**Project plan: Mechanical keyboard**

Pyry Koivistoinen, 100648540

This project is about designing and manufacturing a mechanical keyboard from scratch. Project includes mechanical and electrical design with some programming. The aim of the project is to make a functional keyboard, learn mechanical design in the limits of what is possible to manufacture, learn electrical design and about keyboard matrices.

Mechanical section

* Component design
  + Case
    - Inspiration: Inspiration for this keyboard was Varmilo VA88M. Its sleek and simple design pleases the eye and fits well with simplified pc aesthetics. I wanted to make the case from one piece to ease manufacturing. The weight of the keyboard was important also, it needs to feel heavy, so the keyboard stays firmly in place and doesn’t move around while typing. The whole construction needed to feel sturdy. Material chosen for the case was Al6082 for its accessibility and mechanical properties. The estimated weight for the case would be **\_\_\_ g.** Keyboard layout is TKL, tenkeyless, or 80%, meaning that it doesn’t have number pad on right side of the keyboard. This layout was chosen because of its compact size, nice aesthetics and that I don’t use number pad, so it is useless.
    - Securing:
    - For what do I use the keyboard:
  + Keycaps
    - Varmilo VA88M has color combination that pleased my eye, so I chose to have something similar. The bright colors are too much for me, so I choose to have white base with blue or green accents. In ebay there was a PBT keycap set that had the correct color theme. The keycap set can be seen in **figure X.**
  + Keyboard matrix
  + Requirements and budget
    - Requirements:
      * Cherry MX Brown switches
      * Heavy aluminum case
      * TKL layout
      * USB C cable
      * ANSI layout
      * Sleek and aesthetically good looking design
    - All requirements should be met. Keyboard assembly should be as cheap as possible when requirements are met.
  + Switches
    - My previous keyboard had Kailh Blue switches. This switch type is tactile and loud. I like the tactical bump while typing, but prefer more silent keys, so I chose Cherry MX Brown switches. They are tactile but more silent compared to Kailh Blue.
    - I found cheap used keyboard from tori.fi that had the switches that I wanted. I bought it and removed all keycaps form the PCB for my own use. The PCB also had leds for every key, haven’t decided yet what to do with them.
  + Keyboard units
    - One key is 1 unit etc. :D
  + Plate
    - Plate is the piece locking the keycaps in place. Plate is secured to the case. Plate will be visible at least in the right side of the keyboard when fully assembled. Since the case is made from aluminum, the plate should be too. This matches the materials and gives better structural properties compared to e.g. PLA plastic.
    - I didn’t know where to start with the PCB design, so I searched online for open-source PCB projects. I found one that was based on Hineyboard h88. Differing from normal TKL, this keyboard had F13 extra function key. The keyboard layout was what I wanted, the board looked good, and the project well made, so I decided to order the board from JLCPCB. While testing the board, it turned out that the switch matrix was completely off, every second key was the same as the key before. Because of this I needed to redo the matrix with correct connections. This required a lot of time because I wasn’t familiar with keyboard PCB design.
    - There were still few mistakes in PCB version 2. Two buttons were still tied to the same row and column, which made them register as the same button. This was fixed by cutting the column trace on the PCB and rerouting it to the correct column using jumper wire.
  + Switch stabilizers
    - For longer keycaps that are longer than 2 units, it is required to have switch stabilizer. The stabilizer consists of two buttons and a rod connecting them. When the key is pressed, the keycap is supported from the whole area, and it makes the keypress more stable and haptically better.
    - Problem with plate.
  + PCB
    - It is possible to buy readymade keyboard PCBs, but I wanted to make my own, because:
      * I have experience in PCB design.
      * It is cheaper to make one yourself.
      * I wanted to know how keyboards work.
      * I designed the case, so I needed the PCB to fit and be able to be secured to the case.
    - Requirements:
      * Wanted to use BAV70 diodes, since less components would be needed. It makes the PCB more clean and easier to route the traces.
* Component manufacturing
  + Case and jig CAM
    - All mechanical parts were designed using Siemens NX. CAM was done using Siemens CAM feature.
  + Case machining
    - Case was machined using HAAS UMC750 milling center. It has a capability of milling in five degrees of freedom, but only 3 was needed. Forth dof was helpful for cutting the angles.
  + Plate laser cutting
    - First test version was 3d-printed. It had to be in two parts because the whole plate didn’t fit the 3d-printer. Tolerances for the holes were bit off and some filing work needed to be done to fit the switches into the holes in the plate. Test plate fit nicely, and switches aligned well with the PCB. Next the plate was cut out of aluminum with laser cutting.

Electrical section

* PCB design
  + Problem in v1
* Testing and debugging
  + Communication via USB

Programming section

* Flashing MCU
  + Arduino ISP
  + QMK MSYS
* QMK firmware
  + Mapping kb matrix
* Mapping keys

Discussion

* What was the price?
  + Excel list of components
* How does it look and function?
  + Pictures and video?
* What could be improved?
  + Teams list