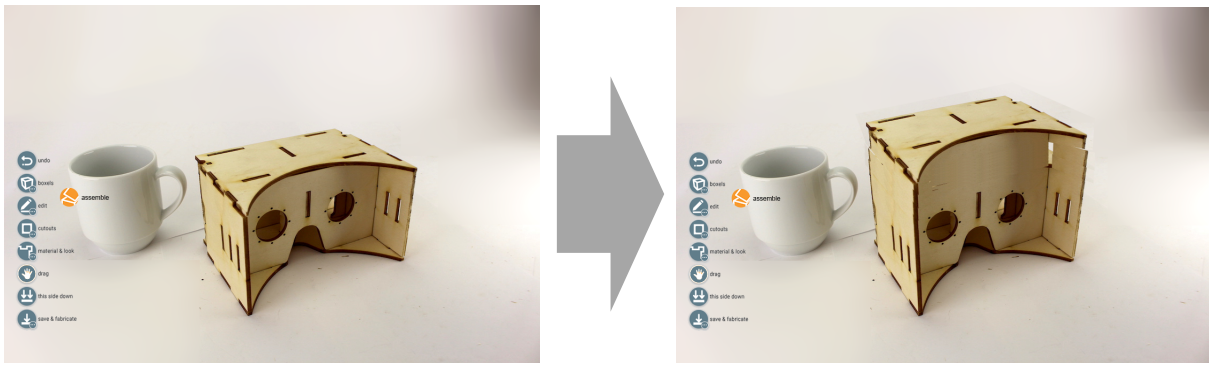
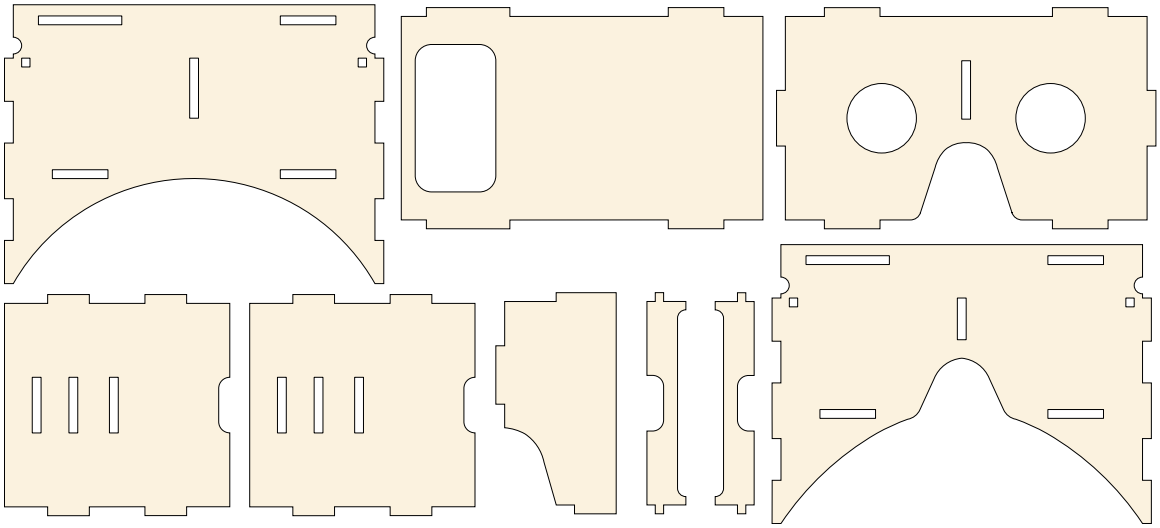
Human Computer Interaction
Prof. Dr. Patrick Baudisch
Masterprojekt Sommersemester 2020

Automatic 3D-Reconstruction of Laser-Cut Models

When building a physical model, a very powerful process would be (1) download a model from the web that roughly matches what you need, then (2) tweak it to fit your needs. The illustration below shows an example: here we would like to adjust the size of this VR headset.



Unfortunately, however, the common way of sharing laser cut models today is in 2D, as shown below. The modifications we just mentioned are all but impossible on this format.



To address the issue, we think the way to go is to **reconstruct the 3D model from the 2D file** found on the web, perform the changes we want easily in 3D (which we already have), and convert the result back to the 2D format laser cutters understand (which we already have as well).

With the current master project, we have taken a first step in that the team has built interactive tools that allow users to import a 2D model into our 3D editing environment, isolate the individual plates, and click them together into a 3D model,

similar to how a human would assemble the model. They have demonstrated this for models of about 10 plates.

Based on this, the **objective of your master project** will be: (1) automate the assembly process and (2) demonstrate it for models with 500 parts. (3) Integrate your algorithm into the existing 3D interactive environment.

The obvious challenge is that the search space is exponential, so the key will be to come up with an appropriate algorithm. A first approach might be to explore backtracking: for which subset of models can you identify dead ends early enough to make the problem tractable?

As a next step, we would like you to explore your choice of machine learning techniques. You will need to find a proper way to represent the problem so as to make it learnable. Then you would generate learning data, probably by finding 3D models, exporting them to 2D (which we already have code for), and using the resulting (3D, 2D) pairs as training data.

You extend the algorithm and implement plate-modification tools

Project Ingredients

1. JavaScript/typescript
2. 3D Graphics
3. 3D Interactive tools to edit, align, assemble 2D plates in a 3De environment
4. Algorithms that deal with np-problems
5. Integration into a medium size system Kyub (110.000 lines of code, kyub.com)

Contact

Email me at thijs.roumen@hpi.de or swing by my office 3rd floor of the main building (H-3.5).