

Summary of my experiences at SMT Prototyping



So...

I have decided to learn a new skill, "SMT prototyping", extending to small scale manufacturing.

As with every new skill I learn, I think of a project at which I can practice and learn this new skill.

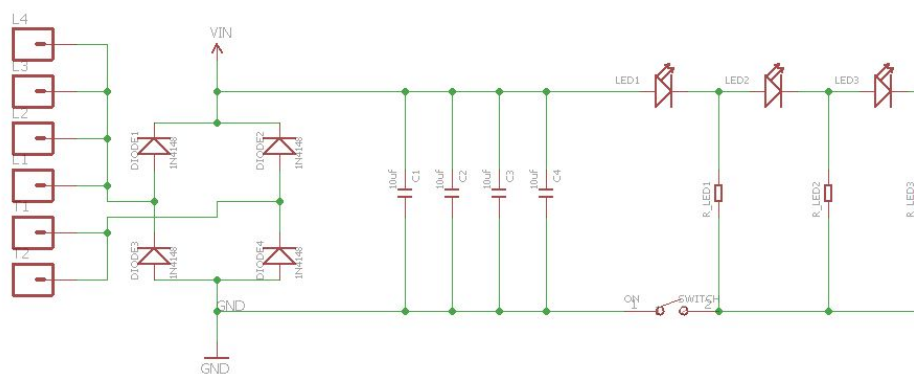
So i went for an electrical circuit Business Card.

The requirements I set for myself for the Business card, are:

- Interactive
- Low cost - up to 1\$ per unit at 100 pcs. (If ever I thought to actually make 100+ pcs)
- SMD components (Duh...)

Considering the requirements I decided to make something without a micro controller / Battery as only those two parts bump the BOM significantly.

The design I went for is based on a piezo generator with some LEDs. By tapping a piezo disc, it generates very low energy, the energy is stored in a few capacitors and released by pressing a button through some LEDs arranged such that the more you tap the more LEDs are turned on. (See schematics).



I have ordered the parts mostly from Aliexpress / Ebay, and ended at around ~0.5\$ For the components per unit, plus ~0.5\$ for the PCB's at 100 units order (I prototyped with 10 pcs orders, so it was 1.5\$ unit). I had a small flaw in my first design as I based the design on a wrong SMD button. (A lesson for grabbing library parts without looking closely at the footprint...).

The first test board I assembled with a soldering iron, as I needed some encouragement before ordering a reflow oven (it's not that cheap even the cheap one I ordered). For the second one I used a syringe with solder paste, and it went pretty well but was time consuming. And lastly I did a 7 pcs batch with a stencil which went very smooth and fast.



PCB & Stencil order:

After comparing some of the PCB suppliers for the hobby market, I went for the first 10 pcs order from <http://smart-prototyping.com/>, they had a good quantity price (which I considered an option for a large order later on) and offered stencils at reasonable prices. The first order was for circuit testings so i added some thru-hole test points, and stayed with minimum additions such as color / thickness. The second order was from <https://www.dfrobot.com/> and was a bit slower to deliver, I assume because they send it to an external manufacturer, but they have very low price addition for a different color and even better quantity prices. Both turned out excellent. Dfrobot even sent 15 pcs instead of 10 ordered (a nice surprise). As a side effect I have started to receive linkedin invitations from PCB manufacturers. (that's for putting my contact information on the PCB...).

For the stencil i ended up ordering from <https://www.oshstencils.com/#>, excellent pricing even for stainless steel. You pay for the area you order and the ordering process is very easy. As a bonus they work directly with eagle files and send out a plastic card to use as a spatula for the Solder paste.

In addition i have designed a 3d printed frame for the Stencil. (it was an opportunity to improve my skills at Fusion360). The frame is handy but not really required for small batches.

Small scale prototyping:

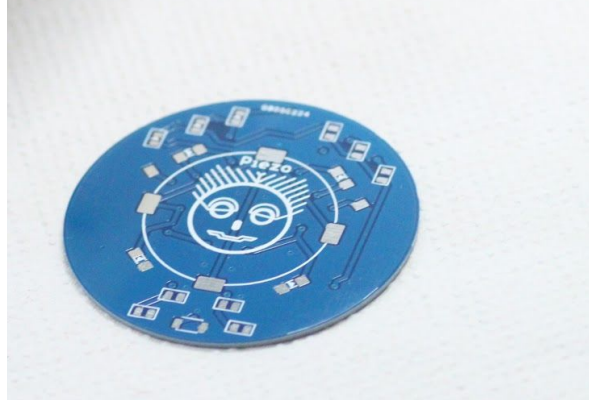
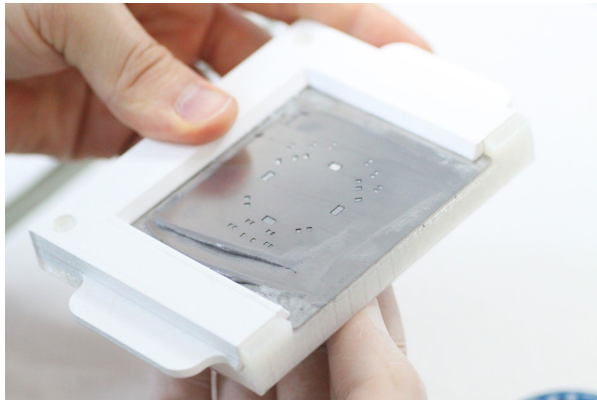
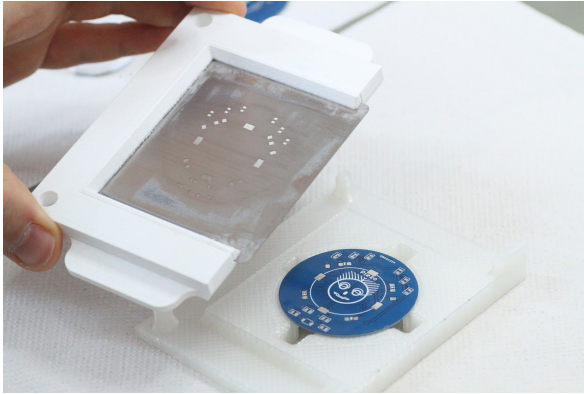
After assembling and testing the first units I arranged myself for the first “batch production”:

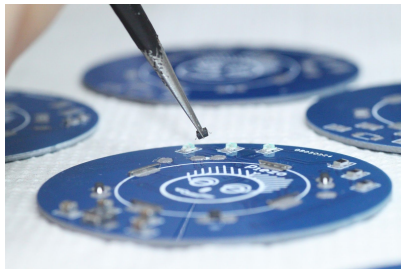
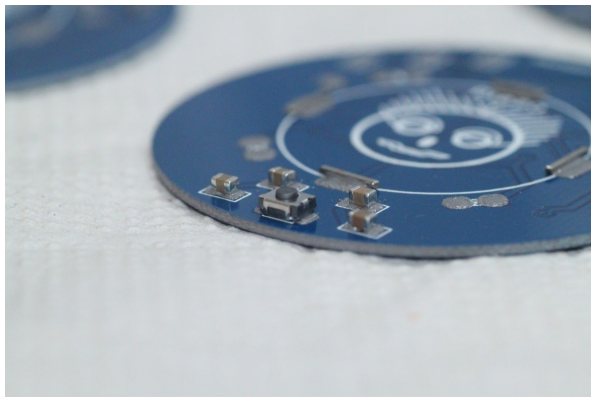
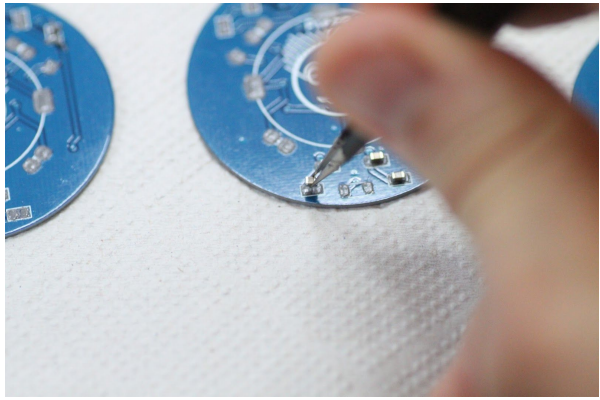
- Stencil (Optional) - <https://www.oshstencils.com/#>
- Stencil Frame (Optional) - 3D printed custom frame
- Reflow Oven (Optional) - T-962
- Magnifying glass (Optional) - Table model with LEDs.
- Solder Paste - NO-CLEAN SN63/PB37
- Spatula for solder paste - Plastic Card
- PCB - <http://smart-prototyping.com/> , <https://www.dfrobot.com/> , <https://www.seeedstudio.com/>
- Tweezers
- SMD components - Pre-arranged in a component box

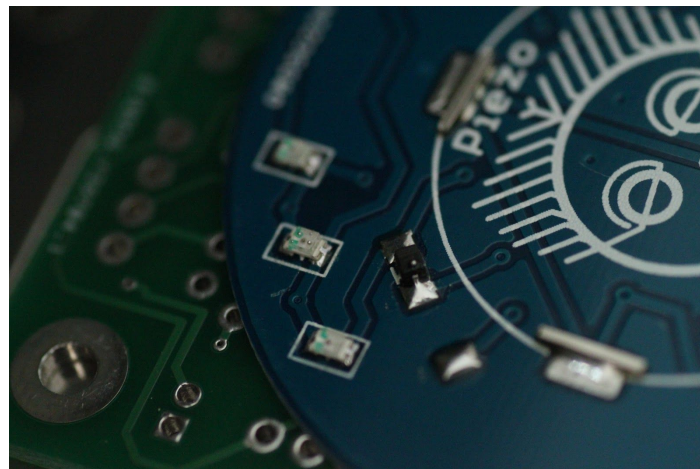
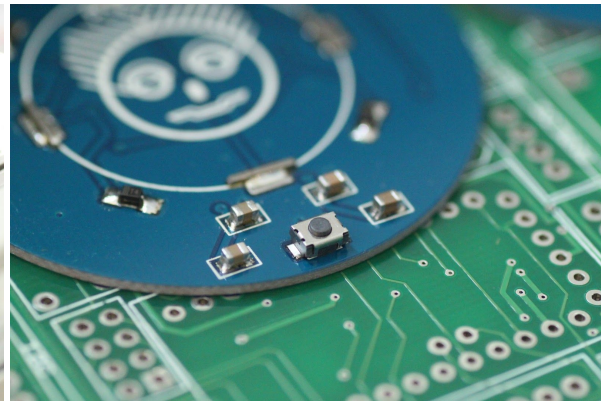
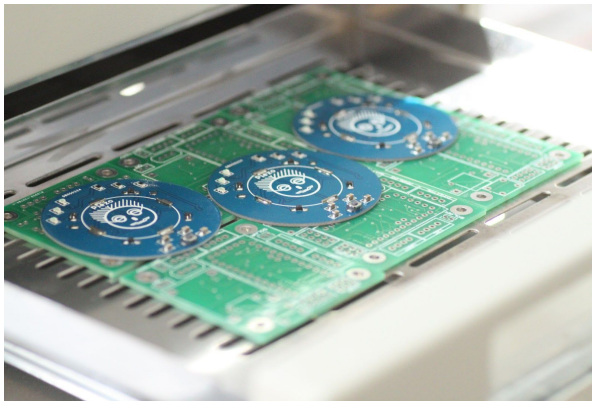
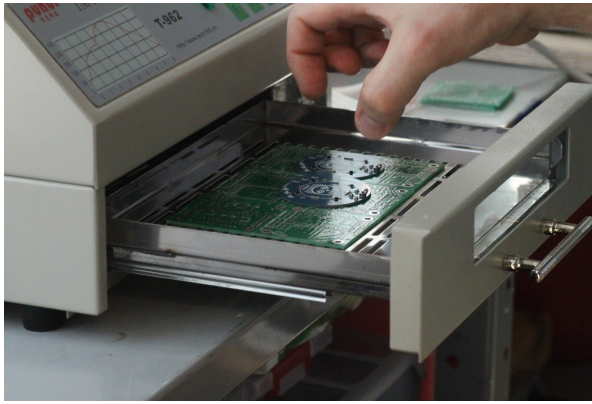
The process is very easy and described very well in sparkfun tutorials (see Resources), applying the solder paste using the spatula through the stencil. Than manually arranging the parts on the PCB using a pair of tweezers, I have started with the diodes which required orientation, and for that the magnifying glass was a life saver. It is quite hard to see something on such small components. After the PCB`s are populated, 7 minutes in the reflow oven and almost done. I have chose to add the piezo disc and its top wiring after process as it seemed that the oven heating process isn't that good for the piezo element. For the finish I covered the piezo with some hot glue, smoothed with hot air.

Summing up the process with some photos:

Thanks to Alon Gruss for taking the images (<http://alongruss.com/>).







Resources:

Designing PCBs - <https://learn.sparkfun.com/tutorials/designing-pcbs-advanced-smd>

Solder Paste Stenciling - <https://www.sparkfun.com/tutorials/58>

Reflow Oven fixes- <http://www.instructables.com/id/T962A-SMD-Reflow-Oven-FixHack/>