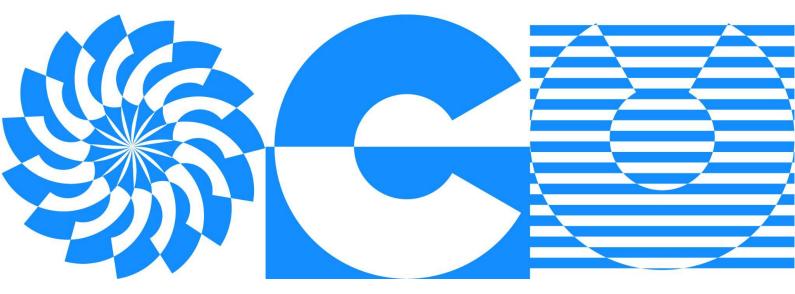
A place where legacy creates future.



CVIP

# Fundamentals of Computer Vision & Image Processing

**Detailed Curriculum** 



# Index

```
Module 1
Getting Started with OpenCV
T
Module 2
Video IO and GUI
Module 3
Binary Image Processing
Module 4
Image Enhancement and Filtering
L
Module 5
Advanced Image Processing and
Computational Photography
L
Module 6
Geometric Transforms and Image Features
Module 7
Image Segmentation and Recognition
L
Module 8
Video Analysis and Object Tracking
I
Module 9
Deep Learning with OpenCV
```



2 of 8 Fundamentals Of Computer Vision & Image Processing

# 1 <u>Getting Started With OpenCV</u>

# 1.1 Introduction to Computer Vision

- 1.1.1 Image Processing VS Computer Vision
- 1.1.2 Problems in Computer Vision

# 1.2 Introduction to images

- 1.2.1 How are images formed?
- 1.2.2 Digital image
- 1.2.3 Image as a matrix
- 1.2.4 Manipulating pixels
- 1.2.5 Displaying and saving an image
- 1.2.6 Display utility functions
- 1.2.7 Color image
- 1.2.8 Image channels
- 1.2.9 Splitting and merging channels
- 1.2.10 Manipulating color pixels
- 1.2.11 Images with Alpha channel

# 1.3 Basic image operations

- 1.3.1 How to create new images?
- 1.3.2 Cropping an image section
- 1.3.3 Copying a region to another in an image
- 1.3.4 Resizing an image
- 1.3.5 Creating an image mask

# 1.4 Mathematical operations on images

- 1.4.1 Datatype conversion
- 1.4.2 Contrast enhancement
- 1.4.3 Brightness enhancement

# 1.5 Sunglass filter: A simple application

- 1.5.1 Load images
- 1.5.2 Use naive replacement
- 1.5.3 Use arithmetic operations

# 1.6 Bitwise operations

1.6.1 Different bitwise operations

# 1.7 Image annotations

- 1.7.1 Draw a line over an image
- 1.7.2 Draw a circle over an image
- 1.7.3 Draw a rectangle over an image
- 1.7.4 Draw an ellipse over an image
- 1.7.5 Draw text over an image





Assig	nm	ent	1
Assig		GIIL	•

# 2 <u>Video IO & GUI</u>

#### 2.1 Video IO using HighGUI

- 2.1.1 Video IO jargon
- 2.1.2 Read and display video
- 2.1.3 Properties of video capture
- 2.1.4 How to write a video

# 2.2 Callback Functions

2.2.1 What are Callback Functions?

#### 2.3 Keyboard as input device

2.3.1 How to take input from keyboard

Assignment 2	Perform Image Annotation Using Mouse
Assignment 3	Enhance GUI features with Sliders

# 3 Binary Image Processing

# 3.1 Thresholding

- 3.1.1 What is Thresholding?
- 3.1.2 Thresholding in OpenCV

# 3.2 Erosion / Dilation

- 3.2.1 Overview on Erosion and Dilation
- 3.2.2 Erosion and Dilation in OpenCV

# 3.3 Opening and Closing

- 3.3.1 Overview on Opening and Closing
- 3.3.2 Opening and Closing on OpenCV

# 3.4 Connected Component Analysis

- 3.4.1 What is Connected Component Analysis?
- 3.4.2 Connected Component Analysis in OpenCV

#### 3.5 Contour Analysis

- 3.5.1 What are Contours?
- 3.5.2 Contour Analysis in OpenCV

#### 3.6 Blob detection

3.6.1 Blob detection in OpenCV



Assignment 4	Implement Different Morphological Operations
Assignment 5	Build a Coin Detection application using Contours

# 4 Image Enhancement & Filtering

#### 4.1 Color spaces

- 4.1.1 RGB color space
- 4.1.2 HSV color space
- 4.1.3 Other color spaces
- 4.1.4 Application: Finding dominant color in an image
- 4.1.5 Application: Desaturation Filter

# 4.2 Color transforms

- 4.2.1 Histogram Equalization
- 4.2.2 Advanced Histogram Equalization (CLAHE)
- 4.2.3 Color adjustment using curves

#### 4.3 Image filtering

- 4.3.1 Introduction to image filtering
- 4.3.2 What is Convolution?
- 4.3.3 Convolution in OpenCV

#### 4.4 Image smoothing

- 4.4.1 Box Blur
- 4.4.2 Gaussian Blur
- 4.4.3 Median Blur
- 4.4.4 Median Blur in OpenCV
- 4.4.5 Bilateral filtering
- 4.4.6 Bilateral Blur in OpenCV
- 4.4.7 Comparison: Median VS Bilateral

# 4.5 Image gradients

- 4.5.1 Introduction to image gradients
- 4.5.2 First Order Derivative Filters
- 4.5.3 Why is smoothing important before gradient?
- 4.5.4 Second Order Derivative Filters
- 4.5.5 Application: Sharpening Filter
- 4.5.6 Canny Edge Detection
- 4.5.7 Canny Edge Detection in OpenCV



Assignment 6	Convert Your Images Into Different Color Spaces
Assignment 7	Implement Camera Autofocus using Image Analysis

# 5 Advanced Image Processing & Computational Photography

#### 5.1 Hough transforms

- 5.1.1 What is a hough transform?
- 5.1.2 HoughLine: How to detect a line in an image?
- 5.1.3 HoughCircle: How to detect a circle in an image?

# 5.2 High Dynamic Range imaging

- 5.2.1 What is High Dynamic Range (HDR) imaging?
- 5.2.2 HDR in OpenCV

# 5.3 Seamless cloning

- 5.3.1 What is seamless cloning?
- 5.3.2 Seamless cloning in OpenCV
- 5.3.3 Application: Face Blending

#### 5.4 Image inpainting

5.4.1 What is image inpainting?

	Create Your Own Instagram Filter
Project 1	Blemish Removal From Face
	Chroma Keying

# 6 Geometric Transforms & Image Features

#### 6.1 Geometric transforms

- 6.1.1 Affine transform
- 6.1.2 Homography
- 6.1.3 Geometric transforms in OpenCV

#### 6.2 Image features

- 6.2.1 Image feature: ORB
- 6.2.2 ORB feature in OpenCV

#### 6.3 Feature matching

- 6.3.1 Different feature matching algorithms in OpenCV
- 6.3.2 RANSAC
- 6.4 Application: Image alignment
- 6.5 Application: Creating panoramas
- 6.6 Application: Finding known objects using OpenCV

6 of 8 Fundamentals Of Computer Vision & Image Processing



Assignment 8	Create Panorama from Multiple Images
Assignment 9	Feature Matching-Based Image Alignment
Project 2	Implement a Document Scanner Application

# 7 Image Segmentation & Recognition

#### 7.1 Image segmentation using GrabCut

- 7.1.1 GrabCut theory
- 7.1.2 GrabCut in OpenCV

#### 7.2 Introduction to AI

7.2.1 Basic overview of AI

# 7.3 Image classification

- 7.3.1 Histogram of Oriented Gradients (HOG)
- 7.3.2 Support Vector Machines (SVM)
- 7.3.3 Eyeglass Classifier in OpenCV

#### 7.4 Object detection

- 7.4.1 Pedestrian detection in OpenCV
- 7.4.2 Face detection using HAAR Cascade
- 7.4.3 Face detection in OpenCV

	Create Your Own Selfie Application
Project 3	Skin Smoothing Filter
	Sunglass Filter

# 8 <u>Video Analysis</u>

- 8.1 Motion estimation using Optical Flow
  - 8.1.1 What is Optical Flow?
  - 8.1.2 Lucas-Kanade Optical Flow
- 8.2 Application: Video stabilization
- 8.3 Object tracking
  - 8.3.1 Different object tracking algorithms
- 8.4 Different object trackers in OpenCV
  - 8.4.1 Object tracking in OpenCV
  - 8.4.2 Comparison of different trackers
- 8.5 Multiple object tracking

7 of 8 Fundamentals Of Computer Vision & Image Processing

OpenCV University

- 8.5.1 How to track multiple objects in OpenCV
- 8.6 Kalman filtering
  - 8.6.1 Kalman Filter Tracker
- 8.7 MeanShift and CamShift
  - 8.7.1 Tracking using MeanShift and CamShift

Project 4	Implement fusion of Detection + Tracking
-----------	--

# 9 <u>Deep Learning With OpenCV</u>

- 9.1 Image classification
  - 9.1.1 Image classification using Caffe and TensorFlow
- 9.2 Object detection
  - 9.2.1 Single Shot Multibox Detector (SSD)
  - 9.2.2 You Only Look Once Detector (YOLO)
- 9.3 Face detection
  - 9.3.1 SSD-Based Face Detector
- 9.4 Human pose estimation
  - 9.4.1 OpenPose

**Explore Other Courses** 



