wowlabz CASE STUDY

Interior Design Tool

An AI-powered tool that uses computer vision algorithms to detect the interiors of the room

CLIENT	PRODUCT	PLATFORM	TIMELINE	DESIGNERS
Resume Parser	Interior Design Tool	Web App	4 weeks	1 Design Lead 1 UX/UI Designer

Abstract

It is an AI-powered tool that uses computer vision algorithms to detect the interiors of the room like floor, wall, ceiling, etc. It uses the OpenCV package to replace the detected floor with a new set of tiles and can add a rug of a given shape and size on top of the floor. This tool can be used to visualize how different floor tiles and rugs will look when laid out and arranged.

Problem Statement

Interior design plays an important role in designing a space. It can create a sense of comfort and relaxation, or it can create a sense of energy and excitement. It can also affect the way a room looks and feels, as well as how it functions. Interior design can also affect the way people interact with a space, as well as how they feel when they are in it. A method needs to be devised in order to help visualize the room with new tiles and a rug to be added on the floor without physically implementing it.

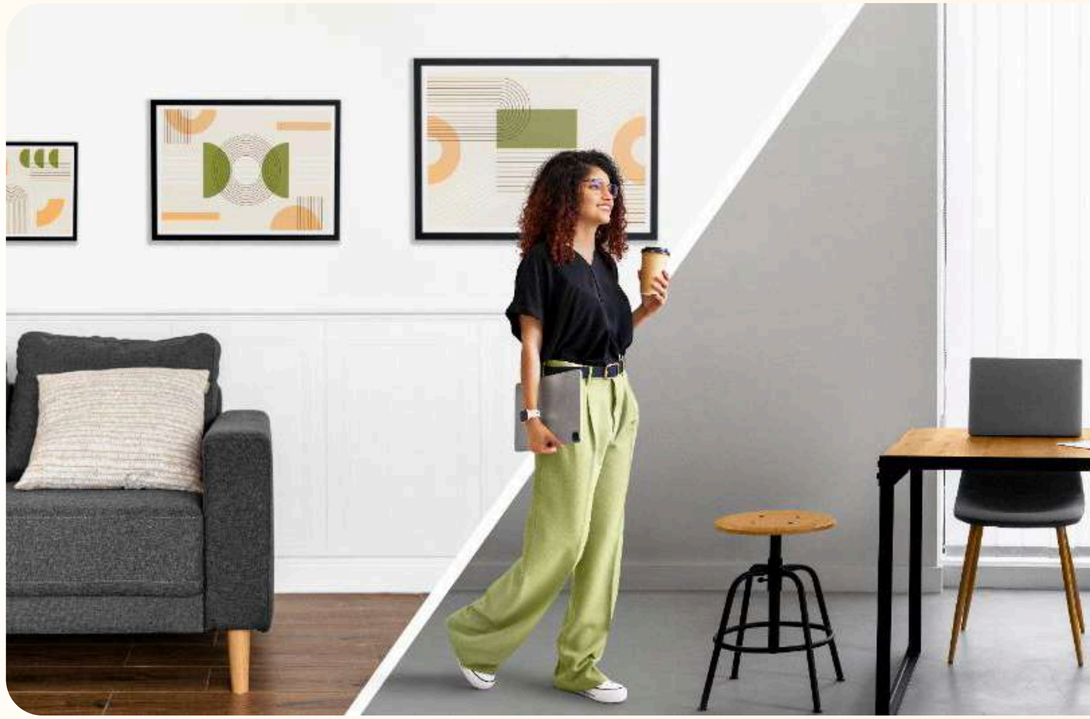
Background

Object Detection is a computer vision technique for locating instances of objects in images or videos. The methods can be categorized into two main types:

One-stage methods - prioritize inference speed, and example models include YOLO, SSD and RetinaNet.

Two stage-methods - prioritize detection accuracy, and example models include Faster R-CNN, Mask R-CNN and Cascade R-CNN.

In our case, the object to be detected is the floor and we need the semantics of it. We have used an algorithm that implements Mask R-CNN. After going through multiple algorithms like pixellib, detectron2 from facebook, Mask2Former to detect floor objects, we realized that Mask2Former panoptic segmentation algorithm outperforms others when compared with output masks.



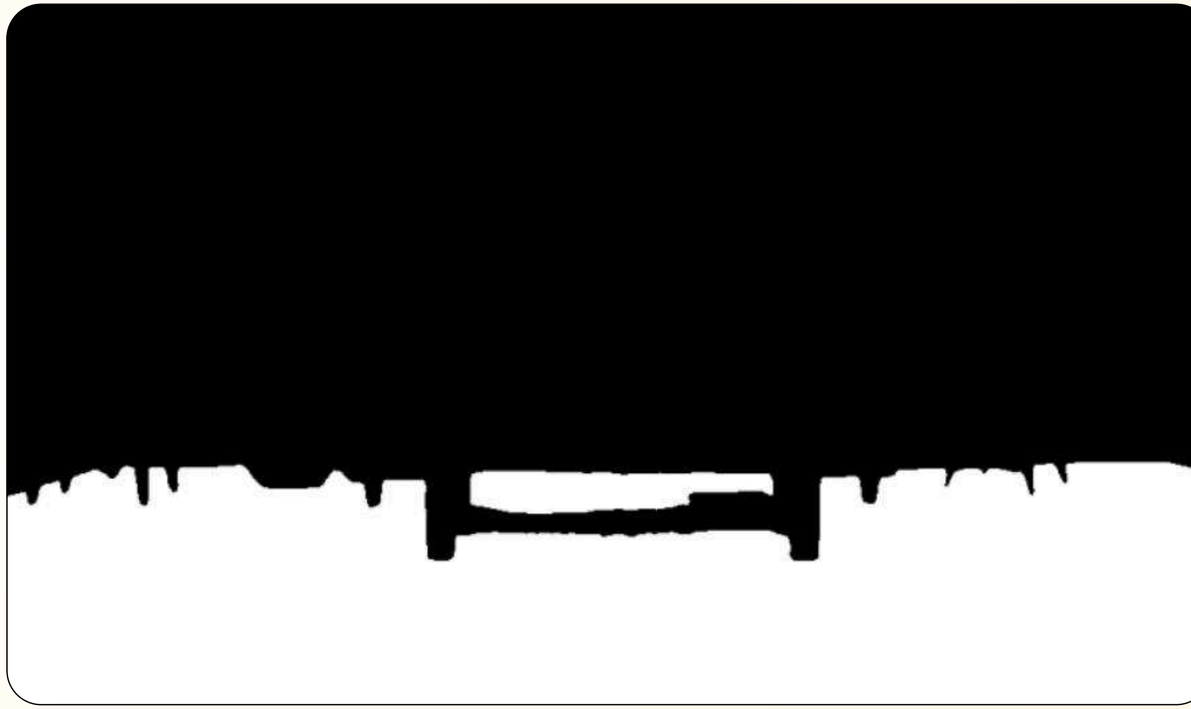
Solution

The first step to solve this problem is to detect the floor object using an object detection algorithm and get the mask for the same. Apply skew transformation on the basis of the mask and overlay the skew-transformed output on the original image. The entire process is explained in the sections below.

DETECTION

Mask2Former panoptic segmentation is created by Facebook which in turn uses Detectron2 as the base architecture. Masks are images used to highlight a specific object from the image. We are utilizing a pre-trained Mask2Former model with a Swin-Transformer as its backbone, which has the capability of panoptic segmentation and has been trained on the COCO dataset, a large-scale dataset for object detection, segmentation, and captioning. Its output is the detected object name with their respective masks. The figure shows the output of this algorithm which represents object names with their respective masks.

The code has been modified to only retrieve masks of the floor in the room. The detected floor and its corresponding mask are then passed on to the next process. The figure illustrates the mask of the floor.

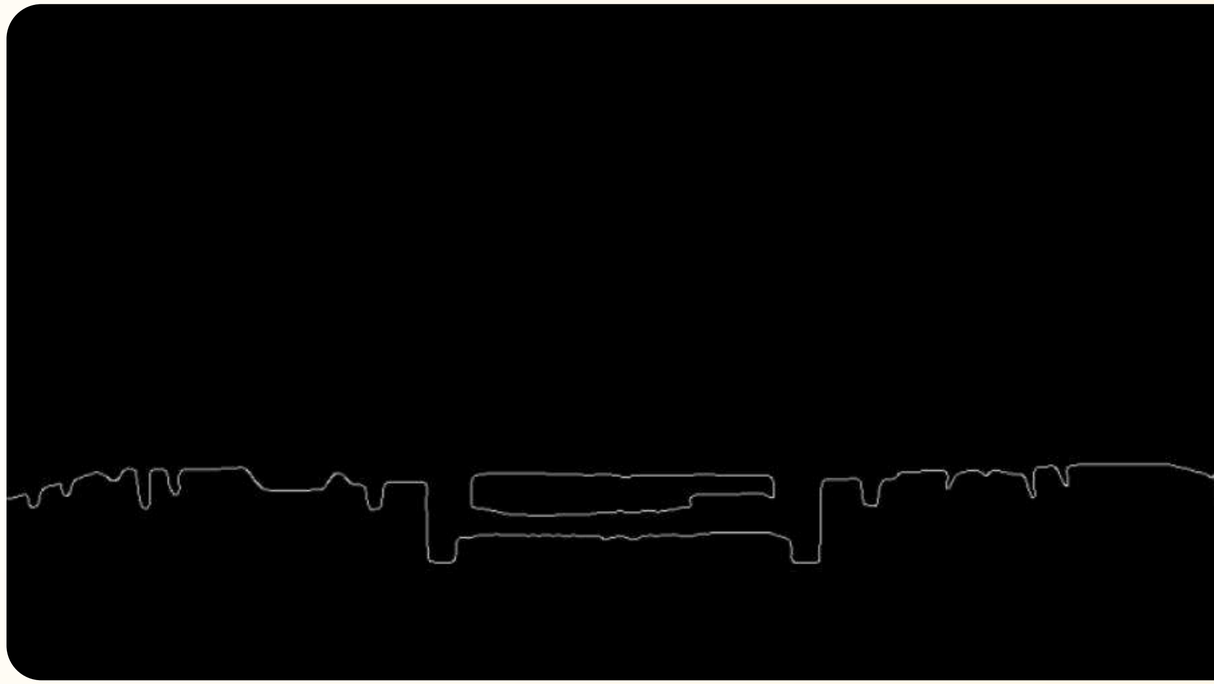


SKEW TRANSFORMATION

It is a type of image transformation that is used to change the shape of an image. It is used to correct the perspective of an image or to make an image appear more symmetrical. Skew transformation can be used to rotate an image, stretch an image, or compress an image. It can also be used to adjust the brightness or contrast of an image.

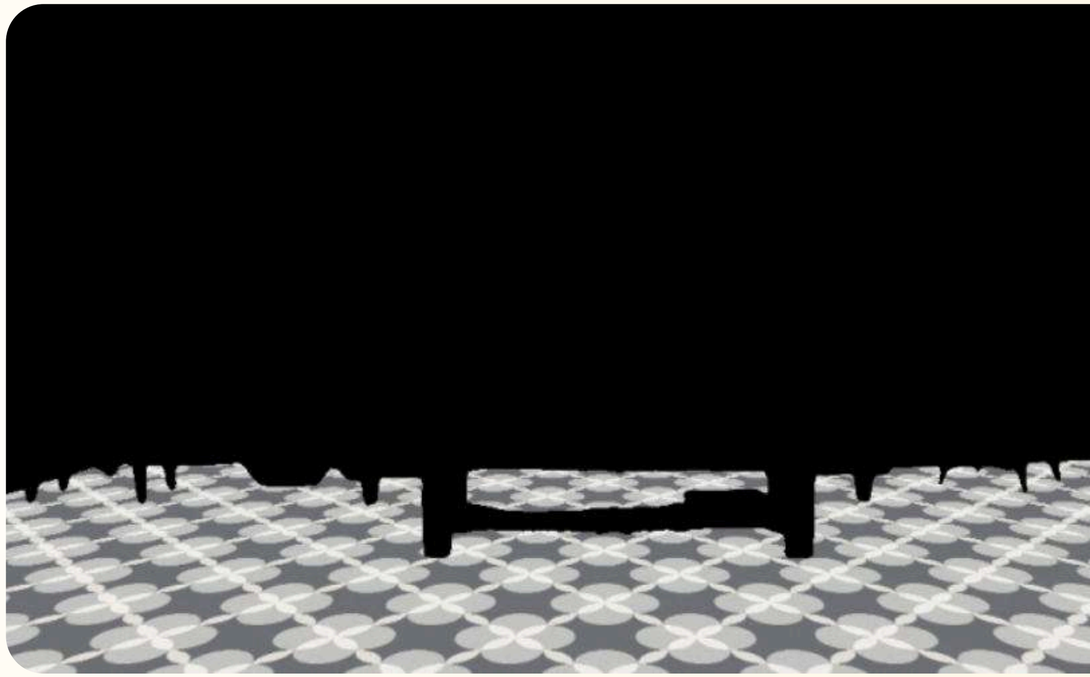
The Image

Every room image has skewness involved. In order to align the tile image to the floor, the skewness of the same has to be considered. The OpenCV package is used to get the skew transformation of the tile on the floor. The Canny Edge Detector is an edge detection operator that uses a multi- stage algorithm to detect a wide range of edges in images. In our case, a canny edge detector is used to calculate the slope of the edge line. Canny edges are generated for the floor mask from the Detection section. The figure illustrates the output of the canny edge detector.



The Image

The extreme left and right slopes of the canny edges are calculated and taken as a reference to further process. Corner points of extreme left and right lines of canny edges are calculated by considering the minimum distance of canny edges from the origin and top extreme right point of the mask respectively. Skew transformation of an image using perspective transformation is a process of changing the shape of an image by manipulating the perspective of the image. This is done by changing the angles of the lines in the image, which can be done by using a transformation matrix. This transformation can be used to create a more dynamic and interesting composition in an image



The Image

This process is accomplished using OpenCV, which requires four points as a reference. Image bottom extreme left and right corners are considered as two points for skew transformation. The slopes which are calculated from canny edges are massaged further to generate a value in order to get the required slopes across the mask. This helps to extract the other two points for mapping the skewness of the floor to the tiles. The mask generated by the detection algorithm is applied to the skewed tile image to obtain a mask of the same. The following figure shows the mask of the skewed transformed image. Finally, the actual room image is overlaid with the masked skewed image to generate an image with new tiles on the floor, as depicted in the figure.

Rug on the floor

To put a rug on the floor, we use a detection algorithm to identify the floor and generate a mask of it. The center point of the floor is calculated from pixel values of the floor mask which we got from the Detection section. Now the rug is skewed on the basis of its size and amount of skewness which is calculated by multiplying the slope with a constant lambda value. The skewed rug is placed at the center of the floor as shown in the below figure. Every room image has skewness involved. In order to align the tile image to the floor, the skewness of the same has to be considered. The OpenCV package is used to get the skew transformation of the tile on the floor.

Use case

This tool can be integrated with e-commerce sites that sell tiles and rugs as it helps in visualizing the interiors of a room with changes in the design of the tile, wall, overlapping new rug on the floor, etc. without physically implementing it.

Conclusion

This tool can help customers to preview the fitting and alignment of different floor tiles and rugs. The Mask2Former can be trained further to optimize its detection algorithm, resulting in improved detection results.

Thank You

You are welcome to our culture of shaping the future.

The WowLabz team is always working with our clients on solutions for new & challeging problems

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