Module 1: Getting Started with OpenCV

1. Introduction to computer vision
   - Image Processing VS Computer Vision
   - Problems in Computer Vision

2. Introduction to images
   - How images are formed
   - Digital Image
   - Image as a Matrix
   - Manipulating Pixels
   - Displaying and Saving an Image
   - Display Utility Functions
   - Color Image
   - Image Channels
   - Splitting and Merging Channels
   - Manipulating Color pixels
   - Images with Alpha Channel

3. Basic image operations
   - How to create new images
   - Cropping an image Section
   - Coping a Region to another in an image
   - Resizing an image
   - Creating an image mask

4. Mathematical operations on images
• Datatype Conversion
• Contrast Enhancement
• Brightness Enhancement

5. Sunglass filter: A simple application
   • Load Images
   • Use Naïve replacement
   • Use Arithmetic Operations

6. Bitwise operations
   • Different Bitwise Operations

7. Image Annotation
   • Draw a line over an image
   • Draw a Circle over an image
   • Draw a Rectangle over an image
   • Draw an Ellipse over an image
   • Draw text over an image

Assignment1: Build QR code Detector

Module 2: Video IO and GUI

1. Video IO using HighGUI
   • Video I/O Jargon
   • Read and Display video
   • Properties of Video Capture
   • How to write a video

2. Callback functions
   • What are Callback functions
3. Keyboard as input device
   • How to take input from Keyboard

**Assignment2:** Image Annotation using mouse

**Assignment3:** Add Trackbar as controller

**Module 3: Binary Image Processing**

1. Thresholding
   • What is Thresholding
   • Thresholding in OpenCV

2. Erosion / Dilation
   • Overview on Erosion and Dilation
   • Erosion and Dilation in OpenCV

3. Opening and Closing
   • Overview on Opening and Closing
   • Opening and Closing on OpenCV

4. Connected Component Analysis
   • What is Connected Component Analysis
   • Connected Component Analysis in OpenCV

5. Contour Analysis
   • What are contours
   • Contour Analysis in OpenCV

6. Blob Detection
   • Blob Detection in OpenCV
Assignment 4: Implement different Morphological Operations

Assignment 5: Coin Detection

Module 4: Image Enhancement and Filtering

1. Color Spaces
   - RGB Color Space
   - HSV Color Space
   - Other Color Spaces
   - Application: Finding Dominant Color in an image
   - Application: Desaturation Filter

2. Color Transforms
   - Histogram Equalization
   - Advanced Histogram Equalization (CLAHE)
   - Color Adjustment using Curves

3. Image Filtering
   - Introduction to Image Filtering
   - What is Convolution
   - Convolution in OpenCV

4. Image Smoothing
   - Box Blur
   - Gaussian Blur
   - Median Blur
   - Median Blur in OpenCV
   - Bilateral Filtering
   - Bilateral Blur in OpenCV
   - Comparison: Median VS Bilateral

5. Image Gradients
• Introduction to Image Gradients
• First Order Derivative Filters
• Why smoothing is important before Gradient
• Second Order Derivative Filters
• Application: Sharpening Filter
• Canny Edge Detection
• Canny Edge Detection in OpenCV

**Assignment 6**: Convert your images into different color spaces

**Assignment 7**: Implement Autofocus

**Module 5**: Advanced Image Processing and Computational Photography

1. Hough Transforms
   • What is Hough Transform
   • HoughLine: How to detect a line in an image
   • HoughCircle: How to detect a circle in an image

2. High Dynamic Range Imaging
   • What is High Dynamic Range Imaging
   • HDR in OpenCV

3. Seamless Cloning
   • What is Seamless Cloning
   • Seamless Cloning in OpenCV
   • Application: Face Blending

4. Image Inpainting
   • What is Image Inpainting
Project 1:

1.1 Create your own Instagram Filter

1.2 Blemish Removal from face

1.3 Chroma Keying

Module 6: Geometric Transforms and Image Features

1. Geometric Transforms
   - Affine Transform
   - Homography
   - Geometric Transforms in OpenCV

2. Image Features
   - Image Feature: ORB
   - ORB Feature in OpenCV

3. Feature Matching
   - Different Feature Matching Algorithms in OpenCV
   - RANSAC

4. Application: Image Alignment
5. Application: Creating Panorama
6. Application: Finding Known Objects using OpenCV

Assignment 8: Create Panorama for multiple images

Assignment 9: Feature Matching based Image Alignment

Project 3: Document Scanner
Module 7: Image Segmentation and Recognition

1. Image segmentation using GrabCut
   - Grabcut Theory
   - Grabcut in OpenCV

2. Introduction to AI
   - Basic overview of AI

3. Image Classification
   - Histogram of Oriented Gradients (HOG)
   - Support Vector Machine (SVM)
   - Eyeglass Classifier in OpenCV

4. Object Detection
   - Pedestrian Detection in OpenCV
   - Face Detection using HAAR Cascade
   - Face Detection in OpenCV

Project 2: Create your own Selfie App with the following feature

   1. Skin smoothing Filter
   2. Sunglass Filter

Module 8: Video Analysis

1. Motion Estimation using Optical Flow
   - What is Optical Flow
   - Lucas-Kanade Optical Flow

2. Application: Video Stabilization
3. Object Tracking
4. Object Trackers in OpenCV
   - Object Tracking in OpenCV
   - Comparison of different trackers

5. Multiple Object Tracking using OpenCV
   - How to track Multiple Objects in OpenCV

6. Kalman Filter
   - Kalman Filter Tracker

7. MeanShift and CamShift
   - Tracking using MeanShift and CamShift

**Project 4:** Detection and Tracking of an object

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**Module 9:** Deep Learning with OpenCV

1. Image Classification
   - Image Classification using Caffe and Tensorflow

2. Object Detection
   - Single Shot Multibox Detector (SSD)
   - You Only Look Once Detector (YOLO)

3. Face Detection
   - SSD based Face Detector
4. Human Pose Estimation

- OpenPose