LabelBot2000

Semi-autonomous Labeling Robot

Spring 2021

Version: May 3, 2021

Christopher Lai & Paul Thai

Contents

1 Changes

1.1 Script Version: v0.1 [Baby: Creation]

1. Output Script Initialization

   - Can open and close webcam from an OpenCV script command
   - Can retrieve frame in the form of a list of reference values from webcam
   - Can apply basic filters to frame in order to enhance contours (grayscale, Gaussian blur)
   - Can apply contour-enhancing filters to frame (adaptive threshold)
   - Can identify contours from frame, find the area of each contour, and find the center of the contour
   - Can display each contour on the frame with the location of the center point shown in the bottom right corner
   - Display the differential x and differential y in the terminal measuring the distance from the center point to target point.
   - Opens up a Graphical User Interface (GUI) upon initiating script, contains the following buttons:
     - **scFrame**: (Source Frame) Opens the frame output, which is the stream of images from webcam.
     - **scMask**: (Source Mask) Opens the mask output, which shows the filters applied to the frame.
     - **RandPoint**: Places a random point onto the frame, when center of contour reaches point, program ends.
     - **Exit**: Safely closes thread and ends tk Graphical User Interface (GUI).

1.2 Script Version: v0.2 [First Steps: Closing Logic]

1. Major Changes

   - Create the close buttons for the scFrame, scMask, and the state.
   - Can open and close the the windows for scFrame and scMask.
   - scFrame and scMask will not be opened when the program is ran, must click on scFrame and scMask to open the window.

2. Minor Changes

   - Fixed the button scaling and the size of the canvas so that all the buttons would fit.
   - Each close button has their own global close variable -¿ Bye

3. Bug Fixes

   - FPS has fixed appropriately for this section.
   - Exit button will close all windows successfully without lagging computer.

1.3 Script Version: v0.3 [Adolescence: Color Detection]

1. Major Changes

   - On program start, open a frame to display a running stream of frames from webcam (sans-filter aka Test Window)
   - Initialized HSV (Hue, Saturation, Value) color masking algorithm to isolate a singular color from the frame and create a contour around it
   - Created track bars to modify the low and high HSV values to manually calibrate the thresholds for the filter
   - Utilized the –state– and close state buttons.
     - –**state**– button will open up the trackbar to allow the user to change the values of HSV. It is separated into two sections: low and high.
     - **close state** button will safely close the trackbar window and reset the values of HSV.
   - Trackbar window will have three smaller windows embedded into it:
     - **Far left**: This window would have the mask effect.
     - **Middle**: This window would directly output what the webcam see.
     - **Far Right**: This window will only outline the color specified in the ranges of the HSV trackbar.

2. Minor Changes

   - Global variables for each close window button.

3. Bug Fixes

   - Fixed a bug where the EXIT button wouldn't close the program properly.

1.4 Script Version: v0.4 [Child: Glow Up]

1. Major Changes

   - Added icons to replace the text on each button (royalty free logos courtesy of Icons8.com)
   - Redesigned GUI, making the design more modern and easier to navigate
   - Added the following buttons:
     - **Switch Mask**: Switches between the adaptive threshold and HSV color masking filter in the mask window
     - **Toggle Contour**: Turns on and off the contour lines in the frame window
   - Assigned ID numbers to each contour to track different objects (object differentiation)
   - Changed the way the contour algorithm detects an object-will only follow the object with the smallest contour. (Sorting algorithm)

2. Minor Changes

   - Defined colors (background color, button color) in hex IDs

- Added *toggle logic* to the buttons to give them on/off states. Can turn on and off

- Created a state machine for the masking algorithms, able to switch from one to another through the toggle mask button

- Prevents user from using button (random point, change mask, toggle contour) if the frame or mask isn't open (failsafes)

- Trackbars will now save their HSV settings upon closing of window

3. Bug Fixes

- Removed test window

- Fixed faulty FPS counter (used to display too high of an FPS to match screen rate and not frame output)

- Fixed the ID tracking of an object:
  - **Before**: Any center point that would reach the target point would successfully complete the random point test.
  - **Afterwards**: Only the smallest object with the smallest contour would be able to successfully complete the random point test.

1.5   Script Version: v0.5

1. Major Changes

- Random Point Test will now output a .JSON file containing statistics of the test run. Data points include:
  - date
  - time
  - version
  - differentials (pX, pY, cX, cY, dX, dY)
  - Time Elapsed

- Create a server that would house all of the serial numbers that will be sent to hardware team in order for the robot arm to do precise movements.

2. Minor Changes

-

3. Bug Fixes

-