SKIN DETECTION PROJECT

By Jacob Graham

INTRODUCTION

- As part of my course: algorithm multimedia and machine learning in python, I developed an application that connects to the PC web cam and analyze the video by detecting human skin and coloring it in green.
- An additional feature of the app is to record video , take photos , and save them as a new avi/png file.

WHAT IS SKIN DETECTION?

- Process of finding skin-colored pixels and regions in an image or a video.
- The color of human skin is created by a combination of blood (red) and melanin (yellow, brown).
- What we need is a function which can tell whether a given color pixel is a skin pixel or not.
- **Range based skin detection technique**
  - transform a given pixel into an appropriate color space
  - skin classifier to label the pixel whether it is a skin or non skin pixel.

COLOR SPACE

- When colors need to be used in digital media so to needs to be presented in numbers. Therefore color space is a set of rules that allows describing colors with numbers.
- **RGB color space** uses *R*ed- *G*reen-*B*lue component of the color and use those component to display the color.
- **RGB Not much useful for skin detection, therefore we will convert the image to YCrCb color space.**

YCRCB COLOR SPACE

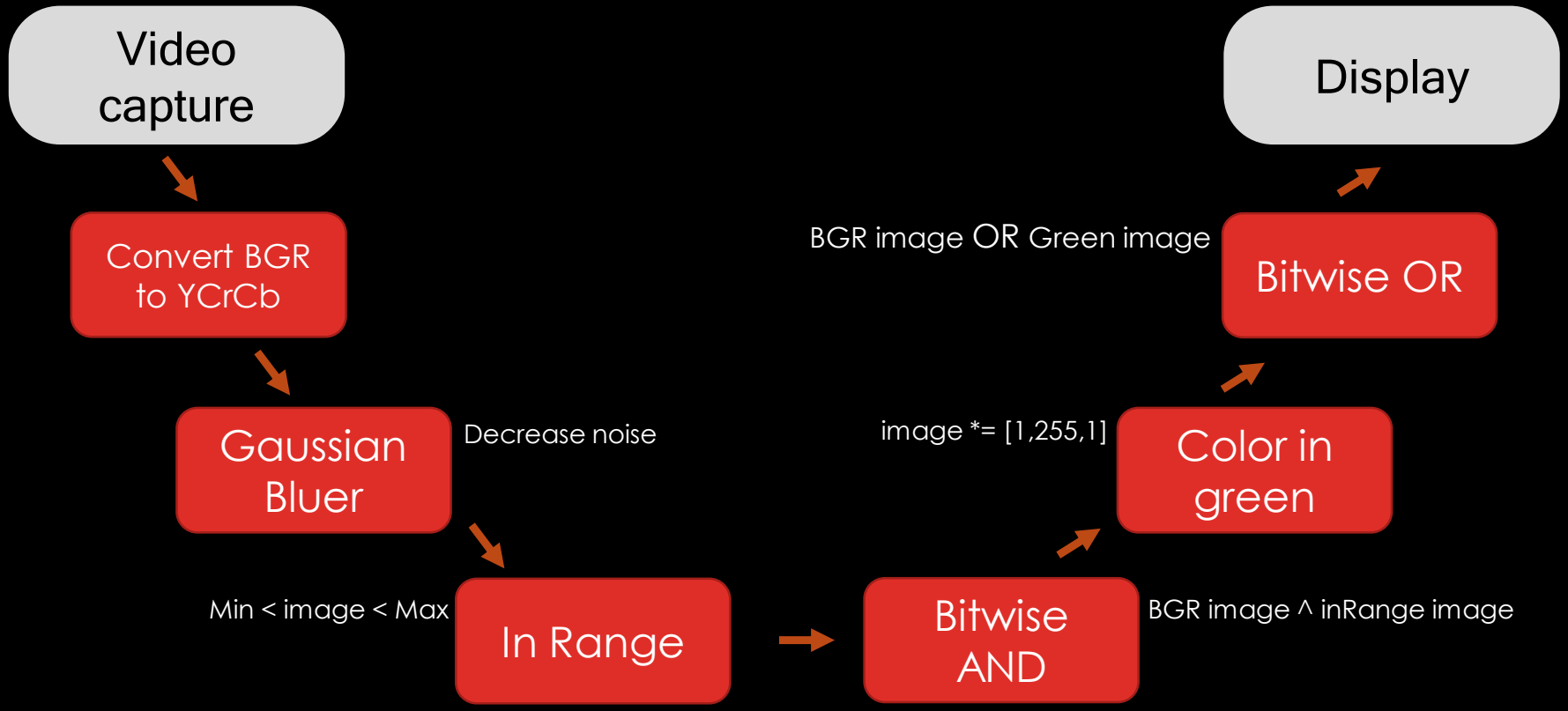
- **Y** is the luma component of the color. Luma component is the brightness of the color. That means the light intensity of the color.
- **Cr** and **Cb** is the red and blue component's related to the chroma component. That means:
- **Cb** is the blue relative to the green component, **Cr** is the red relative to the green component
- Cb = B – Y , Cr = R – Y
- Conversion:

$$[Y\ Cb\ Cr] = [RGB] \begin{bmatrix} 0.299 & -0.168935 & 0.499813 \\ 0.587 & -0.331665 & -0.418531 \\ 0.114 & 0.50059 & -0.081282 \end{bmatrix}$$

OPENCV LIBRARY

- OpenCV is the main library in this project.
- By using the above function's:
  - VideoCapture
  - waitKey
  - flip
  - cvtColor
  - COLOR_BGR2YCR_CB
  - GaussianBlur
  - inRange
  - bitwise_and
  - bitwise_or
  - VideoWriter
  - imwrite
  - imshow

DETECTION PROCESS DIAGRAM



DETECTION PROCESS

- At first, we set two NumPy array as the min_YCrCb and max_YCrCb for the detection range of human skin pixels.
  - Min_YCrCb[40, 140, 77]
  - Max_ YCrCb[150, 170, 127]
- The array's are set as unsigned int.

DETECTION PROCESS

- connect to the camera and analyzing the video fame by frame.
- The live video is Capture frame-by-frame
- Flip the frame 180* to make a mirror effect.

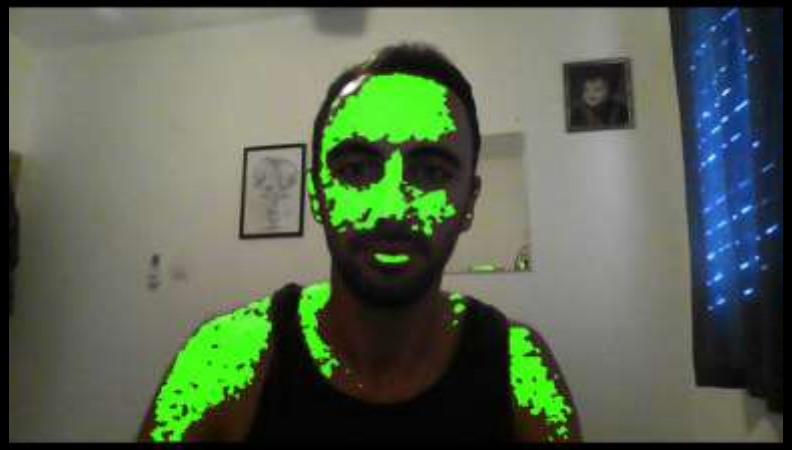
DETECTION PROCESS

- Convert the frame from BGR to YCrCb
- **RGB:** (Red-Green-Blue) Defined in relation to primary colors(like CMYK). **Not much useful for skin detection**
- **YCrCb:** Widely used since the skin pixels form a compact cluster in the Cb-Cr plane.

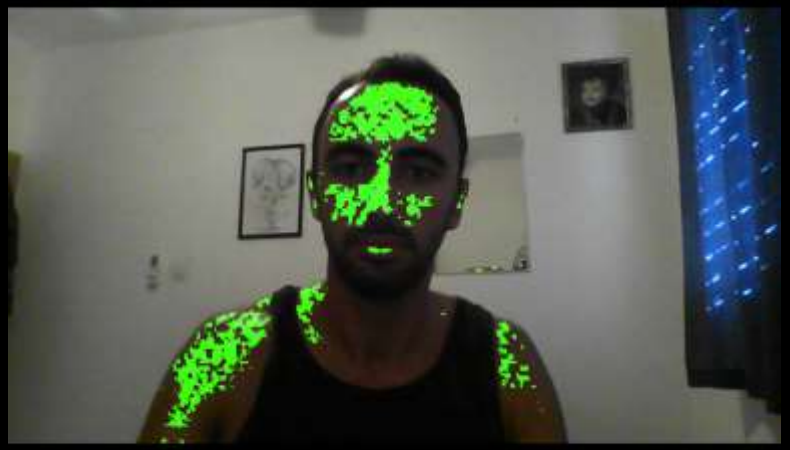
DETECTION PROCESS

- Apply a Gaussian mask size (3,3) on the image to decrease noise and improve detection range
- An example of the outcome:

with mask

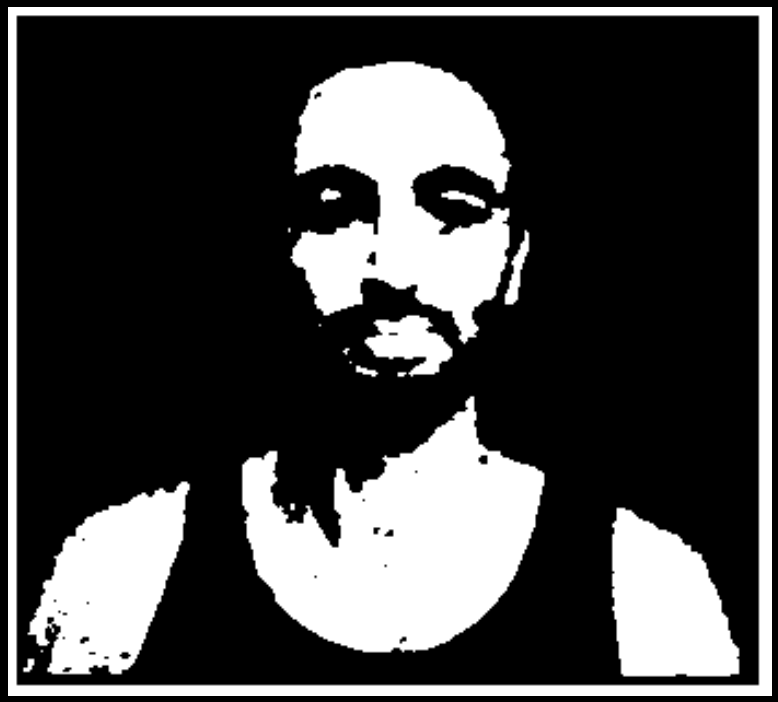


without mask



DETECTION PROCESS

- By using the range YCrCb arrays we scan the YCrCb Converted image.
- Create a mask in the size of the image the has only value's: 0 and 255.
- Where skin = in range = 255
- No skin = out of range = 0

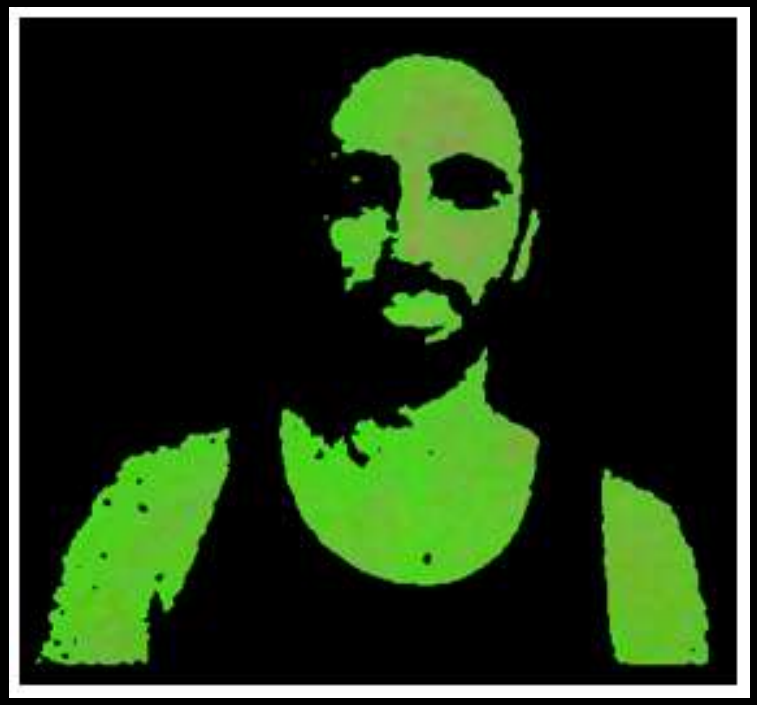


DETECTION PROCESS

- Create a new image by using the AND operation between the camera frame and the mask image.
- This is cutting from the fame the pixel's where skin is detected, and all the other pixel's will be black.
  - Black AND pixel = Black
  - White AND pixel = pixel

DETECTION PROCESS

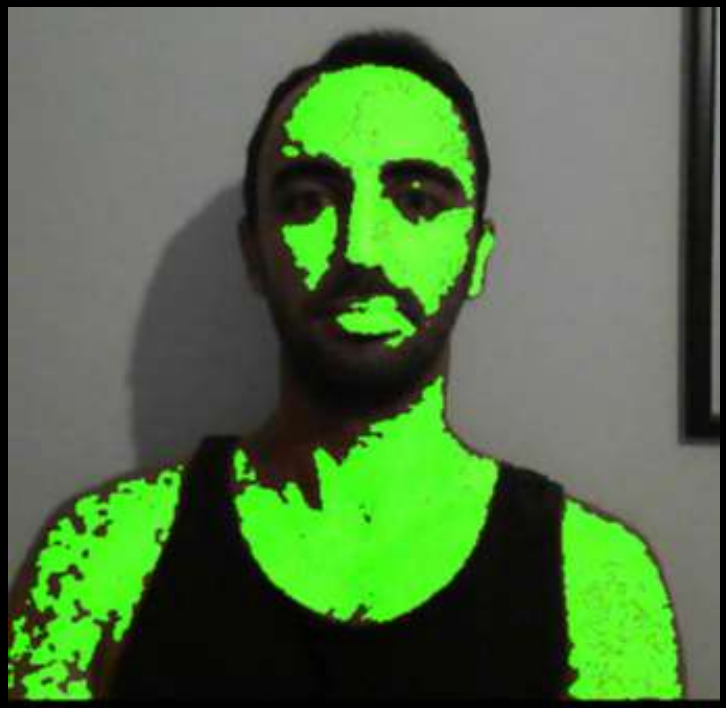
- Take the previous image and multiply all the pixel by [1 , 255 , 1]
- Now the skin is green as needed



DETECTION PROCESS

- Applying OR operation between the camera frame and our green skin image.
- The OR will make sure all the frame pixels that are nor skin will remain the same
- And all the pixels that are skin will be green

- This is the outcome:



APPLICATION USAGE

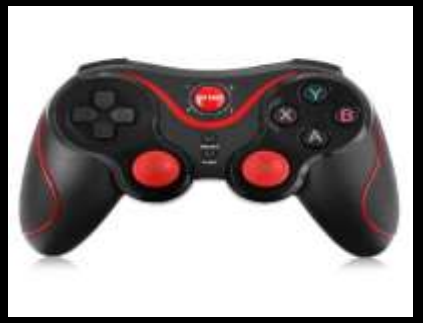
- By Pressing the above:
- ‘q’ – exit
- ‘d’ – take a photo
- ‘s’ – start recording. Press again to stop.
- ‘p’ – pause video

SAVING VIDEO AND IMAGE

- By checking the project directory we make sure the new file that we create wouldn't override the previous one.
- The file name is "file_i" , i = unsigned integer.
- We find the latest i and create a new file with i+1.

FUTURE DEVELOPMENT

- This technology can be used for many purposes. For example:
  - Life saving
  - Gesture trucking
  - Replacing a video game controller



THE END