ParaShape
Parametric Approach to Personal Design
Shadan Sadeghianborojeni
Master of Computer Science Student at the University of Bonn
Motivation
Who is the User?

Expert User

Novice User
**Initial Survey**

<table>
<thead>
<tr>
<th>Expert Users</th>
<th>Novice Users</th>
</tr>
</thead>
<tbody>
<tr>
<td>• Use WYSIWYG CAD to visualize design ideas (AutoCAD)</td>
<td>• Use pen and paper and to visualize design ideas</td>
</tr>
<tr>
<td>• Think more functionalities and learnability makes a tool usable</td>
<td>• Like composing parts to make complex objects</td>
</tr>
<tr>
<td>• Spend minimum 30 minutes on a design visualization</td>
<td>• Spend minimum 30 minutes on a design visualization</td>
</tr>
</tbody>
</table>
Related Work
Related Work
(Problems)

CAD
• High learning curve
• Complex UI

3D Creators/Customizers
• Small range of object models covered

3D model libraries
• Static models, 3D modeling skill required for customizing
Requirements

High flexibility of the existing 3D models for customization

Easy and fast search and browsing for the models

Capability of making complex 3D models without having 3D modeling skill

Time efficiency of the system

High range of object 3D models

Understandable interface

Understandable units of measurement

High learnability of the system

High readability of 3D model code

Capability of code reuse
Makerbot Customizer

- Met 5 out of 10 of our system requirements
- Low system usability scale (52%)
- Users feedback not satisfactory
Hypotheses of ParaShape

- Component-based Modeling
- Primitive Instancing of Components
- Units of Measurements
- Component Code Templates
Every object is made of its composing components
H2: Primitive Instancing of Components
H3: Units of Measurement

- **Metric Units**: a cylinder with a cross section radius of 10 millimeters and height of 44 millimeters

- **Market Units**: AAA battery

76% rated the market units of measurement as a more acceptable system: is more familiar, prevents measurement errors
H4: Component Code Templates

- Increases 3D model code readability
- Supports 3D model code reuse
- Prevents errors
Paper Prototype

• Qualitative user study
• Separate questionnaires for both user groups
• Comments and suggestions used as requirements for final mockup
Mockup
Evaluation of Mockup

- Hypotheses Verification
  H1: Component-based modeling
  H2: Primitive instancing of components
  H3: Units of measurement
  H4: Component code templates

- PSSUQ Results

<p>| | | | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Overall</td>
<td>85%</td>
<td></td>
<td></td>
</tr>
<tr>
<td>SysQual</td>
<td>86%</td>
<td></td>
<td></td>
</tr>
<tr>
<td>InfoQual</td>
<td>87%</td>
<td></td>
<td></td>
</tr>
<tr>
<td>IntQual</td>
<td>88%</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Future Work

• Implement a working system of ParaShape
• Evaluate the system with 3D printers
• Using other interaction techniques (digital pen, virtual clay, etc.)
• Prevent 3D printing mistakes (printability of the model, ergonomics, cost)
Conclusion

• The goal of personal design is to make everyone able to turn their ideas into physical objects.

• ParaShape proved that by using the knowledge of experts, we can make almost everyone able to make complex 3D models needless of having 3D modeling background.
Thank you!