OpenCV Concepts

Tuesday, May 31, 2016 10:52 AM

GUI

- Image
  - Windows
    - waitKey, destroy all windows
  - Plotting with matplotlib
    - Interpolation
    - Colormaps
  - What to do on keypress
- Video
  - Capture from webcam
  - Stream from internet
  - Convert color
  - Read from file
  - Write
- Drawing
  - Draw:
    - Lines, polylines
    - Rectangles
    - Circles
    - Ellipses
    - Put text
- Mouse events
  - Set for named window
  - Callbacks
    - Can get (x, y) coords of event
  - Global vars
- Trackbar
  - Create trackbars
    - Link with window
  - Set range, get position
  - Have calbacks

Core

- Basic operations
  - Select portions of image or individual pixels
  - Can determine image shape, size, datatype
  - Can split BGR images to single planes or merge them
  - Can pad with borders that are constant, reflect, wrap, etc.
- Arithmetic
  - Can cast to different datatypes
  - Can add
    - Numpy - modular addition
    - openCV - saturated addition
  - Add weighted images
  - Can count nonzero
  - Can do bitwise operations
    - Bitwise_not
    - Bitwise_and

Image Processing

- Geometric transformations
  - Resize
  - Shift location
  - 2D location
  - Affine tranformation
    - Lines remain parallel
  - Perspective transformation
    - Lines remain straight

- Colorspaces
  - BGR, HSV, grayscale
  - Find colors in HSV range
  - Bitwise-and inRange mask and original image
- Thresholding
  - Many types of simple thresholding (global)
    - Binary, bin inverse, truncated, tozero, etc…
  - Adaptive thresholding
    - Adaptive mean and adaptive Gaussian
      - Based on neighboring area
  - Otsu Binarization
    - Calculates threshold value for bimodal image
- Image Smoothing
  - Convolution
    - Filter2D
    - Select/create kernel
  - Blurring
    - Over surrounding area
    - Gaussian - over Gaussian kernel
      - Needs $\sigma's$
    - Median
    - Bilateral Filter
      - Preserves edges
  - Morphological
    - Create kernel
    - Erosion
    - Dilation
    - morphologyEx
      - Many options; useful for removing noise
    - Create structuring elements
- Gradients
  - Gradient filters are high pass filters
  - Sobel - resistant to noise
    - Specify vertical or horizontal
    - Specify kernel size
      - Scharr can be used - better results
  - Laplacian
- Canny edge detection
  - Edge detection
  - Needs to have noise removed
- Pyramids
  - Change image resolution

    - Useful in image blending
- Contours
    - Find from threshold
    - Can draw contours
        - Contour approximation
    - Features
        - Moments
            - Centroid
        - Find area
        - Perimeter
        - Approximate shape
        - Can get convex hull
        - Can see if contour convex
        - Get bounding rectangle
        - Rectangle of minimal area surrounding contour
            - Get points of box and draw box contour
        - Minimum enclosing circle and ellipse
        - Fit lines
        - Fit ellipse
        - Minimum and maximum values and their locations
        - Mean value of grayscale image
    - Convexity defects
        - Deviations of object from convex hull
        - Used to find outermost convex points of a shape
    - Functions
        - Point polygon test finds shortest dist between pt in image and contour
            - Returns dist
                - + point inside
                - -point outside
                - 0 point on Contour
        - Match shapes
            - Compare 2 shapes or 2 contours; see how similar they are
    - Have different hierarchies which can be selected; parent-child relationships
- Histograms
    - Plot color intensity vs frequency
    - Equalization - improve contrast in images; distribute histogram throughout intensities
    - 2D histograms - for HSV images
        - Plot hue vs saturation
    - BackProjection
        - Creates img of same size, single channel as that of output image
        - Backproject histogram over test image where we need to find object
- FFT
    - Frequency shift
    - Operations in both domains
        - Dft and idft
    - Use Gaussian windows for masking
    - Laplacian, Sobel are HPFs
        - For higher FFT sizes, take FT of Laplacian
- Template matching
    - Find objects in an image
    - Returns grayscale img where each pixel represents match of nbhd of pixel with template
    - Can use to detect multiple objects

- Hough Line Transform
    - Detect lines in an image
    - Has probabilistic version - HT optimization; considers random pt subset
- Hough Circle Transform
    - Use to detect circles in image
- Watershed Algorithm
    - Marker-based segmentation
    - Give tangent objects labels
- GrabCut algorithm
    - Algorithm takes in rectangle around foreground region and strokes that refine region
    - Gives foreground and background