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vidProcessing.py

Processing raw video data for chromatophore experiments in the Gilly lab at Hopkins Marine Station -- code by Elisabeth Holm, undergrad ML/CV intern

Versions:

Python 3.10.4

imutils 0.5.4

opencv-python 4.6.0.66

numpy 1.22.4

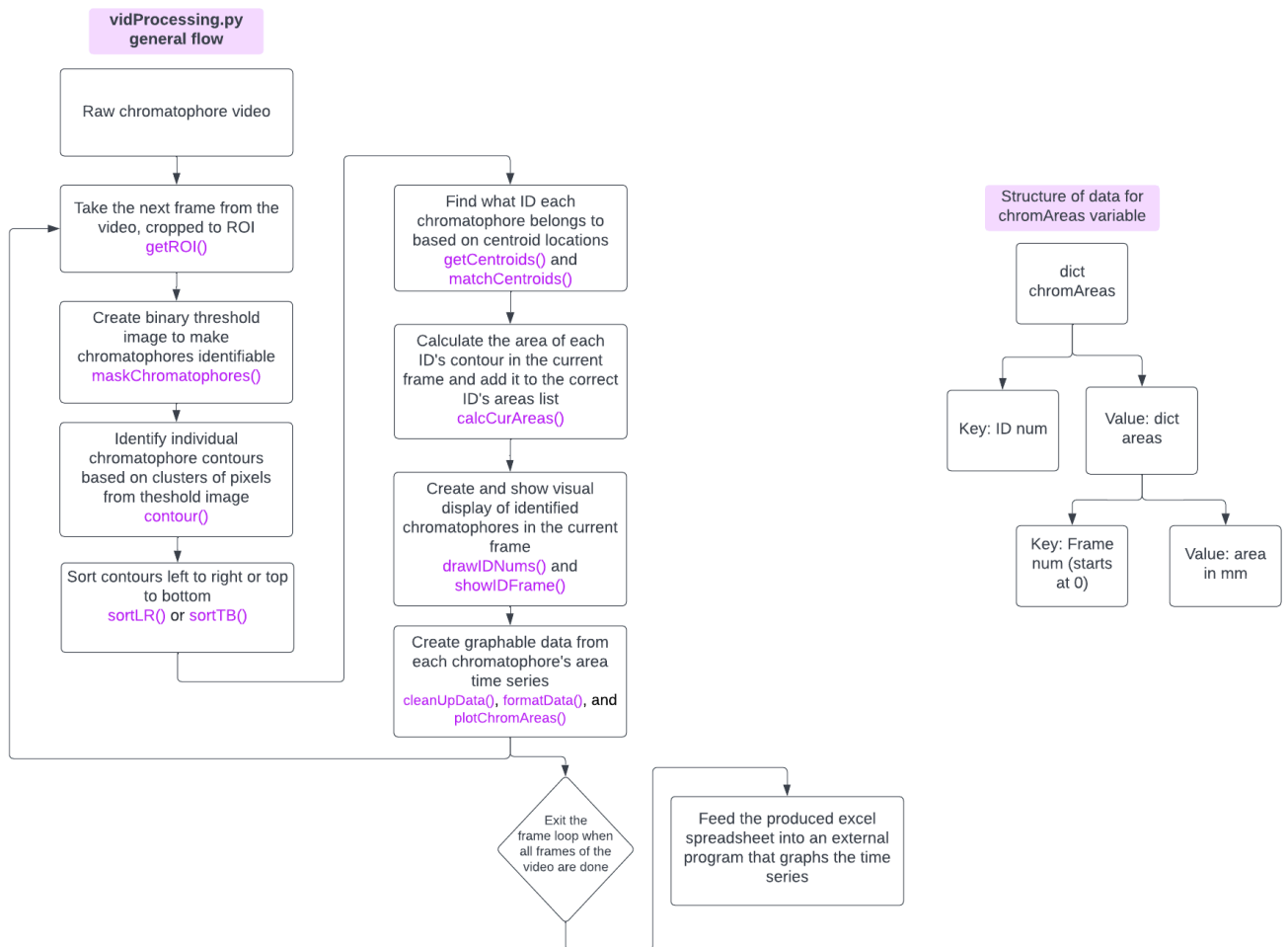
scipy 1.8.1

matplotlib 3.5.2

argparse 1.4.0

xlwt 1.3.0

General flow:



Function breakdown:

- `setGlobalNums()`
 - Sets the global constants for window width and chromatophore pixel diameter based on command line arguments
- `getROI(frame)`
 - Sets ROI (region of interest) from command line or the user manually choosing takes in the first frame of the video and returns ROI coordinates/dimensions
- `maskChromatophores(curFrame)`
 - Masks the current frame from the video to identify only the chromatophores
 - Returns the masked frame
- `contour(threshold, origImg)`
 - Defines and draws the contour lines based on the masked frame
Takes in the binary masked image and original image
 - Returns the list of chromatophores
- `createRotatedBRects(contours)`
 - Creates rotated bounding rectangles for each contour in contours
 - Returns a list of bounding rects
- `drawRotatedRect(rect, img)`
 - Draws rotated rectangle
 - Takes in a rotated rectangle and image to draw it on
 - Returns the image with the rectangle drawn on it
- `sortLR(contours)`
 - Sorts the given contours from left to right
 - Returns the sorted contours and sorted bounding boxes
- `sortTB(contours)`
 - Sorts the given contours from top to bottom
 - Returns the sorted contours and bounding boxes
- `createAreasDict(ff_contours)`
 - Takes in the chromatophore contours found in the first frame (ff) of the video
 - Builds the `chromAreas` list of chromatophores (setting up to later add area data for each chromatophore)
 - Only called during the first frame of the video
- `createMatchedCentroids(curCentroids)`
 - Populate the `matchedCentroids` dictionary with `{objectID: centroid}` in the first frame of the video when there is no previous frame to compare to
 - Only called during the first frame of the video
- `getCentroids(bBoxes, contours)`
 - Put the centroids of each bounding box in a list with the center of each bounding box in the same index as the original bounding box
 - Takes in the list of bounding boxes and contours
 - Note: index of `bBoxes` and `contours` must correspond
 - Returns centroids and a dict that maps each centroid to its contour

- register(centroid)
 - Register a new chromatophore
- deregister(objectID)
 - Deregister given chromatophore in matchedCentroids and disappeared dicts
- matchCentroids(curCentroids)
 - Compare current centroids with previous centroids to determine the closest matches
 - Returns the calculated IDs of each current centroid.
 - Takes in the list of current centroids and dict of previous matched centroids
 - Returns dict of ID_num:current centroids matched
 - Code based on <https://pyimagesearch.com/2018/07/23/simple-object-tracking-with-opencv/>
- calcCurAreas(centroidsToContours, curFrameIndex)
 - Takes in chromatophore contours, calculates area for each chromatophore
 - Adds area to appropriate area time series (the dict of areas under the chrom w/ the correct ID num) in chromAreas
- drawIDNums(boundingRects, frame)
 - Draw ID numbers, bounding boxes, and centroids for each object in the frame
 - Returns frame with everything drawn in it
- getStdDev(areas)
 - Takes in a 1D list of areas, returns the standard deviation
- cleanUpData()
 - Filter out irrelevant data entries (ex: chrom that was only identified in a few frames)
- formatData(numFrames, ROI)
 - Formats final dataset into a spreadsheet and saves it to the same folder as the video
 - Takes in the number of frames in the video and the ROI coordinates/dimensions
 - Important note: the xlwt library currently only supports up to 256 columns, so the number of chromatophores in the selected ROI must be < 256
- plotChromAreas()
 - Plots chrom areas over time (each chromatophore is one line) and then shows the graph. Commented out: saving the graph to the computer
- showIDFrame(curFrameIndex, ID_frame)
 - Shows the current frame with chromatophore IDs, adjusting for mac and windows systems (running on windows caused an error with displaying the frame)
- showAllImages(curFrameIndex, original, gray, threshold, contours, ID_labeled)
 - Show images from each step of the process
- saveIndividualImages(curFrameIndex, original, gray, threshold, contours, ID_labeled)
 - Saves each generated image individually in the frame_cap folder, showing each step of the process for the current frame
 - To use, call at the end of the while True loop in processData() instead of saveImages()
- saveImages(curFrameIndex, original, gray, threshold, contours, ID_labeled)

- Saves one image that shows each step of the process for the current frame.
Saves to the frame_cap folder
 - To use, call at the end of the while True loop in processData()
- processData(vidPath)
 - Summary function of the entire program
 - Takes in filepath to raw video, goes through the entire identification process, and saves the time series of each chromatophores' change in area as .xls files – one for cleaned data and one for uncleaned data