Complete Workshop In a Shelf

Intro: Complete workshop in a shelf

I used to live in a moderate sized apartment. We didn't have a spare room so I had to move all my tools in a tiny compartment of an IKEA shelf and have to find a new workspace too.

I approached this problem, by building a compact yet solid frame made of low-cost aluminum extrusions. It offers some very handy features:

- storage space and organization for my tools
- frame acts as a multi-purpose workbench. It offers:
  - a drill press
  - a router table
  - a bench vise
- Concept is very flexible and may find further extensions.

Everything is designed to fit the size of the compartment. Total costs of this project are about 150 EUR.

Step 1: Step 1: The initial situation

Having a workspace in an apartment is always a huge tradeoff. I come from the countryside and are used to huge basements and workshops. Working in a tiny apartment is totally different. It shifts the focus of your projects (less woodworking, more electronic projects) and lets you re-evaluate the utility of every tool you have. I was lucky to have a dedicated corner of the room for myself.

All my belongings got temporarily stored in one big box and some smaller piles. Although I will have less time in the near future to work on new projects, there has to be a better solution. The space that was left for me, is a compartment of an IKEA shelf (forgot the name of it). It is the size of 37.5cm x 56.5cm x 59.5cm.

So my issues are:

- **Storage**: I need a place where I could store my tools, wires, bolts, and other components I use regularly.
- **Organization**: Even more important than having a dedicated space, is to keep everything in order. I do not want to fumble in a box everytime I need a tool.
- **Reduction**: Having less space also is a chance. I decided to keep only the tools I really needed. This means to get rid of duplicate and unnecessary ones. Going for basic and high quality tools is my approach.
- **Workbench**: I have no workbench any longer and drilling a hole on the living room table is no option. I need a sturdy surface for rough and "dirty" work.

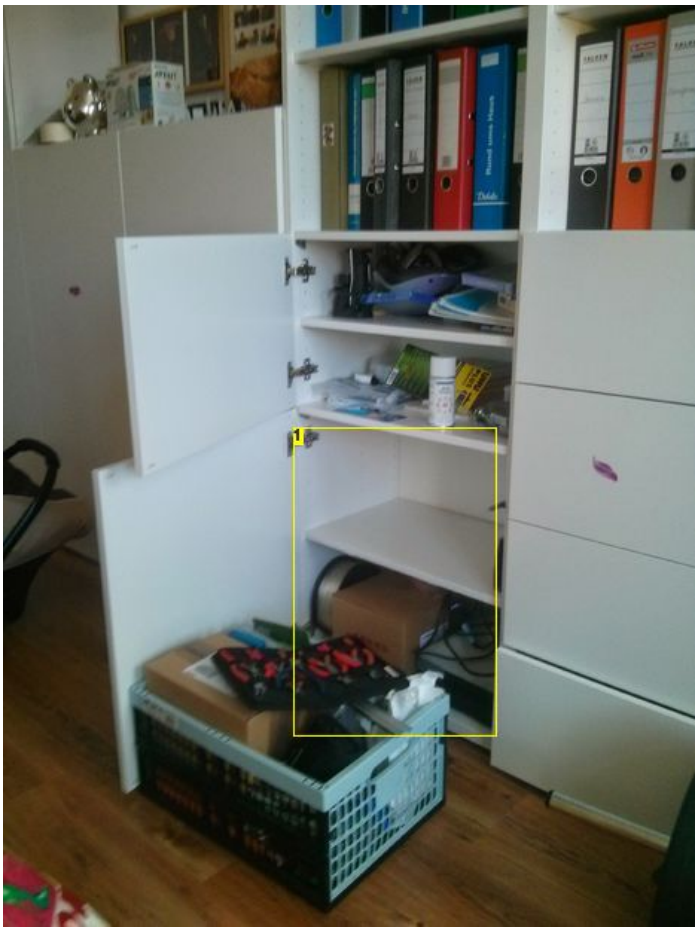


Image Notes
1. This space will contain my next workshop.

Step 2: Step 2: Workbench Design

I got persuaded by the benefits of aluminum extrusions, in recent projects. They offer a sturdy frame for my 3D-printer and are much less expensive than I initially thought. So I decided to used them again.

After many iterations, the final design that I build is the one I provide here.

My major design considerations are:

- Low profile drawers for the hand tools. Pliers, wrenches and so on are usually just a few Centimeters high. The lower the drawers, the more tools I can store.
- Transparent boxes for non-sortable things like nuts, bolts, electronic components, etc. Ordering tiny components in reclosable bags is the most space-efficient storage I am aware of.
- From the very first idea, the frame was thought of as a tool itself:
    - It should provide a workbench for cutting work, soldering etc.
    - Occasionally, I have to drill some holes. I need a working drilling press.
    - Dremel-tools are very versatile. I wanted the frame to be usable as a router table - the extrusions provide good linear rails.
    - Sometimes you have to clamp things down. The frame should act as a bench vise.

I think my design considerations are a good starting point for everyone to do something similar themselves. I am sure you will have great ideas to improve this concept. .

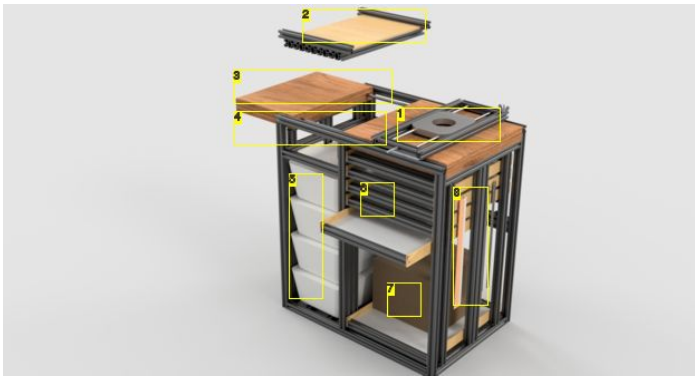


Image Notes
1. Aluminium extrusions act as linear guides in two directions. A router holder (not shown) can be used for Z-axis movement and as a drill press.
2. This wasteboard can be height-adjusted to compensate the small range of the "drill press".
3. Bench vise is realized via two threaded rods, that are turned by a ratchet wrench from the left side.
4. The workbench is cut out from a kitchen countertop. This is solid and can cheaply be made from leftovers.
5. Plastic boxes for storing small stuff.
6. Low profile drawers
7. The soldering station needs more space - so drawers can be freely adjusted.
8. The space betwen the extrusions also offers space - e.g. for hanging a ruler.

Step 3: Step 3: Frame Assembly

I ordered the aluminum extrusions according to the CAD-construction. I only used 20x20 and 20x40 extrusions - these are the most affordable ones. After one week, they came pre-cut to the exact length. Screws, corner-brackets and other parts for frame assembly are almost entirely sourced from China. It takes some time to ship them, but is the cheapest source I know.

The assembly is pretty straight forward, if you have the CAD file. Just measure the length of the extrusions and connect them. The only tools you need is a hex wrench, a plier and a rule.

Tip: Corner brackets and connectors cost more, than the extrusions. You can save connectors, if you drill a hole in the end of the extrusion to turn the screw (should be lens head screw M6) in the opposite extrusion. Some extrusions don't even need tapping.

Image Notes
1. Package with aluminium extrusions
2. Package with aluminium extrusions

Image Notes
1. unboxed extrusions

Image Notes
1. Required tools. Pliers may not be necessary at all.

Image Notes
1. Overview of all components of the frame

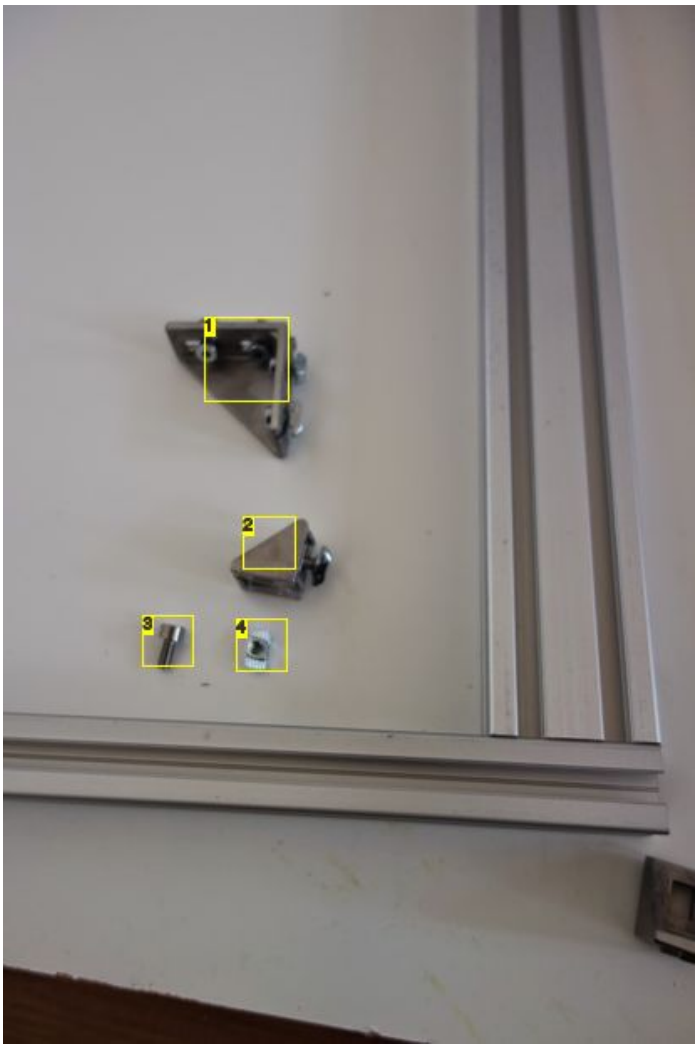
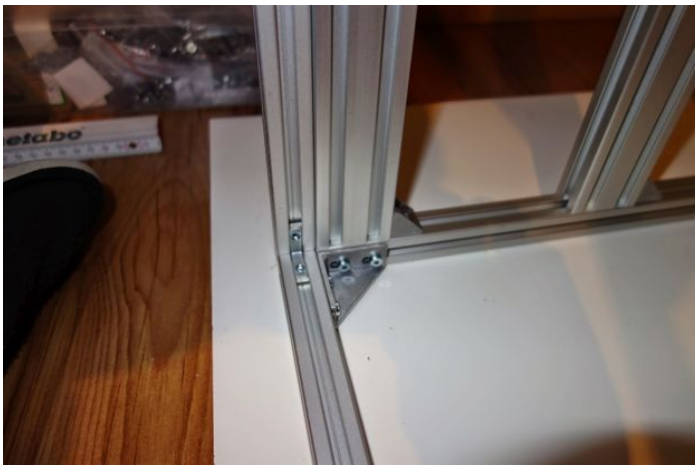


Image Notes
1. Large corner braket
2. Small corner braket
3. M4 screw
4. M4 hammer head nut



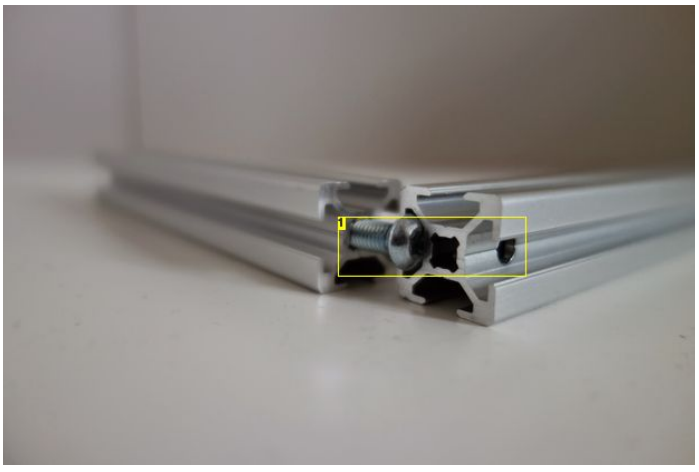


Image Notes
1. Connecting the extrusions this way requires more work, but lets you save on corner brackets.

Image Notes
1. Assemble extrusions to "flat" modules first. Connect them later.

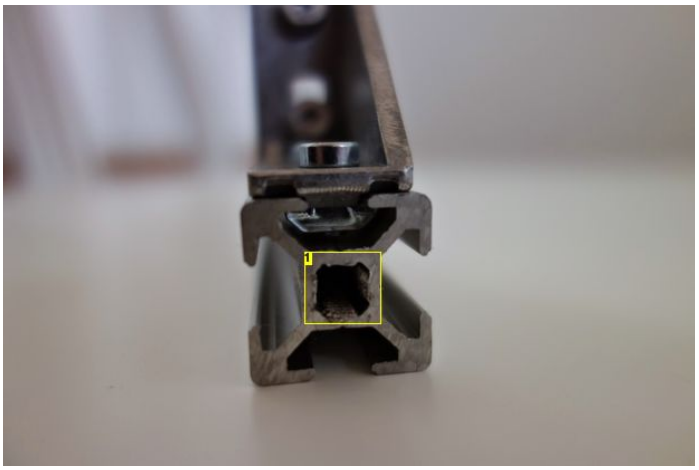
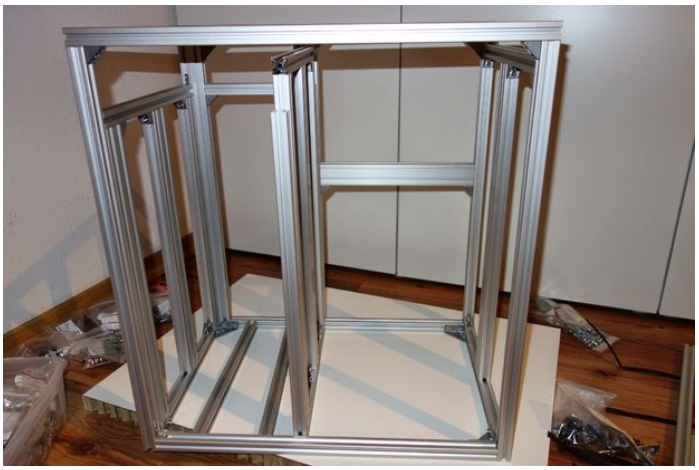


Image Notes
1. Hole in the center of the extrusion can be tapped to fit M6 screws.



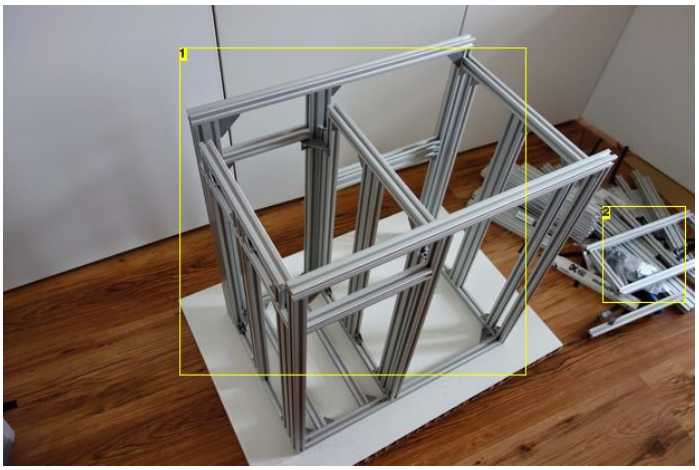
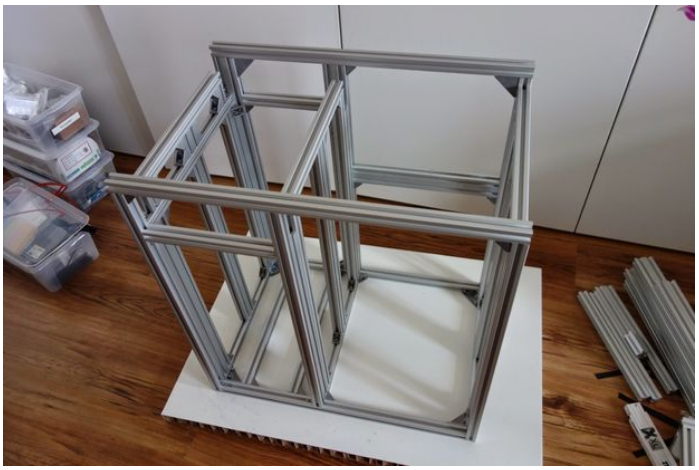


Image Notes
1. Complete frame.
2. Some of this is needed later...



Step 4: Step 4: Woodworking

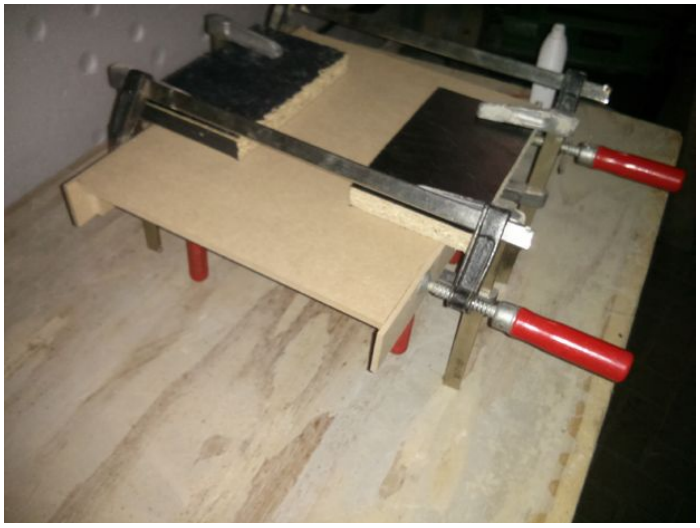
Now that you have the frame, you need to build the drawers and the work surface.

I made the drawers from MDF. On the front-end, I put an aluminum extrusion. This makes them look better, but is primarily intended to keep them in place once they are inside the frame.

The work surface is a former kitchen countertop. I got a used one made of solid oak from eBay. You need to cut the plate into two parts. These parts will be connected with threaded rods to build a bench vise. Important things are:

- The static part of the vise needs a support on both ends. That's why there is an horizontal extrusion in the middle of the frame.
- It is almost impossible to drill a long hole in the plate to fit the threaded rod. Instead the wood was cut parallel to the sliding direction. Then it was milled on the inside with a router - this creates a tunnel for the rod. After that, everything is glued together. Luckily my brother is a carpenter - he had the right tools for that.
- Do not forget to put a nut in the static part of the surface. I used one with a larger flange to prevent slippage and to distribute the forces evenly.

Image Notes
1. Skateboard bearing ensure easy sliding of the drawers and are very cheap and versatile.
2. Drawer - as simple as possible.
3. Drawer - as simple as possible.



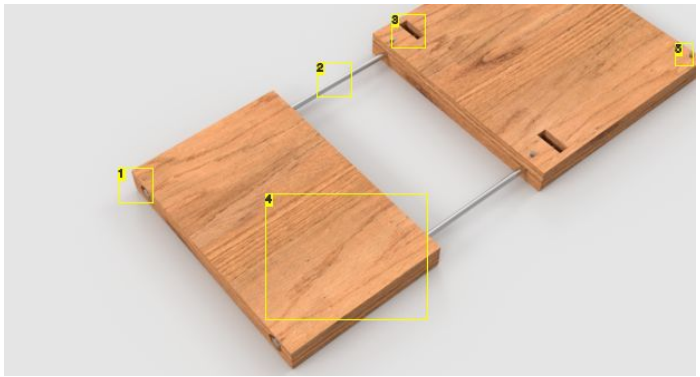


Image Notes
1. Bolt for tensioning the vise.
2. Threaded rod (I used M8)
3. Bedding for a nut. Use washers to distribute the forces on a larger surface.
4. You have to cut the wood parallel to the rod to get a tunnel into it.
5. Small bolt, to keep the static part in place.

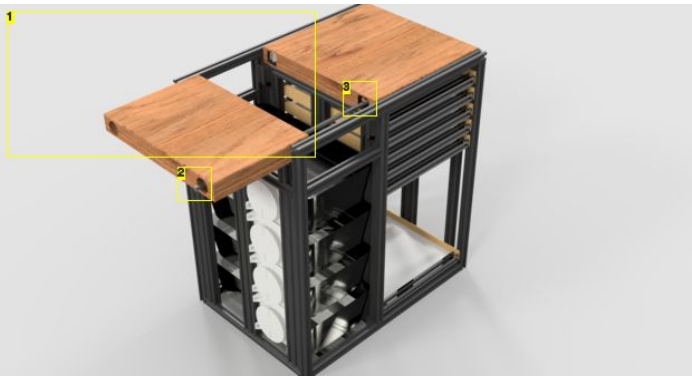


Image Notes
1. This is an early rendering, that shows the idea of the bench vise, but also some things you must be aware of.
2. This end of the rod is always flush. Instead the rod slides into the other part of the work surface.
3. Do not connect it this way! Instead put a nut in the center of the wood, as shown before.

Image Notes
1. This is the correct way.

Step 5: Step 5: Final assembly

The last part is to mount the working surface and to install the drawers.

The work surface is only fixed by a small bolt to prevent horizontal movement. Other mounting is not needed. If you want to use the frame as a router table, you have to remove the surface. So make this as simple as possible.

Skateboard bearing placed on screws ensure a smooth motion of the drawers. The aluminum extrusions prevent them from moving, when inside the frame.

Image Notes
1. Hammer head screws can be slided into the extrusion at every place. That makes them easy to insert and to adjust height of each drawer.

Image Notes
1. I added brakets in the back to prevent the drawers from sliding out in the wrong direction.

Image Notes
1. Bearings on a screw.

Step 6: Step 6: Further Improvements

Now you have a compact workshop that hides in a shelf. However, the flexibility of the extrusions offers you various possibilities for further improvement.

One thing I mentioned, is the drill press and router guide. I designed them to be used when the work-area is removed. On the left side is a height adjustable board that holds the work pieces. The extrusions do also good work as linear guides. 3D-printing some gliders made of PLA ensures smooth motion. I am currently working on this...

Second, if you build a compact workshop, you will use every inch of it. The extrusions have a depth of 2 cm. That's why I want to use the space between them too. I have already designed and printed a wire coil that fits exactly on the empty space on the left. A ruler holder for the right will be my next objective.

There are many other things that would enhance the functionality of this "workshop in a shelf".

I hope you will find inspiration by this project.

PS: Finding the right tools for this workshop is a challenging task. I decided to fill it with tools that have a level of quality that will hopefully last the rest of my life

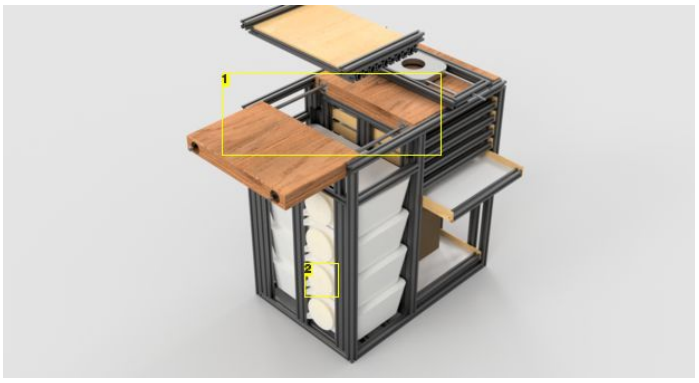


Image Notes
1. The complete workspace - as planned.
2. 3D printed wire coils

Image Notes
1. You can height-adjust this wasteboard.

Image Notes
1. Two-dimensional linear guide for a Dremel-tool. (you have to remove the countertop before)

Image Notes
1. Everything hides in the shelf. Tools are still accessible from the front.

Image Notes
1. The vise is operated with a ratchet wrench that is part of the toolbox.

Image Notes
1. 3D-printed wire coil, to take advantage of the empty spaces between the extrusions.

Image Notes
1. Front view.

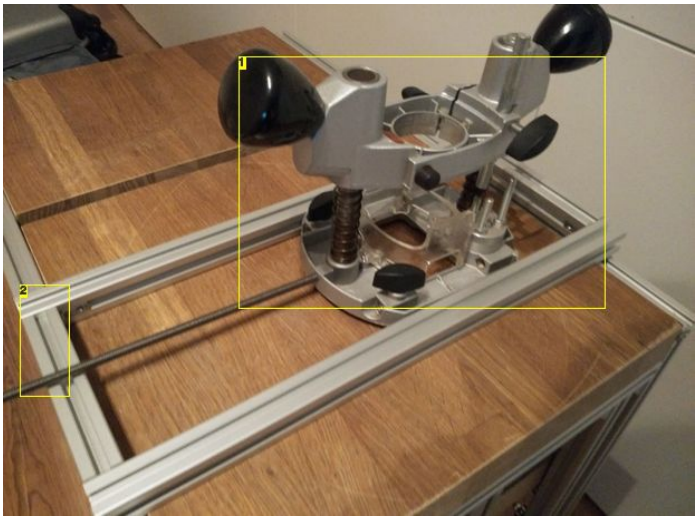


Image Notes
1. I found out, that the most rigid form to implement a drill press, is to use a router mount. It works pretty well for small holes.
2. To allow linear motion, a sliding connector has been 3D printed.