NapCAD

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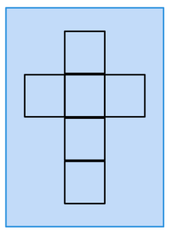
NapCAD is an OpenCV-based image to CAD program that translates JPEG images of a geometric net (diagram of an unfolded form) to STL files.

Project Goals

The purpose of this project was to create a system that would allow users to visualize folded sheet metal parts from drawings more easily. Our minimum viable product was defined as software that can read in the 6 different views of an object and create an STL file of a cube with those 6 faces. We also met our first and second stretch goals, which were to create a GUI to facilitate user interaction and to fold a geometric net of a cube rather than seperate face drawings.

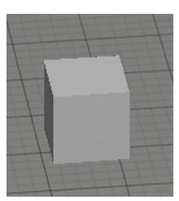
Usage Context

It can be difficult to visualize how a sheet metal drawing will fold into the final part. By simulating the folds in software, users can ensure that a part is correct before actually cutting any material.



Draw sketch of unfolded form, with fold lines.

Run program. Hold sketch up to webcam, and preview the interactive 3D rendering in window.

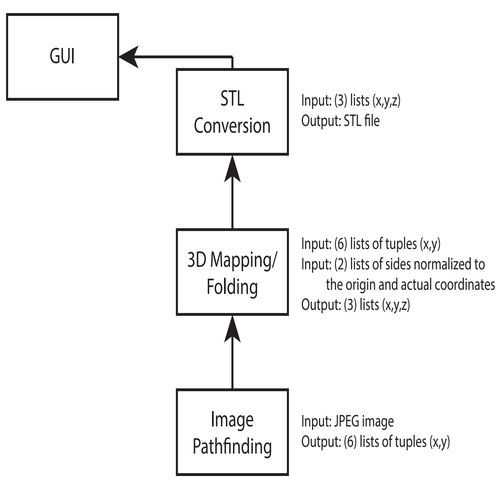


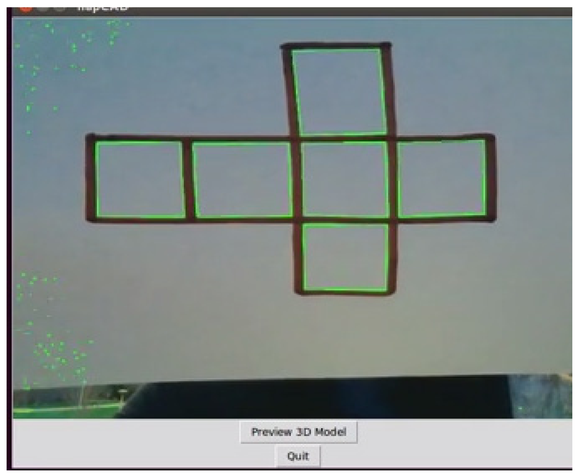
If rendering is as expected, save as STL file, which can then be opened and scaled in CAD programs.

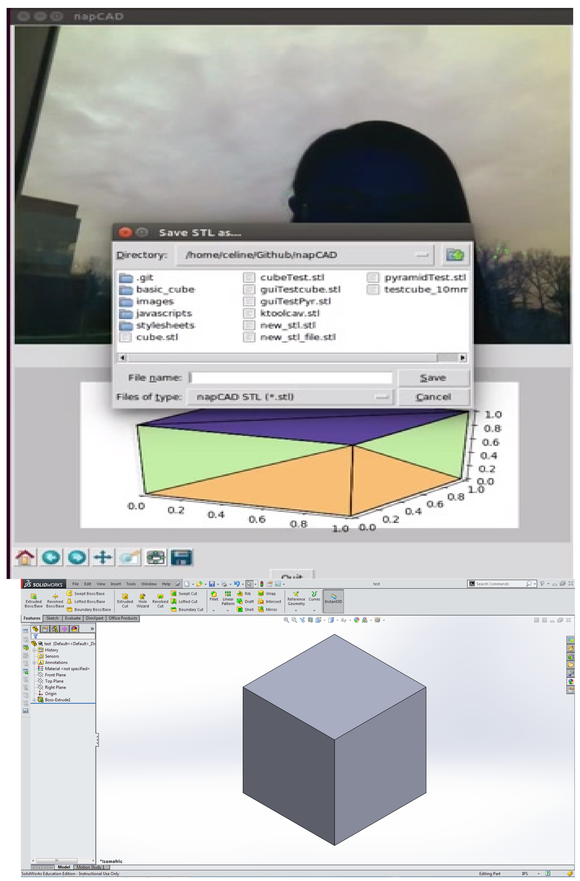
Code Architecture

The NapCAD code structure consists of three separate processes. First, the image pathfinder uses OpenCV to read the contours and fold lines of the input image. The vertices of these lines are then passed to the folding process to sort them into faces and then add the necessary z coordinates to the vertices. These new 3D vertices are used to create the final STL file. These files are all imported into the main program script, which handles the the GUI, user input and output, and integrates all the modules.

Software Diagram







Folding Process

We fold the 2D vertices from the image into a set of 3D coordintes to represent the folded shape by using the Euler-Rodrigues formula. This folding method checks each face against another face and attempts to fold it into place by decreasing the angle between them to check if they will meet. This process continues to fold the sides together until the final shape is assembled and there are no extra sides remaining.

Future Work

This work could be expanded in the future to:

- Read non-rectangular prisms
- Add support for extrusions and other features
- Add the ability to work with organic shapes

The final version of this product would ideally read and fold any sheetmetal drawing given to it by a user.