Roadmap for pixel-level computer vision image processing

Object of Interest:

Our pixel-level computer vision system must be capable of identifying several objects of interest within the library environment. These objects include:

Chairs: To determine their current positions.

Chair Legs: To understand the structure and placement of chairs.

Table Sides: To identify the position and orientation of tables.

Pair of Human Legs: To avoid collisions with library patrons.

Walls: To create a map of the library boundaries.

Book Rack: To avoid obstacles and understand the layout of the library.

1.2 Color vs. Grayscale:

The choice between color and grayscale images depends on the specific requirements of each object of interest.

Chairs and Table Sides: Color information can help distinguish different chair and table types.

Chair Legs and Walls: Grayscale images are often sufficient for edge detection and object identification.

Pair of Human Legs: Color information can help distinguish between humans and other objects. (optional)

Roadmap for Pixel-Level Computer Vision:

Step 1: Preprocessing

Input: Raw image pixels.

Objective: Enhance the image quality and reduce noise.

Techniques: Noise reduction, histogram equalization, and contrast enhancement may be applied to improve feature visibility.

Step 2: Edge Detection

Input: Preprocessed image.

Objective: Detect edges and boundaries of objects.

Algorithms: Utilize edge detection algorithms such as the Canny edge detector or Sobel edge detector to identify abrupt changes in intensity.

Step 3: Feature Extraction

Input: Edges detected in the previous step.

Objective: Extract distinct features from the detected edges.

Algorithms: Choose feature extraction methods like Scale-Invariant Feature Transform (SIFT) or Speeded-Up Robust Features (SURF) based on the nature of the objects. For chairs and tables, SIFT may be suitable due to its scale and rotation invariance.

Step 4: Clustering

Input: Extracted features.

Objective: Group similar features together for easier identification.

Algorithms: Apply clustering techniques like k-means or hierarchical clustering to group features that likely belong to the same object.

Step 5: Feature Point Identification

Input: Feature clusters.

Objective: Identify feature points, which are the centers of the clusters.

Outcome: These points represent key reference locations on objects of interest.

Example Application: Chair Leg Detection

Preprocess the image to enhance visibility.

Detect edges to highlight chair leg boundaries.

Extract features using the SIFT algorithm.

Cluster features to identify distinct chair legs.

Feature point identification results in points representing chair leg positions.