Implement toolchain for .OBJ objects in PySide6 GUI to create a 3D modeling software

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1 Introduction

A program that has a graphical user interface to import, view and manipulate with the help of subdivision methods .OBJ format files.

2 Project goals and methods for evaluation

2.1 Project milestones

The main goal of the programme is to construct a graphical user interface that gives the user a simple way to manipulate 3 dimensional objects in a simplified way and to see the changes in the programme. The user should have several possibilities to interact with the programme.

1. Users shall be able to import their own .OBJ files into the programme.
2. Users should be able to see imported files in the software's own 3D-viewer.
3. Users should be able to manipulate the devices via buttons and slider. Manipulation will be limited to:
    - the application of a subdivision.
    - the scaling of the whole project.

2.2 Project Methods

To realize the implementation, a modular tool chain is built with which the users can interact, through buttons and sliders, and the developers can add tools in a simplified way without having to rework the entire code. For the development of the GUI, the Python 3-based framework PySide6 is used. More about this in the Tools section. For the use of the subdivision, own implementations are used to adapt the imported 3D objects accordingly. For more information, see section Algorithms.

3 Algorithms

The two main algorithms in the program will be the loop subdivision algorithm and the linear subdivision algorithm for surfaces consisting of triangles. The loop subdivision algorithm is intended to shape the objects more smoothly. The linear subdivision algorithm the triangle sides into smaller triangles, while preserving the shape of the body. The result of this subdivision can be used in possible extensions of the program, for example by allowing individual triangle faces to be extruded.

Charles Loop invented the Loop subdivision to allow designers to create a smooth surface. A structured set of control points are used to define and manipulate the surface. Unlike many other surface design schemes, the Loop subdivision does not require a regular structure of control points. [1]

4 Tools

The programming language used for the project is Python, using the Visual Studio Code editor. The Qt framework is used, which is integrated with the PySide6 module. With the help of this framework the GUI will be implemented. To be able to design the GUI visually, the program Qt Designer is used. There, buttons, sliders and other elements can be positioned via drag and drop. In Qt Designer, a Python file can be generated afterwards. Further elements and functions are programmed with Python and the classes generated in Qt Designer are integrated. Other programs to be used are the 3D graphics suite Blender and the slicing application Cura. Blender will be used to create the .obj files that will be imported and Cura will be used to

convert the exported .obj file into G-code. The object will be printed with AnyCubic i3 Mega s 3D printer, using PLA filament.

PySide6 is the official set of Python bindings provided by the Qt for Python project. It provides pre-built widgets, controls, charts and data visualizations, making it easier to create 2D and 3D graphics in Python. To install PySide6, Windows users must enter the following commands in the terminal:

```
python -m venv env
env\Scripts\activate.bat
pip install pyside6
```

[1]

The Fusion 360 program served as inspiration for the project. Fusion 360 is a CAD, CAM and CAE software. It is suitable for 3D design and modeling, for example. It includes many modeling tools, such as rendering, sketching, direct, parametric and free-form modeling. Other possible applications of the program is additive manufacturing, generative design and simulation. [2]

5 Working Packages

There are four packages in the project. These are called GUI, Backend, .obj File Processor and Create and Print. The packages are divided into smaller tasks. The tasks can be seen in the graphic 1.

[1] https://www.qt.io/qt-for-python#getstarted, (visited on: 06/07/2021)

[2] https://www.autodesk.com/products/fusion-360/features, (visited on: 06/07/2021)

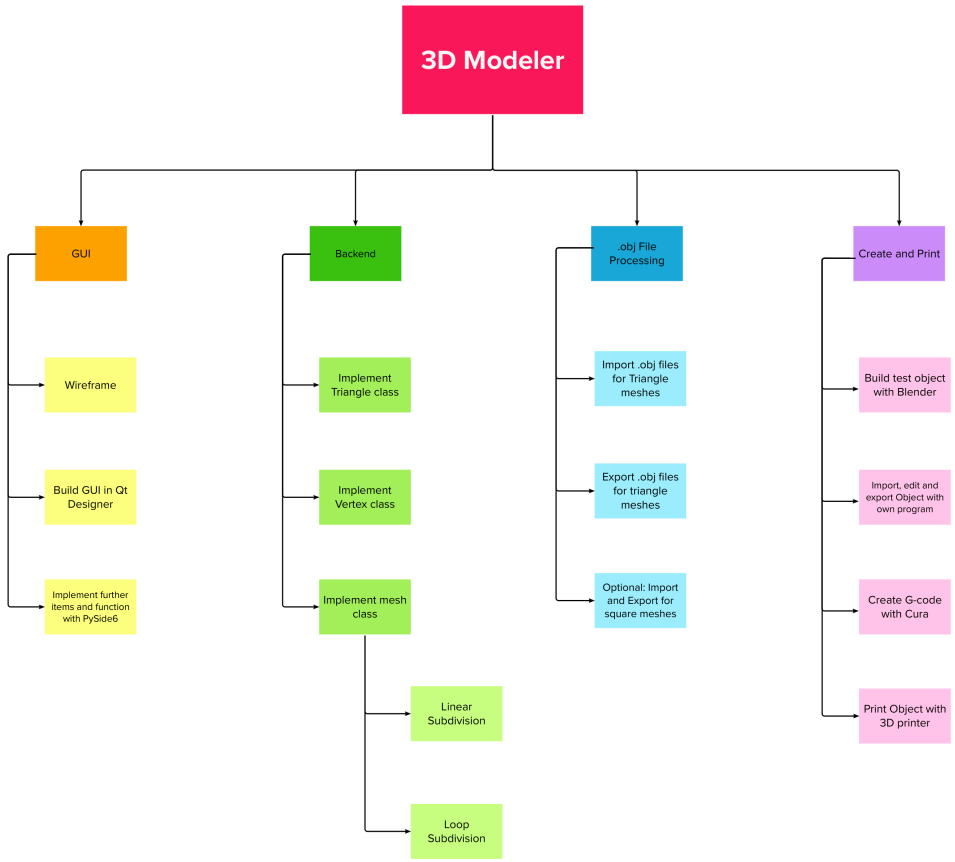

Figure 1: Working Package

6 Milestones

6.1 GUI

We expect to build a full-scale interactive GUI that will enable the user to view, edit, and create 3D objects using packages from PySide6. This will be completed as the first milestone.

6.2 Subdivision

Implement the subdivision algorithms in the backend, and enable the user to choose which subdivision and how many iterations of it for each object they interact with in the GUI.

6.3 OBJ File Processing

Allow the user to import, export, and create OBJ files using our GUI tools described above.

7 Time Table

06.07 : Discussion of project ideas
06.11 : Exposé upload
06.21 : GUI implementation completed
06.28 : Subdivision implementation completed
07.05 : OBJ file processing and full project completion
07.12 : Final project presentation

8 Literature

For our project, we will be mostly using PySide6. PySide is a python binding package of the cross-platform GUI toolkit called QT. It is a popular alternative to the standard library package called Tkinter.

References

[1] Charles Loop. https://www.microsoft.com/en-us/research/wp-content/uploads/2016/02/thesis-10.pdf, (visited on 06/07/2021). Utah, USA, 1987.