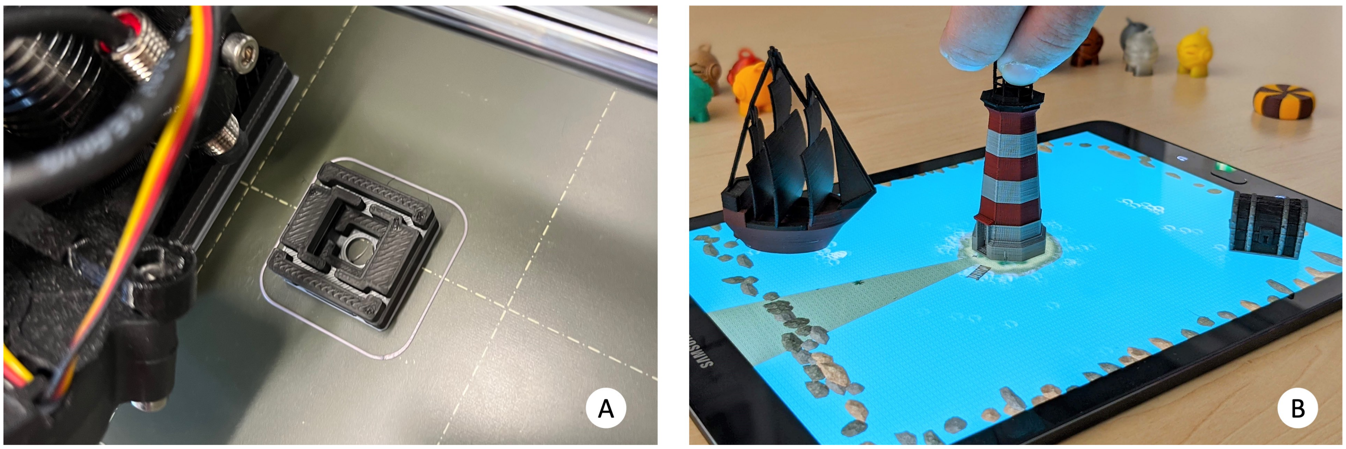

Figure 1: (A) Multi-material component during the 3D printing process and (B) an electrical functional 3D printed multi-material component in use in an interactive board game.

ABSTRACT

The parallel improvements in multi-material 3D printers and the quality of conductive filament open new possibilities for the fabrication of tangible and functional objects. In this studio, we discuss best practices for 3D printed electronics, talk about encountered problems, and derive design recommendations. We will guide the participants through a fabrication process by practically designing and printing objects. Consequently, we contemplate individual functional fabricated components, including small printed circuits and multi-material prints. We aim to spark a discussion about individually experienced challenges participants encountered during their design and fabrication process. This discussion includes problem-solving strategies, whose insights benefit other participants. Finally, we show the potential of printed electronics and discuss encouraging new opportunities in this field.

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CCS CONCEPTS

• **Hardware** → *Printed circuit boards*; *Emerging technologies*; • **Human-centered computing** → *Interaction design*.

KEYWORDS

Printed Electronics; Circuit Engineering; 3D Printing; Additive Manufacturing

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1 DETAILED PROPOSAL DESCRIPTION

While 3D printing has become a well-known fabrication process in the maker domain, printing functional electrical components using 3D printing is not as widespread. However, we believe this to be a valuable and easy-to-learn skill to create engaging and tangible objects.

To channel current best practices in this field and inspire potential new users, we plan the following activities during this studio:

- **Project Demo and Presentation:** Participants who already have successfully implemented 3D printed electronics projects

present and demonstrate their prototypes in a hands-on format.
- **Example Workflow:** We demonstrate one example workflow from CAD-Tool to 3D printed component to show how easily potential new users could start their own projects.
- **Identifying Challenges and Solutions:** In this activity, we aim to identify common struggles when 3D printing electronics and develop potential solutions in small group sessions.
- **Printing Session:** Building upon the Example Workflow small groups will develop and design small 3D printed components and start their own print.
- **Future Tools and Applications:** In this closing activity, we aim to identify potential needs for tools by expert-users

Depending on the actual expertise of the participants, we will adjust the time spent on each of these activities. In doing so, we aim to ensure the appropriate use of time based on existing knowledge.

2 GROUNDING IN THEORY

With the increasing use and availability of 3D printers also the field of printing electronic functional components grows. This opens up new opportunities to create customized tangible 3D printed objects that allow for many new ways for interactions as demonstrated by previous related work [4, 6, 7]. In contrast to inkjet printing of electric circuits [1], 3D printing offers to integrate the functional elements directly into the printed objects as it gets printed via multi-material printing. This further accelerates rapid prototyping since it reduces the need for postprocessing of components. While this functionally can either be to replace electrical wires for electrical conductivity or print a custom printed circuit board (PCB), it is also possible to e.g. print sensor elements [2, 3, 5].

3 MATERIALS TO BE EXPLORED

We focus on printing with conductive polylactic acid (PLA) in this studio. Depending on available printers, we will rely on single-material prints with conductive PLA or also demonstrate the use of multi-material prints with conductive elements.

4 LEARNING GOALS

The primary goal of this studio is the experience exchange in the field of printed electronics and learning from the experiences of other workshop participants. This can be the foundation of a knowledge base ranging from design to printing knowledge. Key takeaways will be the design recommendations. In the project presentation and demo session, we want to encourage a hands-on experience of the projects to spark further ideas of what is possible with printing conductive materials. This session aims to reach the second goal, inspiring potential new users to create their own tangible and functional objects with the help of 3D printed electronics.

5 SCHEDULE

Table 1 shows the planned schedule for this studio. Depending on the background and expertise of participants, we plan to adjust the times accordingly.

Time	Agenda Point
10:00	Welcome and Start Into the Topic
10:30	Short Introduction of the Participants & Presentation and Demo of favorite 3D Printed Electronics Project
11:30	Design Process into Starting a 3D Print
12:00	- Lunch Break -
13:00	Energizer: Failed PE Projects
13:15	Collecting & Clustering Struggles of PE Projects
13:30	Small Groups: Discussing Solutions for one Problem
14:00	Plenum: Solution Presentation
14:15	Designing and 3D Printing Small Projects
15:30	- Coffee Break & Free Discussion -
16:30	Discussion: What Tools and Features do we want?
17:00	End

Table 1: The planned schedule of the studio

6 FORMAT OF THE WORKSHOP

We plan for a physical on-site format only due to the tangible nature of this studio. Consequently, no hybrid format is planned.

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