

Table of Contents

Preface	1
Chapter 1: Introduction to Image Processing	7
Image processing - its applications	8
Image processing libraries	10
Pillow	10
Installation	10
Getting started with pillow	11
Reading an image	11
Writing or saving an image	12
Cropping an image	12
Changing between color spaces	13
Geometrical transformation	16
Image enhancement	17
Introduction to scikit-image	19
Installation	20
Getting started with scikit-image	20
Summary	27
Chapter 2: Filters and Features	29
Image derivatives	29
Kernels	31
Convolution	31
Understanding image filters	33
Gaussian blur	34
Median filter	36
Dilation and erosion	37
Erosion	37
Dilation	38
Custom filters	40
Image thresholding	41
Edge detection	42
Sobel edge detector	42
Why have pixels with large gradient values?	43
Canny edge detector	44
Hough line	47
Hough circle	48
Summary	49

Chapter 3: Drilling Deeper into Features - Object Detection	51
Revisiting image features	52
Harris corner detection	53
Local Binary Patterns	56
Oriented FAST and Rotated BRIEF (ORB)	59
oFAST – FAST keypoint orientation	59
FAST detector	59
Orientation by intensity centroid	59
rBRIEF – Rotation-aware BRIEF	60
Steered BRIEF	61
Variance and correlation	62
Image stitching	65
Summary	69
Chapter 4: Segmentation - Understanding Images Better	71
Introduction to segmentation	72
Contour detection	73
The Watershed algorithm	75
Superpixels	77
Normalized graph cut	79
Summary	82
Chapter 5: Integrating Machine Learning with Computer Vision	83
Introduction to machine learning	84
Data preprocessing	85
Image translation through random cropping	85
Image rotation and scaling	85
Scikit-learn (sklearn)	86
Applications of machine learning for computer vision	86
Logistic regression	88
Support vector machines	92
K-means clustering	98
Summary	100
Chapter 6: Image Classification Using Neural Networks	101
Introduction to neural networks	102
Design of a basic neural network	102
Training a network	104
MNIST digit classification using neural networks	105
Playing with hidden layers	107
Convolutional neural networks	108

Challenges in machine learning	112
Summary	112
Chapter 7: Introduction to Computer Vision using OpenCV	113
<hr/>	
Installation	113
macOS	114
Windows	114
Linux	115
OpenCV APIs	115
Reading an image	115
Writing/saving the image	116
Changing the color space	116
Scaling	117
Cropping the image	118
Translation	119
Rotation	120
Thresholding	121
Filters	122
Gaussian blur	124
Median blur	124
Morphological operations	125
Erosion	125
Dilation	126
Edge detection	127
Sobel edge detection	127
Canny edge detector	129
Contour detection	129
Template matching	131
Summary	133
Chapter 8: Object Detection Using OpenCV	135
<hr/>	
Haar Cascades	135
Integral images	136
Scale Invariant Feature Transformation (SIFT)	139
Algorithm behind SIFT	139
Scale-space extrema detection	140
Keypoint localization	143
Orientation assignment	145
Keypoint descriptor	147
Speeded up robust features	151
Detecting SURF keypoints	151
SURF keypoint descriptors	153
Orientation assignment	153
Descriptor based on Haar wavelet response	154
Summary	157

Chapter 9: Video Processing Using OpenCV	159
Reading/writing videos	159
Reading a video	160
Writing a video	161
Basic operations on videos	162
Converting to grayscale	162
Color tracking	163
Object tracking	166
Kernelized Correlation Filter (KCF)	166
Lucas Kanade Tracker (LK Tracker)	168
Summary	170
Chapter 10: Computer Vision as a Service	171
Computer vision as a service – architecture overview	172
Environment setup	173
http-server	173
virtualenv	174
flask	174
Developing a server-client model	175
Client	175
Server	181
Computer vision engine	185
Putting it all together	188
Client	188
Server	189
Summary	189
Index	191