Pushables: A DIY Approach for Fabricating Customizable and Self-Contained Tactile Membrane Dome Switches

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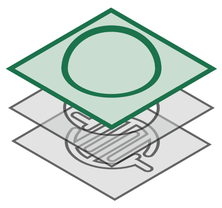
Motivation and Basic Idea

Push-buttons or pre-manufactured membrane switches often do not fulfill individual design requirements and lack customization options for rapid prototyping. With this work, we present Pushables, a DIY fabrication approach for producing thin, bendable and customizable membrane dome switches.

Contributions

- ▶ **DIY-Embossing:** Using DIY-thermoforming to produce custom membrane switches.
- ▶ **Fabrication Pipeline:** We describe a three-stage process for the fast production and assembly of membrane switches for makers with different skills.
- ▶ **Application Examples:** To demonstrate the applicability, we present examples from ubiquitous, mobile and wearable computing.

Application Examples



1 PVC Dome Layer

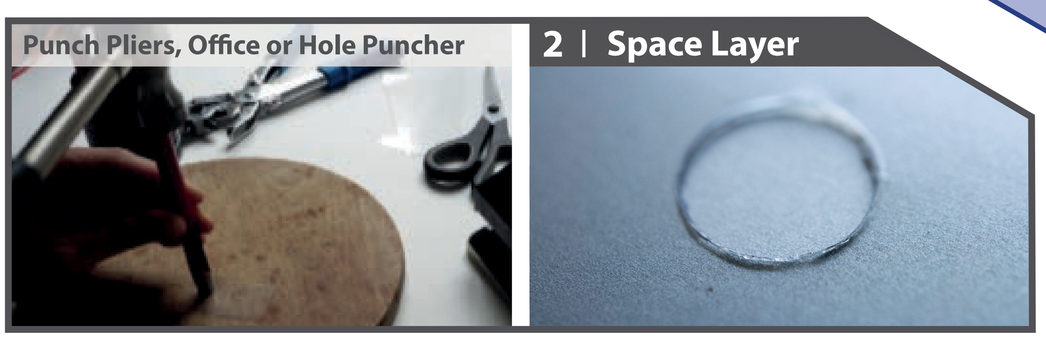
In order to realize membrane buttons with a great tactile feel and nice perceptible counter pressure, we introduce three ***embossing processes*** that show how dome-shaped polyester overlays can be DIY fabricated.

***Methods** for different skill levels*

- ★ **Manual Embossing** ..... Modified solder iron.
- ★★ **Semiautomatic Embossing** .... Building a Z-axis embossing machine.
- ★★★ **Automatic Embossing** ..... Make use of a 3D-printer to control the X/Y/Z-axis for more complex designs.

▲ **Manual Embossing** The easiest way to build tactile overlays is to manually emboss a dome in a plastic film, however exact timings (4 seconds, orthogonal, 100°C) must be kept.

▲ **Automatic Embossing** Our (semi-) automatic machines handle temperature control and timings to simplify the embossing process.

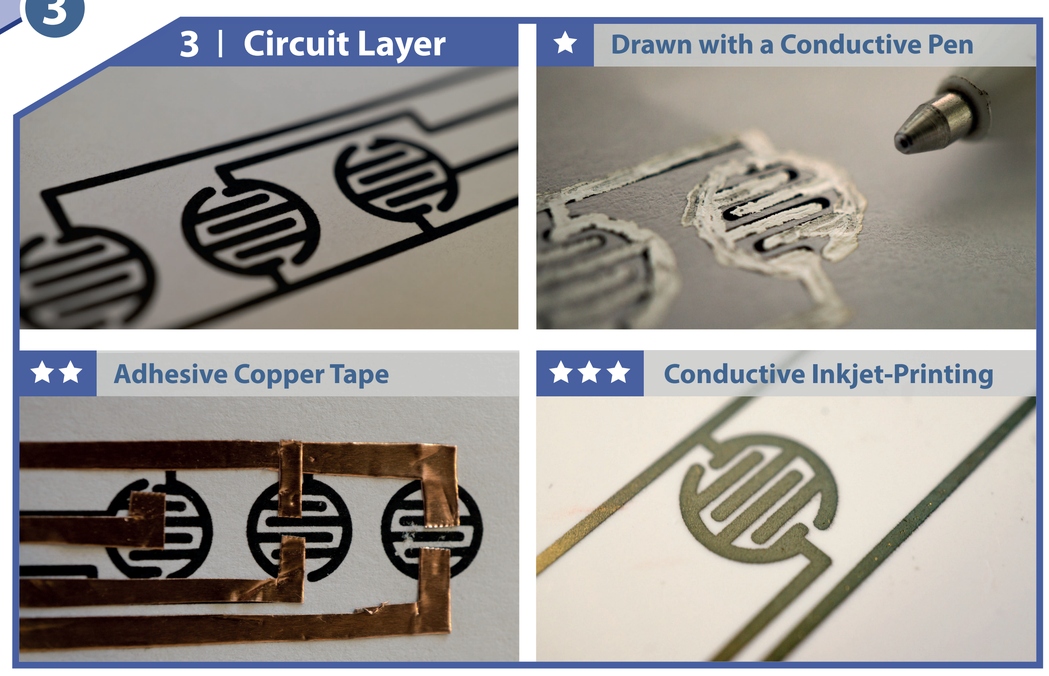


2 Spacer Layer

The second layer extends the travel of the tactile layer and can be easily produced with ***hole or offices punchers*** with standard 0.5 mm thick PVC foils.

Methods

- ▶ Office Puncher
- ▶ Punch Pliers
- ▶ Hole Puncher



3 Circuit Layer

As a last layer, we have to realize the circuit switch layer that is bridged by a pressed top layer. This could be done by using ***conductive pens***, adhesive ***copper tape*** or ***conductive inkjet-printed*** traces.

Methods

- ▶ **Conductive Pens:** Simply draw the circuit on a surface, such as paper.
- ▶ **Copper Tape:** Cut and glue copper traces on any surface.
- ▶ **Inkjet-printed:** Use conductive inkjet printing to generate complex circuit boards.

Future Work

For further developments, we plan to

- ▶ **Build a graphical editor** simplifying the G-code generation of our automatic embossing machine.
- ▶ **Emboss more complex forms and patterns** to provide further sophisticated tactile widgets and applications.
- ▶ **Investigate new application scenarios,** for example, enhancing braille exercises for blind and partially sighted people.

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