AI ETHICS AND APPLICATIONS
LAB - 7

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AIM: The aim of this lab assignment is to perform various computer vision tasks using OpenCV and image processing techniques. The assignment involves performing a series of operations on an image, including colour space conversion, rotation, translation, image segmentation, edge detection, image filtering, contour detection, and feature extraction and matching. Additionally, we will explore face detection using OpenCV's Haar Cascades and deep learning-based models.

Software Required: Google Colab , install open cv

Prerequisite:

a. Problem Solving , Understanding Computer Vision Tasks and Open CV library

Theory/Concept:

1. Read an Image:

Digital images are composed of pixels, with each pixel representing a specific colour or intensity value. Images can be read into computer programs as arrays of pixel data, and this forms the basis for image processing.

2. Change Color Space

Color spaces are mathematical models for representing and describing colors. Converting an image from one color space to another helps in image analysis and manipulation, as different color spaces can reveal different image characteristics.

3. Image Rotation

Image rotation is essential for changing the orientation of an image. It involves using geometric transformation functions like 'getRotationMatrix2D' and 'warpAffine' to apply a rotation matrix to the image.

4. Image Translation

Image translation involves shifting an image in a specific direction by applying a translation matrix. This is useful for repositioning objects or regions within an image.

5. Image Segmentation

Image segmentation is the process of dividing an image into meaningful regions or objects. The Watershed Algorithm is used for this purpose, which treats the image as a topographic landscape and divides it based on gradients, similar to filling basins with water.

6. Edge Detection

Edge detection is the process of identifying boundaries within an image. The Canny edge detection algorithm identifies significant changes in pixel intensity, highlighting edges.

7. Image Filtering

Image filtering involves applying convolution operations to modify the pixel values in an image. Filters like Gaussian, Median, and custom filters are used for tasks like blurring, sharpening, or noise reduction.

8. Image Contours

Image contours are the boundaries of objects within an image. Contour detection helps in shape and object recognition, and it can be achieved using OpenCV functions.

9. Scale Invariant Feature Transform (SIFT)

SIFT is a feature detection algorithm that identifies distinctive keypoints and their descriptors in an image. These keypoints are invariant to changes in scale, rotation, and illumination, making them valuable for object recognition.

10. Speeded-Up Robust Features (SURF)

SURF is another feature detection algorithm similar to SIFT but computationally more efficient. It also identifies keypoints and descriptors, suitable for object detection and matching.

11. Feature Matching

Feature matching involves comparing keypoints and descriptors extracted from different images. Matching algorithms like 'cv2.BFMatcher()' are used to find corresponding features between images.

12. Face Detection :

Face detection is a crucial task in computer vision. OpenCV provides tools for detecting faces, including Haar Cascades and deep learning-based models. These methods use features specific to facial structures for detection.

Relative Applications:

1. **Change Color Space:**

- Video Streaming: Converting color spaces for video streaming to optimize bandwidth and quality.
- Art and Design: Adjusting colors for graphic design and photo editing.

2. **Image Rotation:**

- Mobile Photography: Auto-rotating images based on device orientation.
- Document Scanners: Correcting the orientation of scanned documents.

3. **Image Translation:**

- Augmented Reality: Translating and positioning virtual objects in real-world scenes.
- Language Translation: Optical Character Recognition (OCR) for translating text in images.

4. **Image Segmentation:**

- Medical Imaging:** Identifying and isolating organs or tumors in medical images.
- Autonomous Vehicles:** Segmenting road scenes for safe navigation.

5. **Edge Detection:**

- Robotics: Detecting edges for robot path planning and obstacle avoidance.
- Quality Control: Inspecting products for defects in manufacturing.

6. **Image Filtering:**

- Photography: Applying filters for artistic effects and enhancing photo quality.
- Image Restoration: Reducing noise and enhancing details in old or damaged photographs.

7**. Image Contours:**

- Object Recognition: Identifying and tracking objects in video surveillance.
- Agriculture: Counting and categorizing objects like fruits and plants.

8**. Scale Invariant Feature Transform (SIFT):**

- Image Retrieval: Finding similar images in large databases.
- Augmented Reality Games: Recognizing objects for interactive experiences.

9. **Speeded-Up Robust Features (SURF):**

- Image Stitching: Combining multiple images to create panoramas.
- Object Recognition in Robotics: Identifying and grasping objects with robots.

10. **Feature Matching:**

- Image-Based Navigation: Matching landmarks for drone or robot navigation.
- Augmented Reality Apps: Overlaying information on recognized objects.

11. **Face Detection:**

- Social Media: Automatic tagging of people in photos.
- Security: Access control systems and surveillance for identifying individuals.

Output: