Build your own customizable 3D objects with Sculpteo

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Slides & examples : http://goo.gl/huXbk

Who we are

- A company based near Paris
- Providing a 3D printing service online

but also...

- Tools to integrate 3D-printing in your business seamlessly
- Tools to easily create customizable products

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Our technologies

- Automatic mesh analysis and fixing tools
- Interactive online 3D viewer
- Multiformat file importer
- Online quotation engine
- Online customization engine

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Outline

- Why customize ?
- Interactive customization tools
- Scripted customization
- Conclusion & Questions

+ interactive demo

Why customize ?

- 3d-printing pros :
  - allows shapes that are hard or impossible to create with standard manufacturing
  - functional mechanical parts may be synthesized directly
  - objects are made on demand
  - enables local production and quick delivery

- 3d-printing cons:
  - not cost effective to produce large series of the same object
  - quality of printed objects is limited by printer resolution and often slightly worse than what mass production can provide

Why customize ?

- Customization :
  - Adds value to the object by making it unique
  - Takes advantage of the capability of printing objects of largely varying shapes and sizes
  - Adds virtually no production cost compared to 3D-printing a fixed design

Why customize ?

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How to customize ?

- Objects are represented by 3D solids
- Customization is provided by :
  - Adding and merging other solids
  - Carving
  - Modifying the shape of the solids
  - Modifying the color and texture of the solids

How to customize ?

- Our customization engine
  - Works with meshes internally
  - Supports and maintains colors and textures
  - Imports from a wide variety of 3D file formats
  - Handles automatic repair to ensure the meshes represent solids
  - Sends a solid mesh to the printer

Outline

- Why customize ?
- **Interactive customization tools**
- Scripted customization
- Conclusion & Questions

Interactive tools

- Online customization for designers and end-users:
  - Writing text
  - Adding extruded shapes or logos
  - Adding or replacing textures and colors
  - Using predefined filters
- Customizable template designs for end-users:
  - Prepared by designer using the interactive tools above
  - Prepared by designer using scripting
  - End-user may only customize the available prepared options

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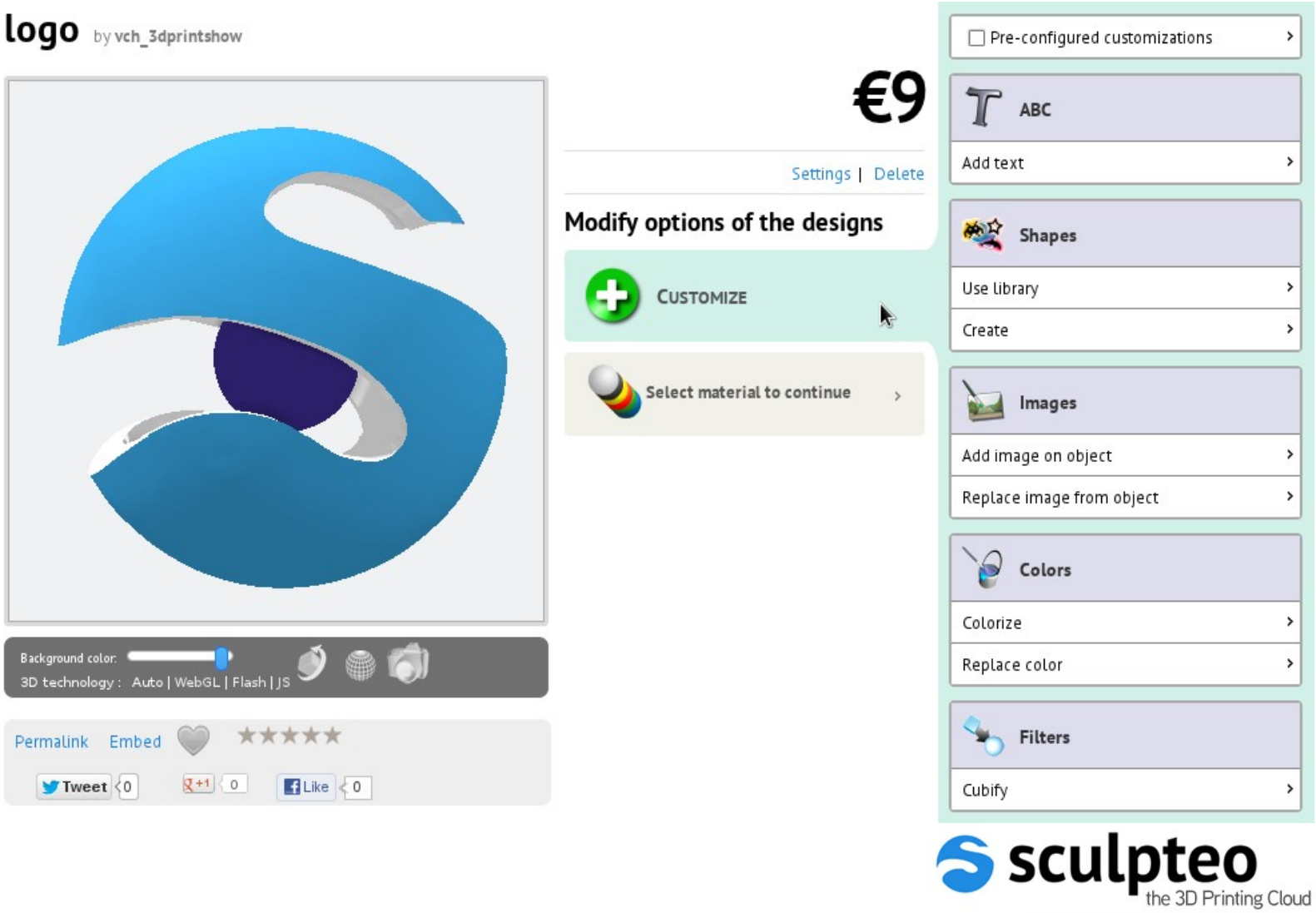
The Web Interface



Text Tool

- Writes text on solid
- Follows curvature
- Either extruded or carved in the solid

- Choose font or use your own
- Choose color
- Adjust size and elevation

Text Tool

logo by vch_3dprintshow

Background color:
3D technology : Auto | WebGL | Flash | JS

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Modify options of the designs

CUSTOMIZE

Text [*Hello world!*]

Select material to continue

Type the text you want, its color and its font. Then click on the model in the viewer to set the center of the text zone.
Show video tutorial

Text Carve
Hello world!

Font
GoodDog

Size Height

Color

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Shapes Tool

- Add or carve symbol from library
- Use your own logo or symbol (binarized)

- Choose color
- Adjust binarization contrast/detail
- Adjust size and elevation

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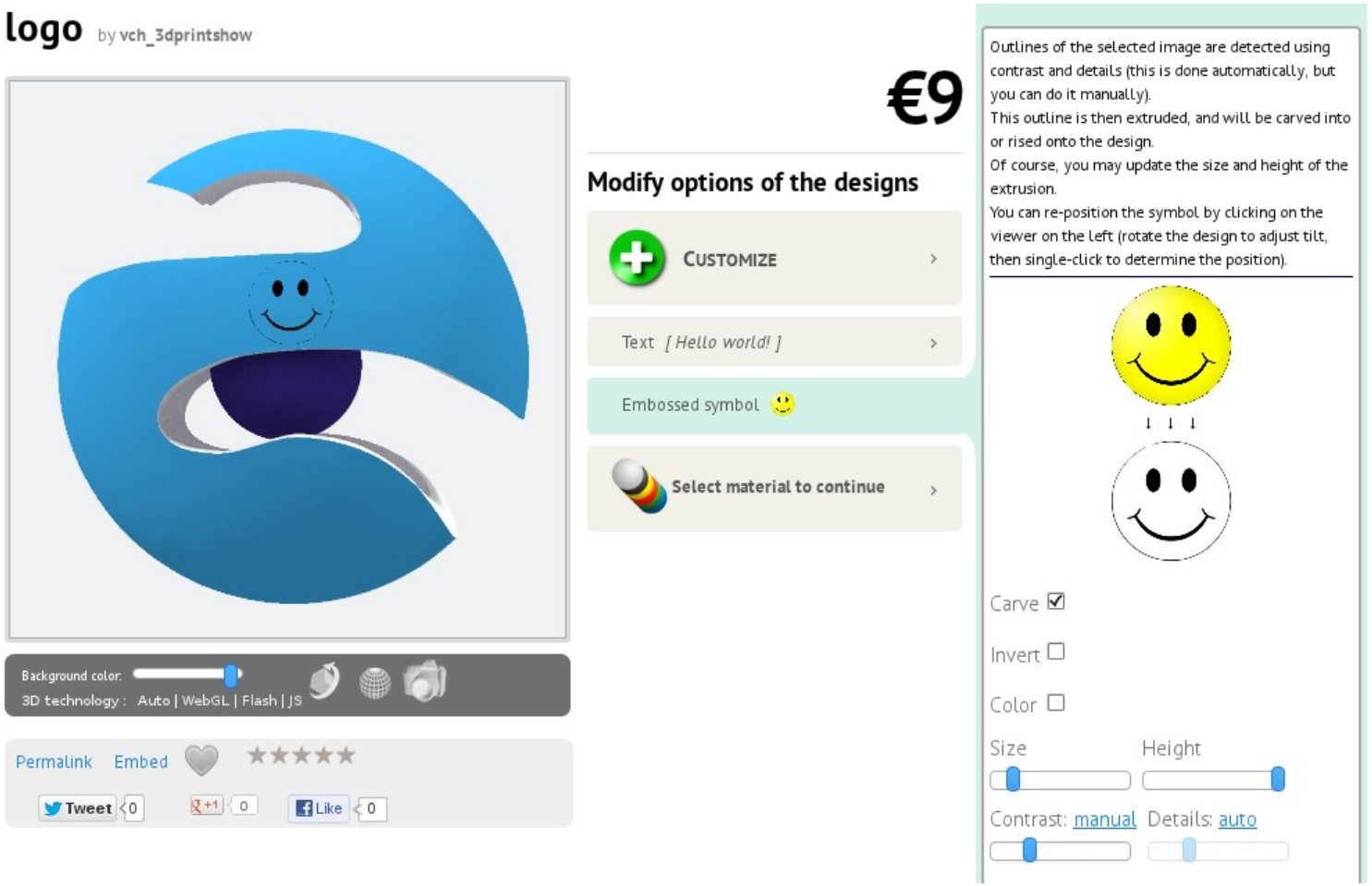
Shapes Tool



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Color and Texture Tools

- Apply color or color gradient on model
- Replace a color with another one
- Apply texture on model
- Replace an existing texture
- Supports cropping the new texture

Color and Texture Tools

logo by vch_3dprintshow

Background color:
3D technology : Auto | WebGL | Flash | JS

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Modify options of the designs

CUSTOMIZE

Text [*Hello world!*]

Embossed symbol

Replace with color

Select material to continue

Update a color of the design.
Select the color to be updated (you can single-click on the viewer to select it), then select the replacement color.

New color

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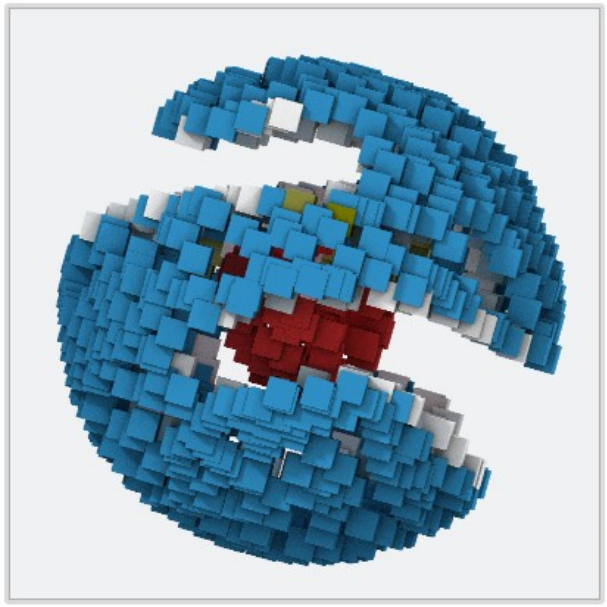
Filters and Effects

- Cubify : replace object surface with randomly placed cubes
- More to come later...

Filters and Effects

logo by vch_3dprintshow



Background color:
3D technology : Auto | WebGL | Flash | JS

⚠ Design has small details which might break, please check its solidity

Permalink Embed ★★★★★

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Modify options of the designs

CUSTOMIZE

Text *[Hello world!]*

Embossed symbol

Replace with color

Cubify

Select material to continue

Apply a '3D-pixelization effect' on your design.

Number of cubes: [Reset]

Size of the cubes: [Reset]

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Template designs

- Designers may prepare templates for other users
- Users focus on customizing the options chosen by the designer

Designer view

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User view

logo by vch_3dprintshow

Background color:
3D technology : Auto | WebGL | Flash | JS

Permalink Embed

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Modify options of the designs

Text *[Hello!]*

Select material to continue ›

Add this text to the logo:
Type the text you want, its color and its font. Then click on the model in the viewer to set the center of the text zone.
Show video tutorial

Text
Hello!

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Outline

- Why customize ?
- Interactive customization tools
- **Scripted customization**
- Conclusion & Questions

Why scripting ?

- Interactive customization only offers a limited set of tools
- Scripting allows more control on design, placement and constraints
- Scripting allows more flexible user interface
- Much faster and easier for us to extend

- Cons:
  - need some programming skills
  - need to learn API

OpenSCAD

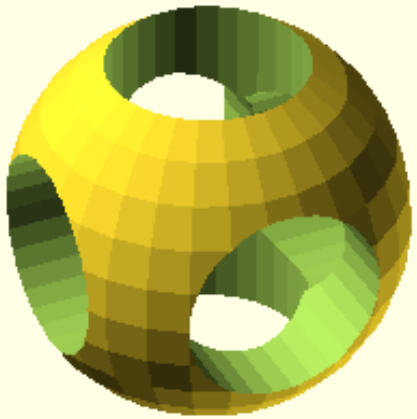
- Open initiative to provide a programmatic way of creating solid 3D CAD objects
- CSG and extrusion
- Using its own scripting language

OpenSCAD

OpenSCAD - example001.scad*

File Edit Design View Help

```
module example001()
{
	function r_from_dia(d) = d / 2;

	module rotcy(rot, r, h) {
		rotate(90, rot)
			cylinder(r = r, h = h, center = true);
	}

	difference() {
		sphere(r = r_from_dia(size));
		rotcy([0, 0, 0], cy_r, cy_h);
		rotcy([1, 0, 0], cy_r, cy_h);
		rotcy([0, 1, 0], cy_r, cy_h);
	}

	size = 50;
	hole = 25;

	cy_r = r_from_dia(hole);
	cy_h = r_from_dia(size * 3);
}

example001();
```



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CloudSCAD

- OpenSCAD online
- UI Parameters are specified via comments

- Restricted access
- No news since it was started in 2010

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OpenSCAD on Sculpteo

- Plain OpenSCAD files are supported, just upload them
- Additional comments provide a mean to define interactive UI parameters (CloudSCAD syntax + our extensions)

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OpenSCAD on Sculpteo

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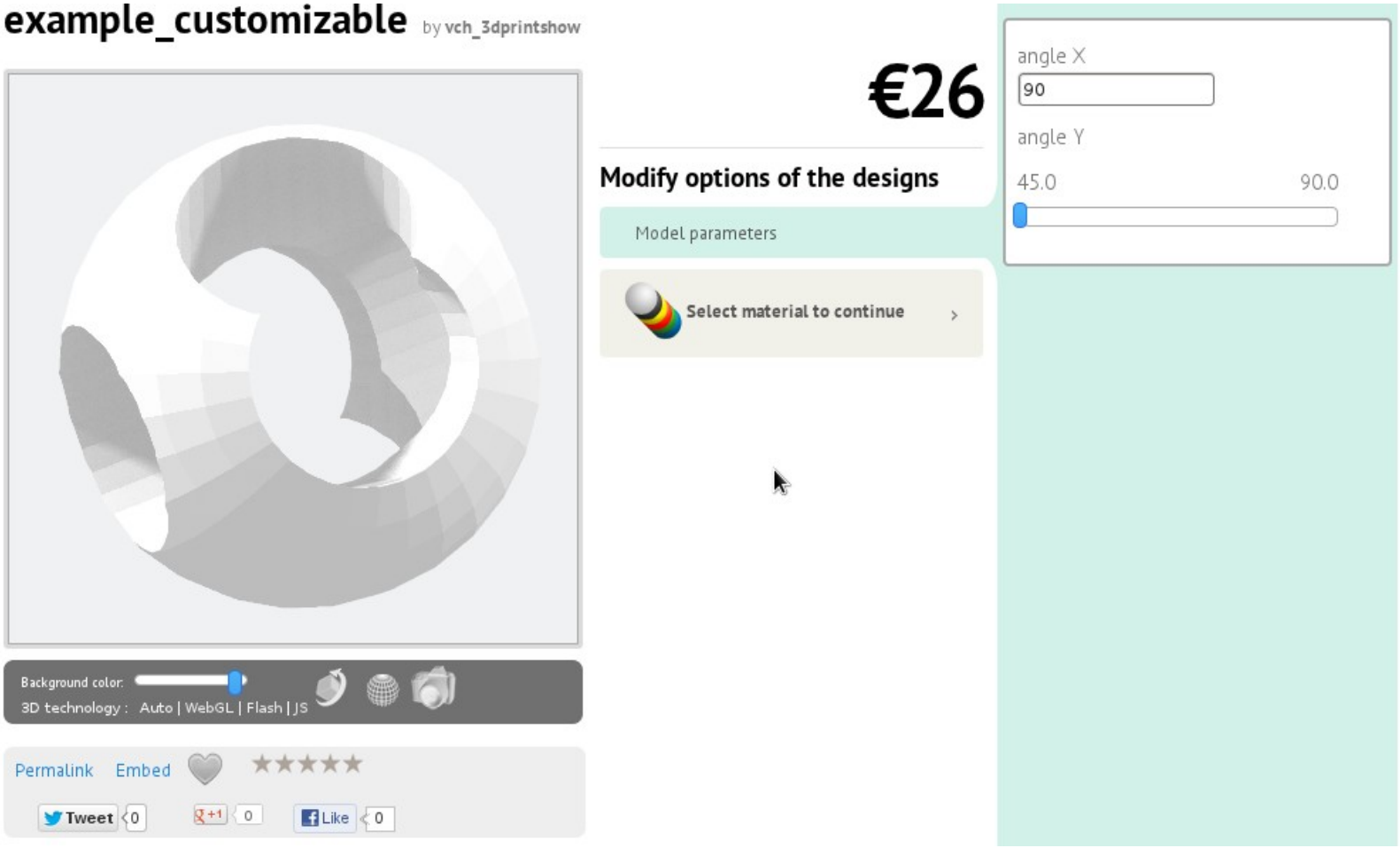
OpenSCAD on Sculpteo



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Beyond OpenSCAD

- OpenSCAD is the right trend and does a great job !

Still, a few drawbacks for preparing online customizable designs:

- New dedicated language to learn
- CAD engine is based on CGAL, slow and not fully robust for online use, especially with generic mesh input
- No support for texturing

→ provided inspiration to build our own **online** scripting engine, mixed with inspiration from **Web standards**

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Our scripting engine

- **XML** description of the design and customization parameters
- **Javascript** program to define how customization interacts with the model

- Uploading those files creates a customizable design directly
- Script may be re-edited online by designer, with interactive feedback

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Our scripting engine

- No complex new language or programming skills needed, conceptually similar to web page design
- Javascript environment is well defined and robust
- Javascript language is well known and becoming just as powerful as any other scripting language
- XML description is human-readable while allowing future extensions and easy import/export
- Customizable design template may be prepared and modified offline

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Example XML

```
<?xml version="1.0" encoding="UTF-8"?>
<sculpteo>

  <design configurable="1">
    <name>Logo</name>
    <description>This is our company logo, choose the color of the ball.</description>
    <model src="logo.3ds"/>

    <operation type="replacecolor">
      <color rgb="#ff0000" locked="0"/>
      <material id="2" locked="1"/>
    </operation>

  </design>

</sculpteo>
```

Example XML

Logo by vch_3dprintshow

Background color:
3D technology : Auto | WebGL | Flash | JS

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This is our company logo, choose the color of the ball.

Modify options of the designs

Replace with color

Select material to continue ›

Update a color of the design.
Select the color to be updated (you can single-click on the viewer to select it), then select the replacement color.

New color

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XML description file

- Design information: name, description, units, front view orientation, etc...
- Customization modifiers: any of the interactive tools or a script modifier
- Supports inline, local, or remote import of external ressources (models, fonts, scripts)
- Supports updating a design you already own
- Supports uploading multiple designs at once

Example Script

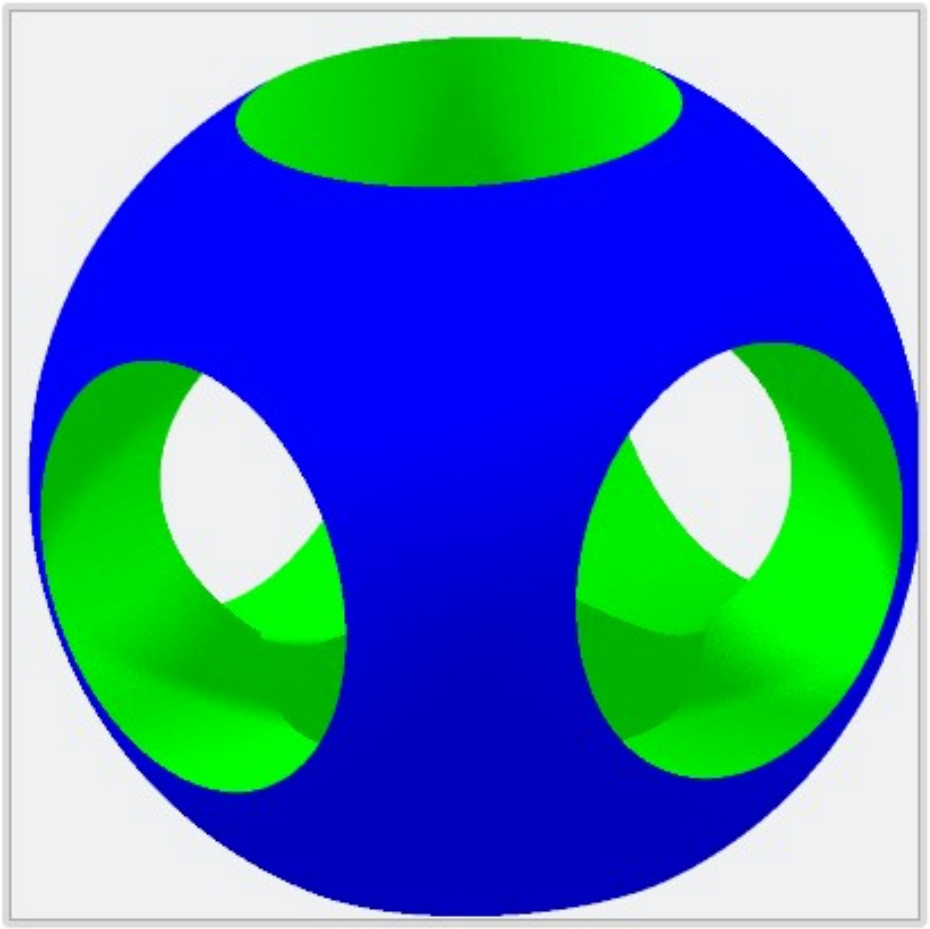
```
var sphere = new Sphere();
var cylinder = new Cylinder(0.5, 2);

sphere.color(0,0,1);
cylinder.color(0,1,0);

sphere.difference(cylinder);
sphere.difference(cylinder.rotate(90,0,0));
sphere.difference(cylinder.rotate(0,0,90));

append(sphere);
```

Example Script



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Javascript API

- Primitives (Cube, Sphere, etc...)
- Color and textures
- Text and fonts
- CSG (union, intersection, difference)

- UI parameters may be bound to Javascript variables
- input/output mesh is the global Mesh object

Full example

```
<?xml version="1.0" encoding="UTF-8"?>
<sculpteo>

  <design configurable="1">
    <name>Drilled Sphere</name>
    <description>Customizable drilled sphere.</description>

    <operation type="script">

      <parameter type="slider" value="0.3" min="0.1" max="0.5">
        <description>Drilling radius</description>
        <bind value="radius" />
      </parameter>

      <script locked="1">
/* <![CDATA[ */

var sphere = new Sphere();
var cylinder = new Cylinder(radius, 2);

sphere.color(0,0,1);
cylinder.color(0,1,0);

sphere.difference(cylinder);
sphere.difference(cylinder.rotate(90,0,0));
sphere.difference(cylinder.rotate(0,0,90));

append(sphere);

/* ]]> */
      </script>
    </operation>

  </design>

</sculpteo>
```

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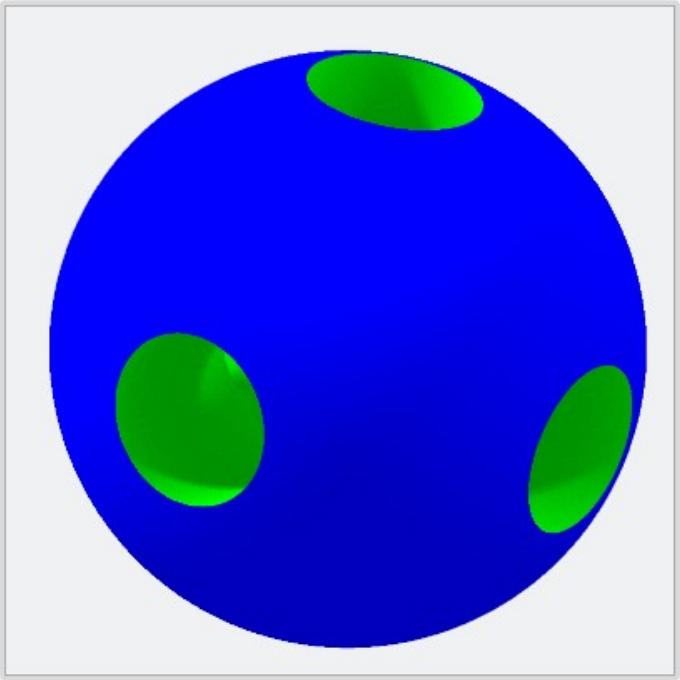
Full example

Drilled Sphere by vch_3dprintshow



Background color:
3D technology : Auto | WebGL | Flash | JS

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Customizable drilled sphere.

Modify options of the designs

Model parameters

Select material to continue ›

Drilling radius

0.1 0.5

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More examples

- Rough&Smooth cylinder (parametric function)
- Fractal tree (recursive function)
- Lucky coin (design&font parameter)
- Flakeball

Outline

- Why customize ?
- Interactive customization tools
- Scripted customization
- **Conclusion & Questions**

Conclusion

- Customization tools for various needs:
  - interactive mode for end-users
  - interactive template mode for designers
  - scripted mode for designers and programmers
- Works in our mobile Apps as well
- This is how we built our most recent 3DPCase service, meet us in our booth to discover it

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Questions ?

- This presentation and supporting files :
  - http://goo.gl/huXbk
- Full API documentation :
  - http://www.sculpteo.com/en/developer/webapi/create/
- Contact information :
  - Booth K9B
  - vivien@sculpteo.com

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