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DIGITAL IMAGE PROCESSING (CSE478): PROJECT PRESENTATION

AUGMENTED REALITY 3D ROOM DECORE PREVIEW
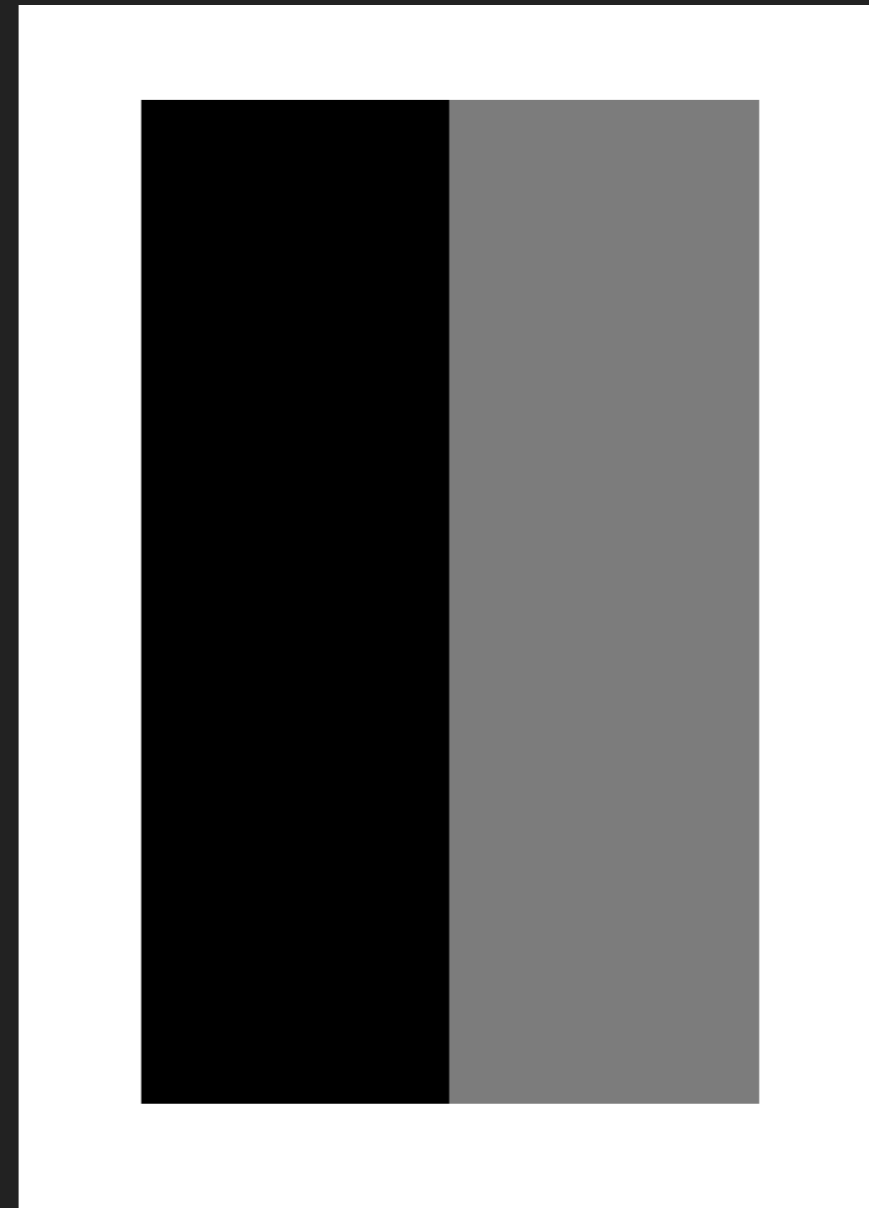
PROBLEM STATEMENT

To preview 3–D Room Decor using Augmented Reality

▸ Creating a Matlab application to add 3-D models of chair, lamp, table etc in a captured real world image so that it can be previewed/simulated what would room look like if the object was really present there.
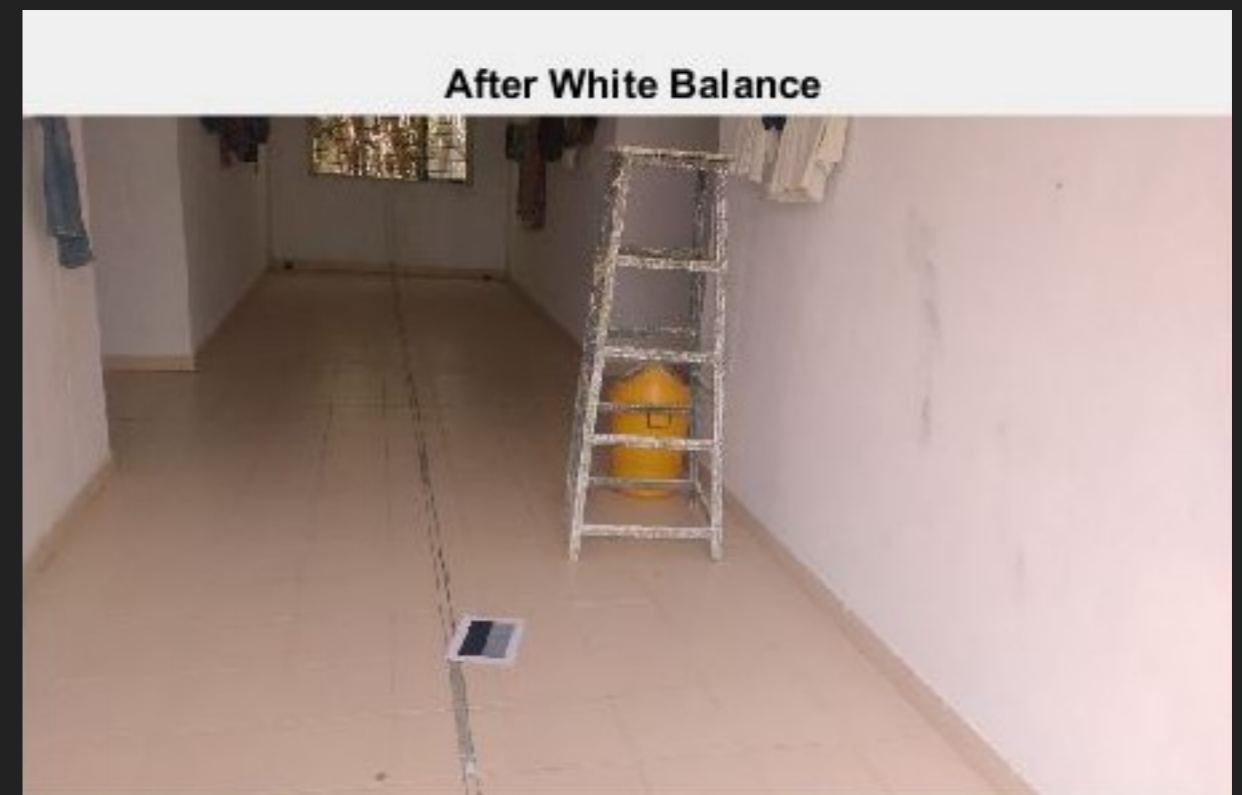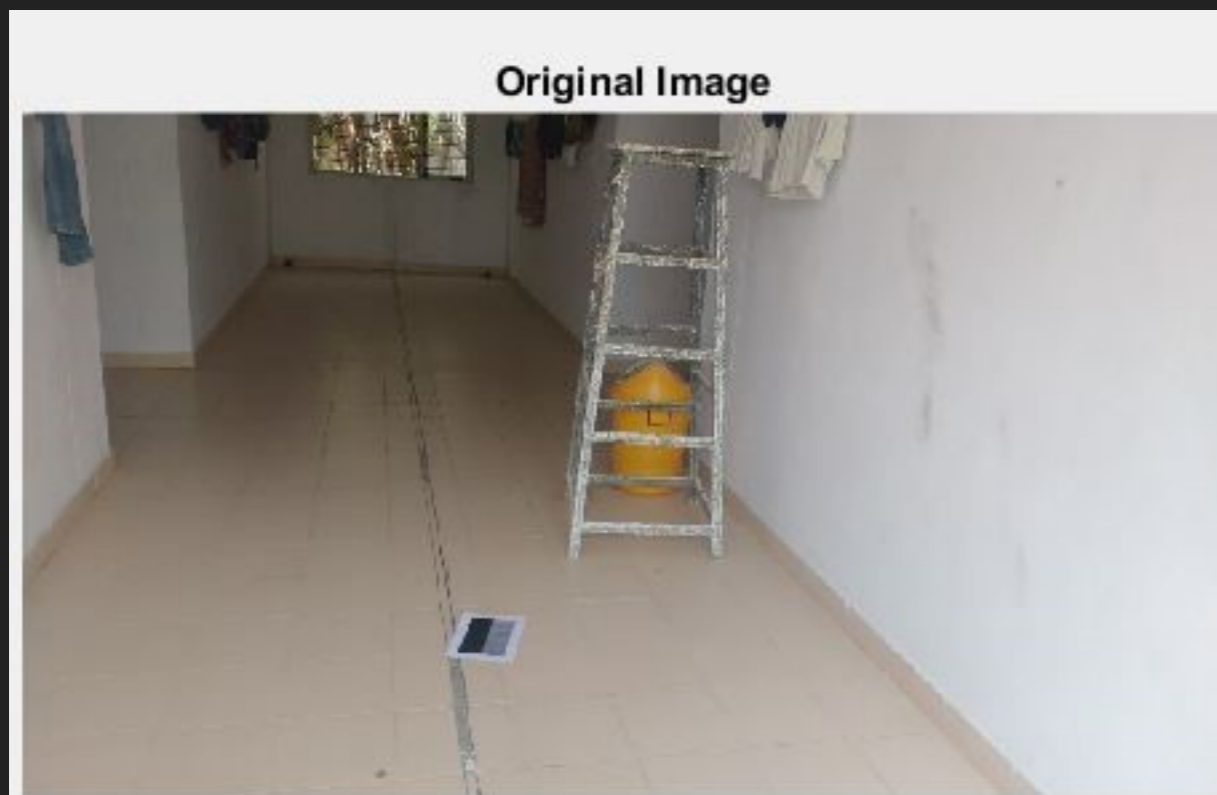
▸ Physical Marker of A4 size

▸ Three Different Color

    ▸ White (0)

    ▸ Black (255)

    ▸ Grey (255/2)

▸ Black and Grey to indicate Direction in (360)

▸ White Boundary to ensure inner edges are preserved whatever colored floor or surface.

WHITE BALANCING

▸ The Main idea of von kries method is to convert the white pixel in the image to desired white pixel and apply the corresponding transformation to each of the pixel in LMS space and convert it back to RGB space.

▸ $[L\ M\ S]t = [1/Lw\ 0\ 0\ ;\ 0\ 1/Mw\ 0;\ 0\ 0\ Sw]*[L'\ M'\ S']t$

▸ Where Lw , Mw , Sw are lms value of current white pixel

▸ $[L\ M\ S] = [0.7328\ 0.4296\ -.1624;\ -.7036\ 1.6975\ 0.0061;\ 0.0030\ 0.0136\ 0.9834]*[X\ Y\ Z]$

Original Image

After White Balance

THRESHOLDING

▸ After illumination correction we applied gaussian filter followed by global thresholding which gave us some possible candidate corresponding to our Marker

▸ Utilizing the characteristic of our marker we choose certain morphological operation as follow:

▸ Convex Shape

▸ Area

▸ Solidity

▸ Euler Number

▸ Eccentricity

Here red point correspond to centroid of the possible match for the marker
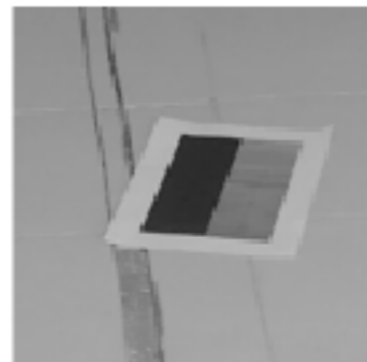
CREATING A TEMPLATE AND A PATCH

▸ Creating template at candidate centroid with 1.2 times size of its diagonal from thresholded image and 3 times size of diagonal from gray image.

▸ Applying Edge Detection on both of them.
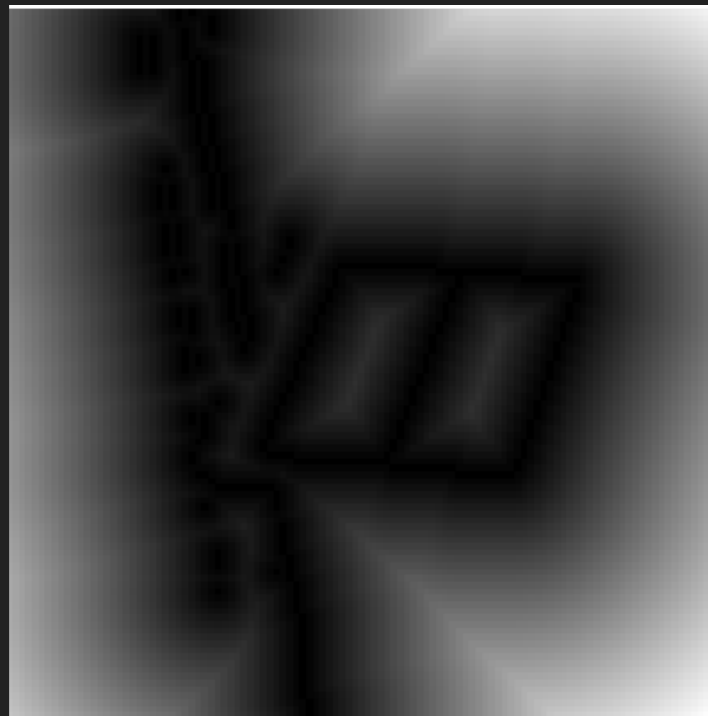

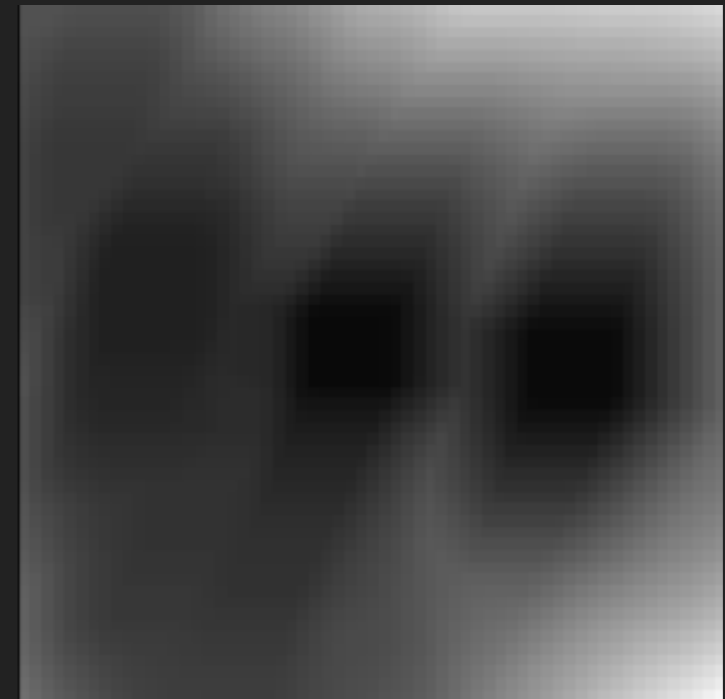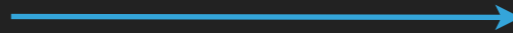Cropped Thresholded Image

Boundary

Cropped Original Gray Image

Edge Image of patch

CHAMFER MATCHING

‣ Distance Transform of patch is computed of the patch and is convolved with the template.

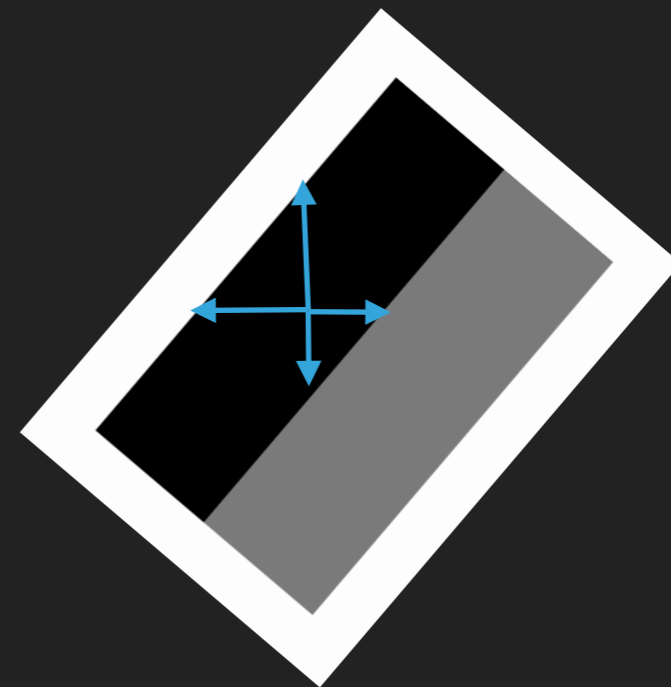‣ There has to be at least two peaks separated by some distance.

Distance Transform

After Convolution with Template

‣ We travel in 4 direction from centroid on gray scale image and mark down values in four direction when there is a jump in intensity value.

‣ Orientation of the marker can be anything but at most only two out of four can be gray and that to consecutive. At least one should be gray. We put all 4 values in two beans. White bean should have 2 or 3 and Grey bean should have 1 or 2.

▸ Now we found out the orientation of the major axis of the marker so that we can further import 3D model corresponding to that orientation
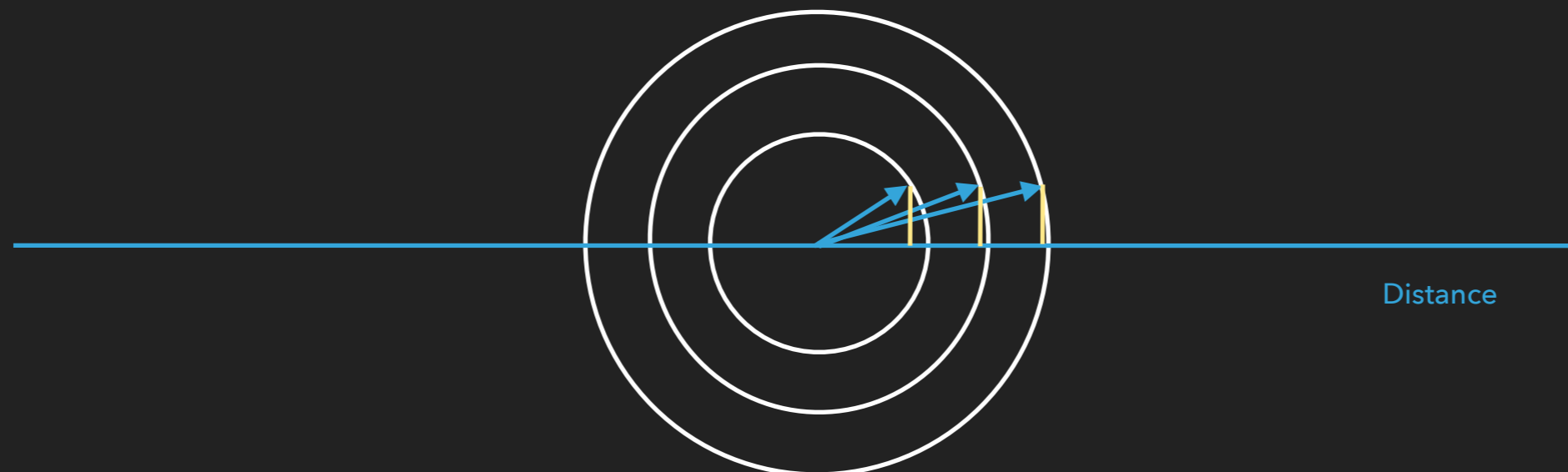
▸ For finding the orientation of the connected component corresponding to the marker we find direction of major axis of connected component. (Same was implemented using hough transform on edge image of patch, but major axis direction gives slightly better result.)

▸ Scale of marker is decided by finding the distance of centroid to the extreme coordinates of connected components. The size of the added 3D object would be directly proportional to square root of diagonal length. Scale factor is stored.

▸ Elevation/Altitude will also be proportional to distance from patch given person is taking photo's from same height. (In below image, Yellow line represents person taking picture. Blue line is line of sight.)
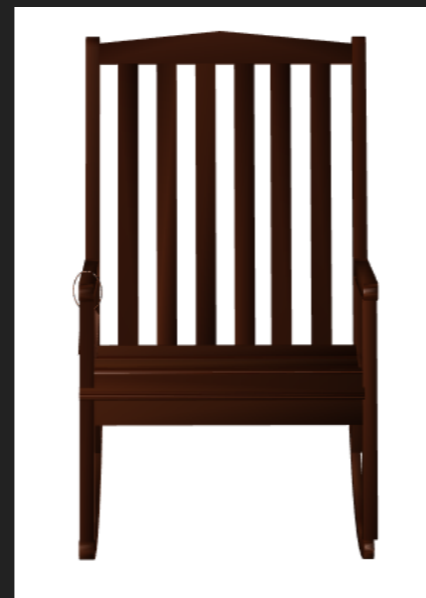
Distance

IMPORTING 3D MODEL AND APPLYING TEXTURE

- We are using .obj format 3d model.

- We import this extension file in Matlab which creates (x,y,z) coordinates of vertices and faces of the 3D model. Texture is added on that model. *

- We know the orientation of the Marker in -90 to 90 and we also have decided gray location. Either -90 (left) or +90(right). So we have orientation now in -180 to 180. Image is also scaled down as per the scale factor found previously.

.obj 3d Model

Imported to Matlab

Added Wooden Texture

Setting Angles and Lighting Source
(Azimuth and Elevation)

Code to import .obj to Matlab is taken from internet.

▸ Now for blending the image of chair at the position of marker we have to create a mask image and target image.

▸ In Target image chair should be placed at the position of marker and in mask image where we have to place chair should be white and rest all place should be black.

▸ Mask is eroded to give better result when blended.

Original

Target Image

Target Image Mask

BLENDING USING GAUSSIAN PYRAMID

▸ Now using mask image we blended target image and original image.

▸ We down sampled and passed the resultant image with gaussian filter to create source and destination image for different level and made mask more blurred at higher level. Using source,destination and mask image we created laplacian pyramid for final image and using laplacian pyramid created the our final blended image.

Original Image   After Blending

RESULTS

Original Image

After Blending

RESULTS

Original Image

After Blending

RESULTS

Original Image

After Blending

RESULTS

Original Image

After Blending

RESULTS

Original Image

After Blending

EXTENSIONS

▸ We physically add marker in real world and then take picture. Marker gives very high accuracy and uses very less computation power. But this gives limitations. The next step would be to implement this without using marker so that we can use this on any given image.

▸ Without marker we would require to have some perception of 3D environment from 2D image we have.

REFERENCES

▸ An Augmented Reality Application for Previewing 3D Décor Changes by Mai Le, Aaron Zarraga, Kangrong Zhu

▸ DIP Classes Monsoon 2016

▸ Code & Results: https://www.dropbox.com/sh/oweo41j72xlzxm4/AAB2QLC-fKLKGDZFygt7BaVva?dl=0

The End