Hacking A Door

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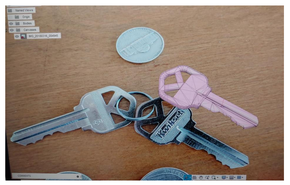
Goal

- Produce a working copy of a key using only a 2D image of the original key for the door. The key produced from from the image should be close enough to the original such that it can lock/unlock the designated door.

Motivations and Objectives



- Motivations
  - To investigate the manufacturing of major key brands commonly used in residential areas
  - To implement image processing functionality into physical product
- Objectives
  - To be able to print keys using two approaches from a given image of a legitimate key
  - Compare the outcomes of both type of keys

Research Challenges

- Challenge 1 - Calculating the depth of the key ridges
- Challenge 2 - Making fine-tuned edges of the key
- Challenge 3 - Analyzing the key image taken at an angle
- Challenge 4 - Setting the appropriate configurations for precise 3D-printing

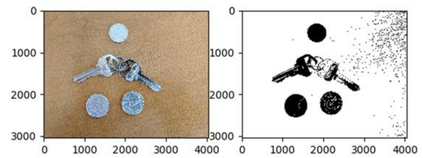
Methodology

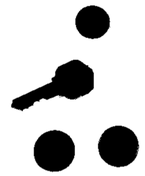
Hardware Approach

- The coins were placed near the keys as a scale for appropriate sizing
- For 3D printing, a model needed to split into printable layers
- Gauge a kwikset key
- 3D printing model used to make the key using CAD to draw the structure first

Software Method

- Develop python code to filter input image based on color.
- Take the filtered image and further refine the image with a photo editing software
- Import the image in a CAD software to make it into a 3D model

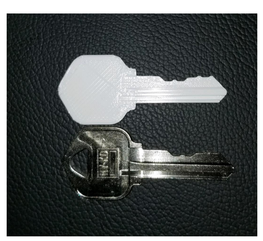




Results

Hardware Approach

- At first glance, the 3D printed key appears to be a perfect match. Upon closer inspection, however, the base first layer was not perfectly lined up with the highest layers. This resulted in the metal key not being as well defined as the 3D printed key



Software Approach

- A python library allowed the colors of the objects to be filtered such that only the colors of the these objects are visible and everything else is disregarded
- Hence, the background is white and the outline of the objects are clearly visible for tracing
- A 2D trace was produced with missing ridges
- Needed CAD software to overlay with a 3D model

References

[1] https://realpython.com/python-opencv-color-spaces/
[2] https://www.explainthatstuff.com/yalelock.html
[3] https://www.lsamichigan.org/Tech/Kwikset_KeySpecs.pdf