

Salah-Iy

Recoloring Football Matches for Color Blindness

We all love to watch football matches and support our favorite teams and players. Football is the most popular sport all around the world and all of us have access to football matches online nowadays. But watching football may be not as easy or entertaining if you are color blind. Sometimes the 2 teams are wearing 2 colors, that due to some case of color blindness can be seen as the same color.



A photo from Russia vs Saudi Arabia World Cup game, as seen by a color blind



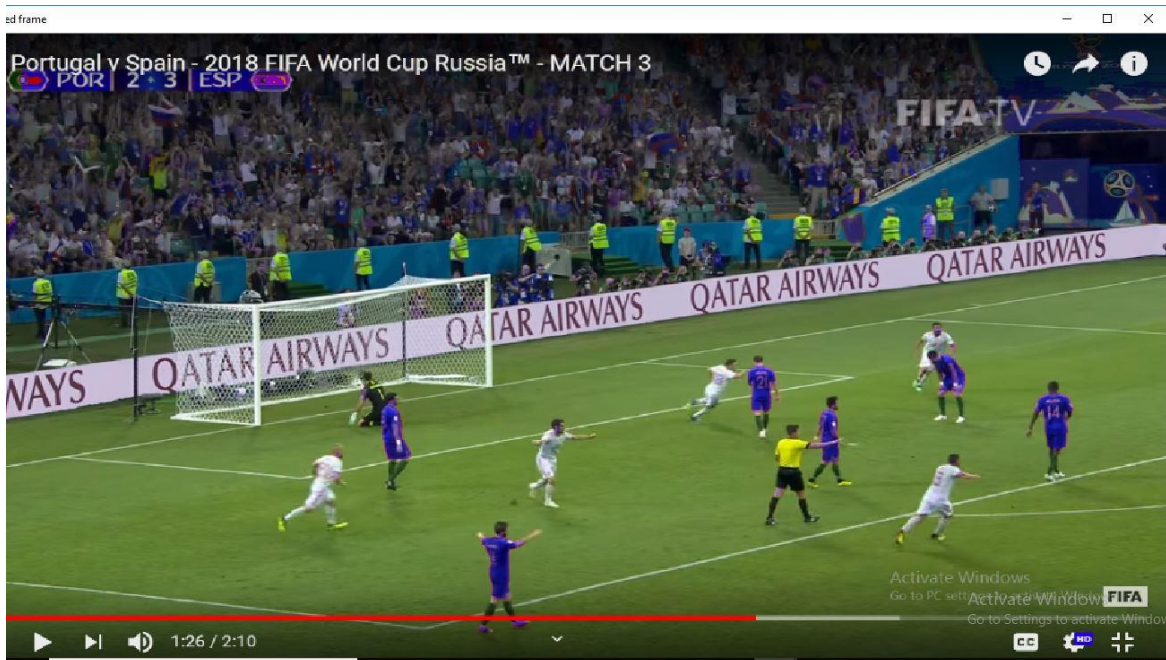
The original image

Our application aims to make things easier for people suffering from this condition. The user uploads a video of some football match and choose the 2 colors he wants to see the 2 teams wearing. So the user can choose any 2 colors that he is able to distinguish from one another and enjoy watching the video.

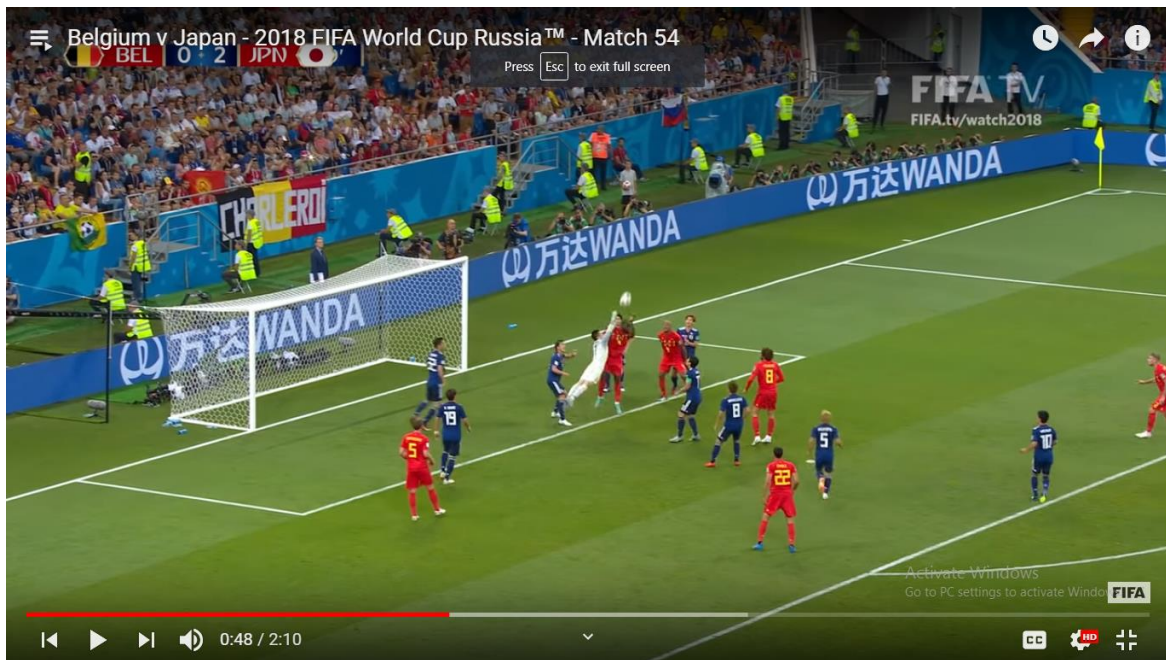
Program Output Examples:



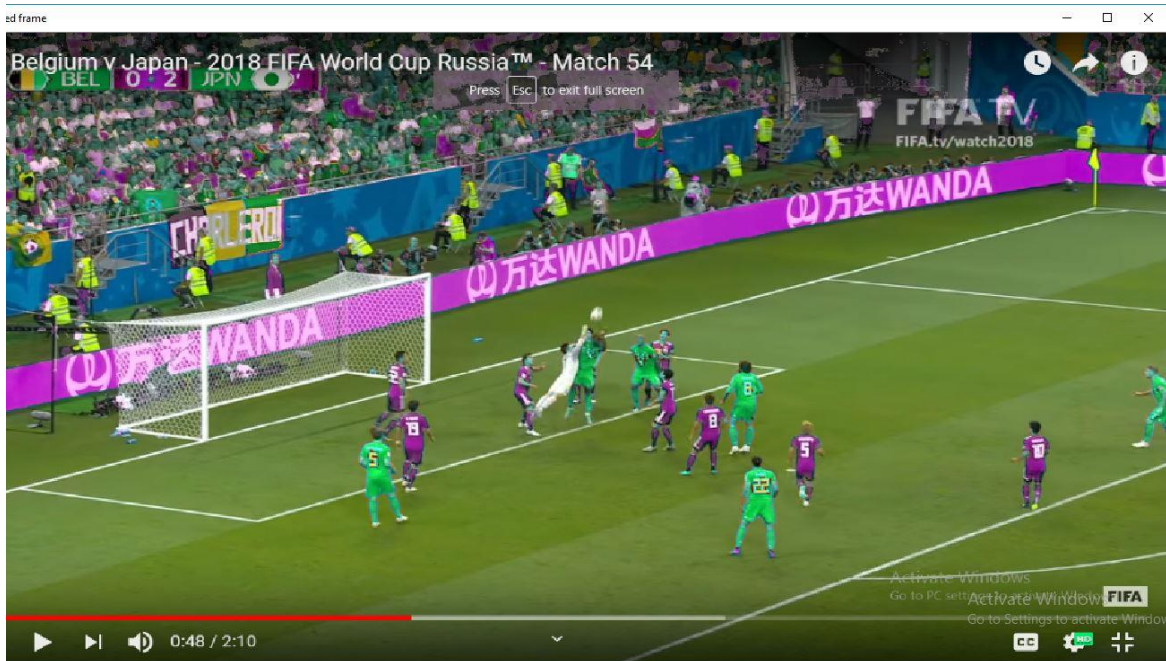
Original frame



Output



Original Frame



Output

Algorithms Main Steps:

1. Finding suitable frame from the video, for colors detection
2. Detecting the t-shirt colors
3. Calculating the desired transformation equation
4. Applying the transformation equation to color the t-shirts

Finding suitable frame from the video, for colors detection:

We have defined colors set, which defines each color by its range of each of the HSV channels. This means we can find out the color of any pixel by assigning its HSV values to one of our defined colors. We test the videos' frames sequentially by computing the color histogram of each frame, this histogram of alongside with our color ranges can be used to understand the colors present in the frame.

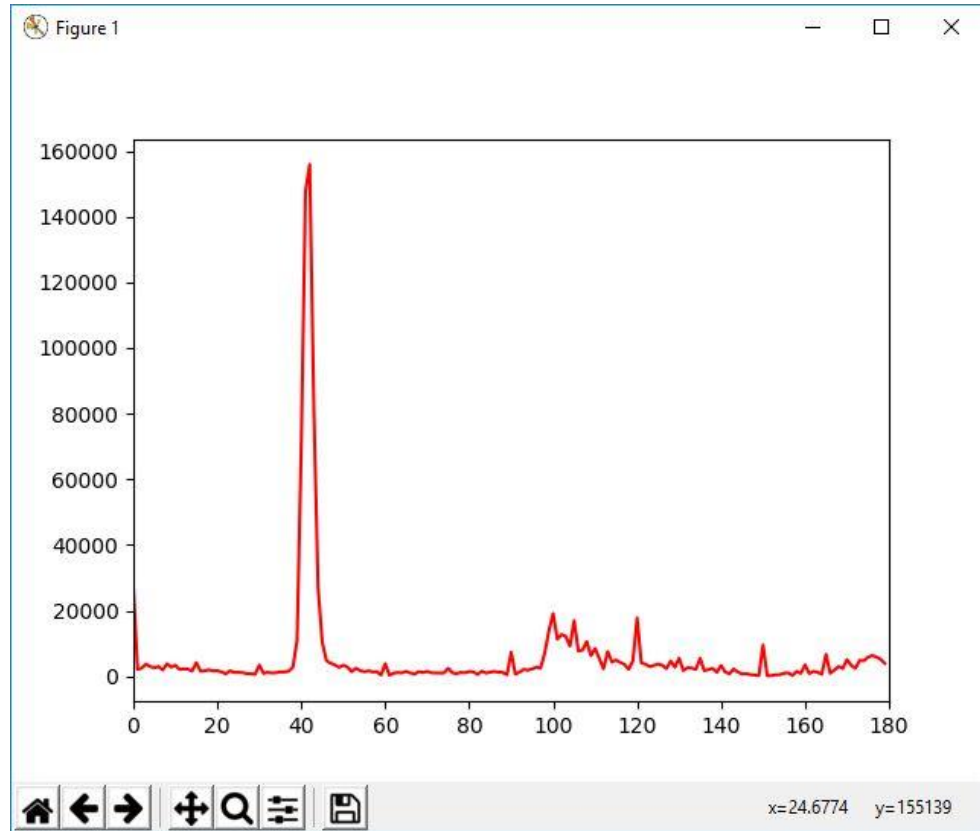
Then from the histogram of the frame, we can find the percentage of green colored pixels in the frame. We need a suitable frame for color detection, this means we don't need a frame of the fans, the coaches or a zoomed in frame. We need a wide shot frame with players from the 2 teams. So, to find such a frame, we test the frames and get the first suitable frame, which have a high percentage of green colored pixels "more than a preset threshold"

Detecting the t-shirt colors:

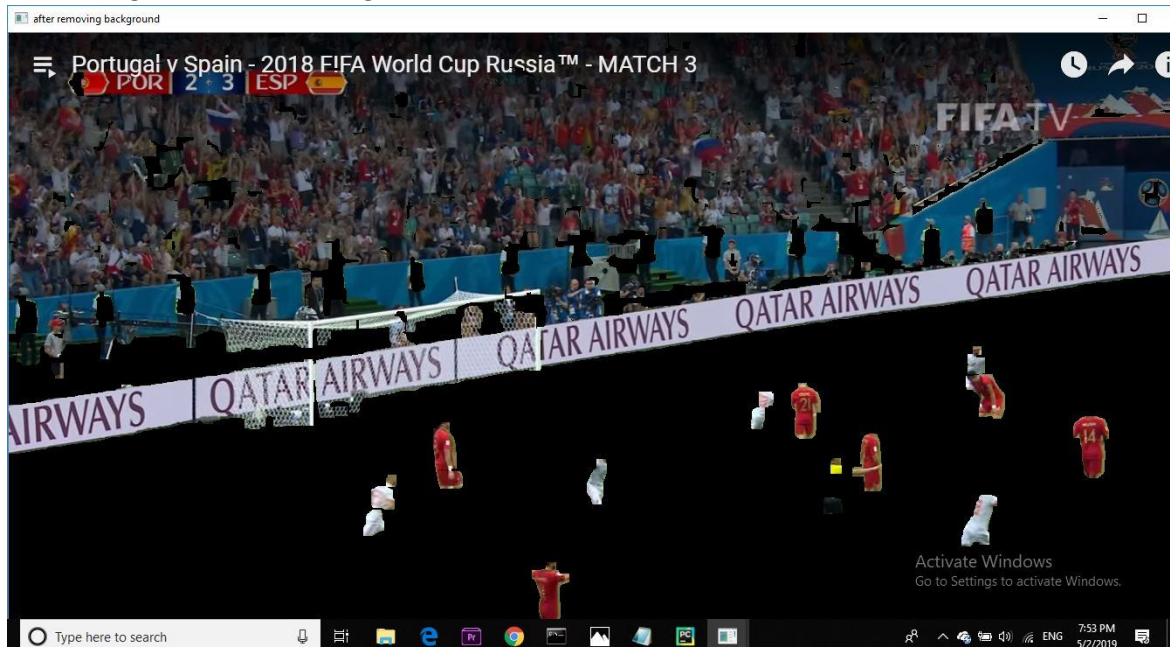
The second step is to find the colors of the 2 teams t-shirts. This is a very important step and these colors will be used in the recoloring process as will be shown. So we will work on the frame we have got from the previous step. For illustration, we will work on this frame from the World's Cup 2018 match between Portugal and Spain.



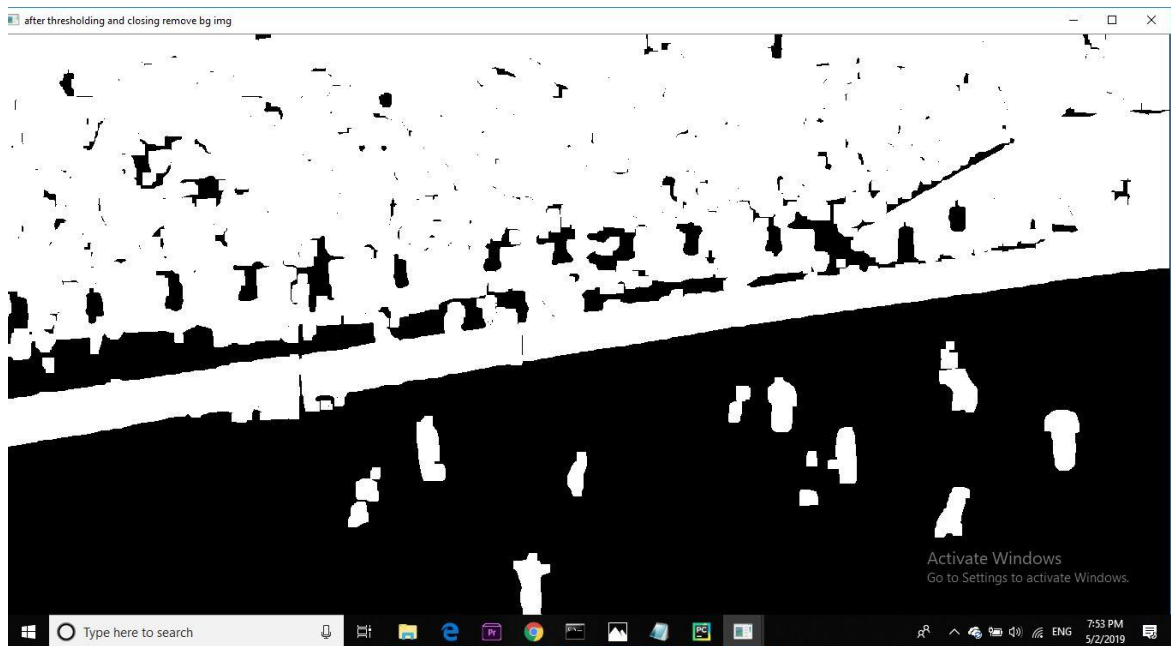
1. We find the histogram of the frame, the maximum color will be the playground's color. We will extract that range from the histogram



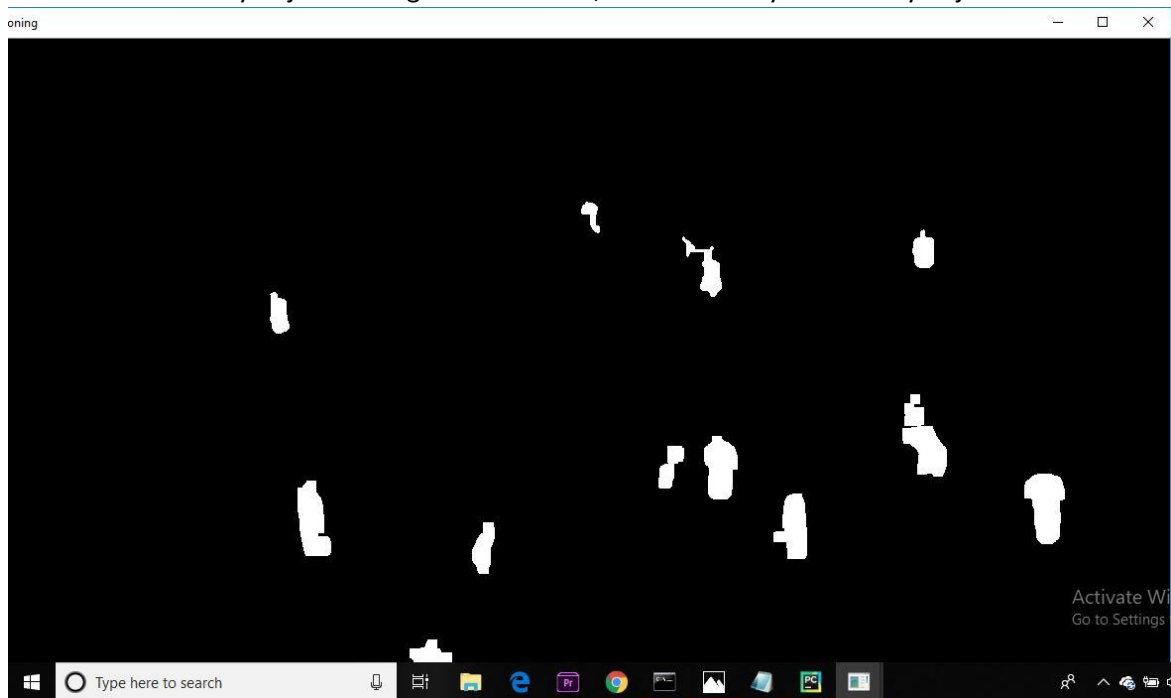
2. Now we have the pitch's color range, we will remove it by finding pixels in that range, and subtracting them from the original frame



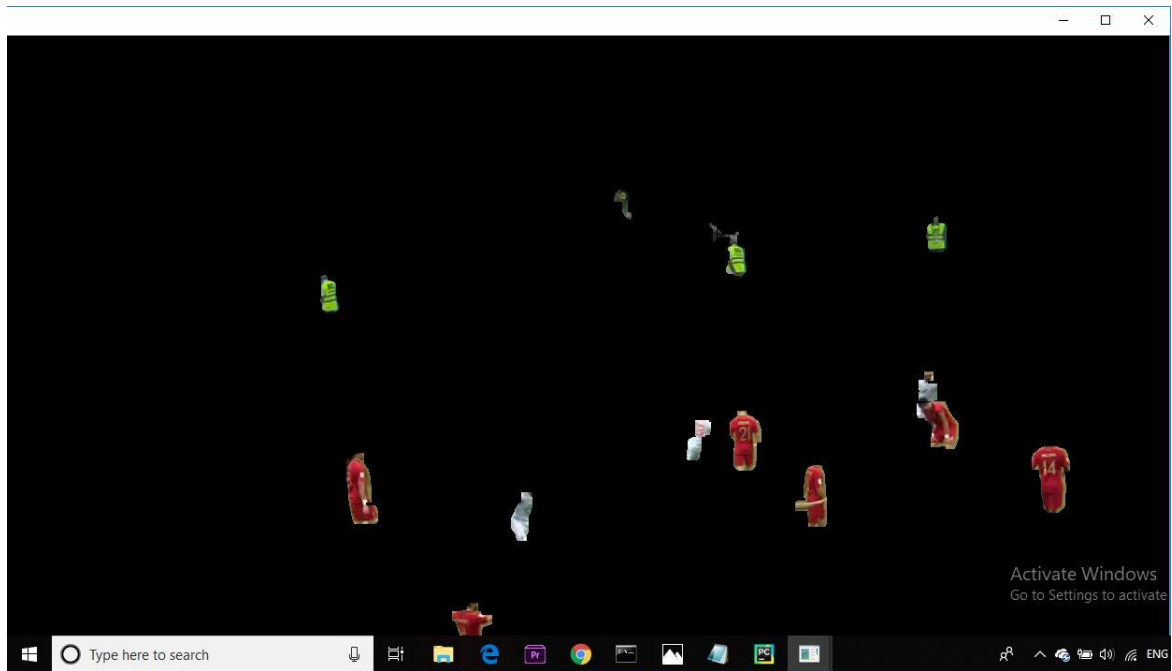
3. Then we threshold the resulted image and perform morphological closing to connect any small holes.



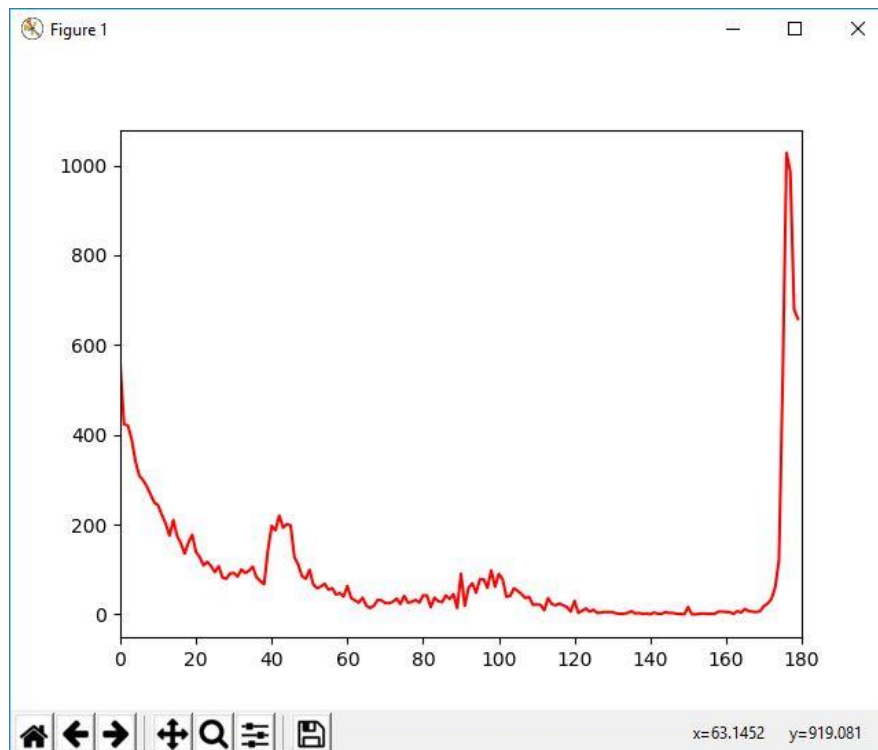
4. We need only the players of the 2 teams to get their color, so we need to remove the signs around the playground and the fans.
So we find the contours in the image, and we remove any object with width more than height.
We also remove any object of height less than 10, to remove any small noisy objects.



We perform bitwise anding between this image and the original frame, we get the following. The image only contains our red team players and some small noise.



5. We find the histogram of the resulted image. Now most of the image pixels are the team players, so the max range in the histogram will be the color of the t-shirt color.



We can see that the peak is nearly at 175, which is H value of red color.

NOTE: The same steps are used if we need to color the 2 teams t-shirts. We here use an example where one of the teams wear white for illustration only.

Calculating the desired transformation equation:

Now we have the HSV range of our teams' t-shirt colors. The user will input the 2 new t-shirt colors he wants. The problem is that this is only one value, not a range, and we need the t-shirts to still have colors variations in different areas as the original image.

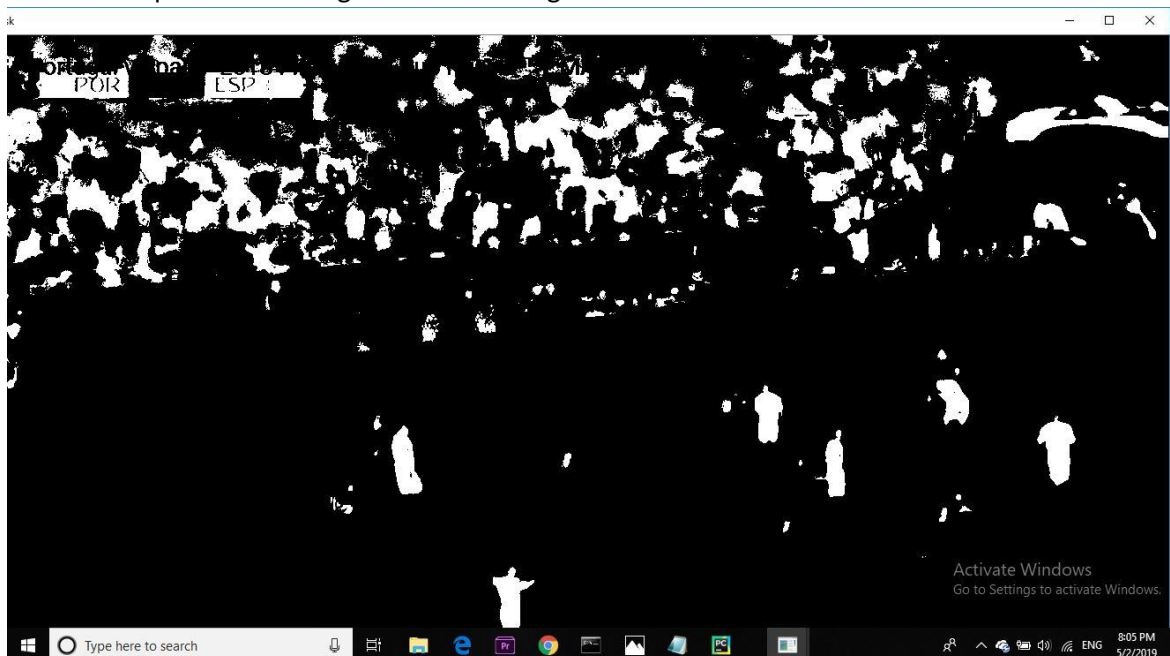
So, we find the value of the most dominant color in our t-shirt color range. This is the color of most of the pixels. We then subtract the new desired colors from this value. We have now a new HSV value we call "transformation color" this will be added to each of the t-shirt pixels to recolor it, as will be shown in the next step.

Applying the transformation equation to color the t-shirts:

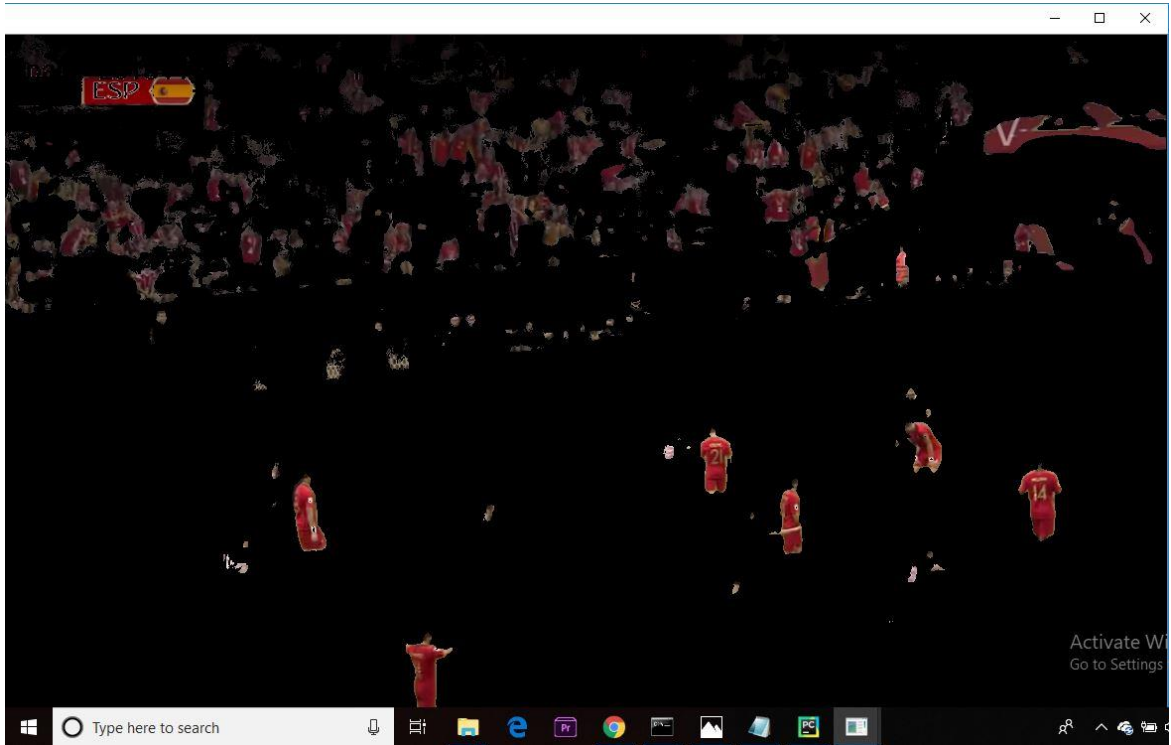
1. We create a new matrix with the same dimensions of our video frame, then fill it with our transformation color calculated from the previous step



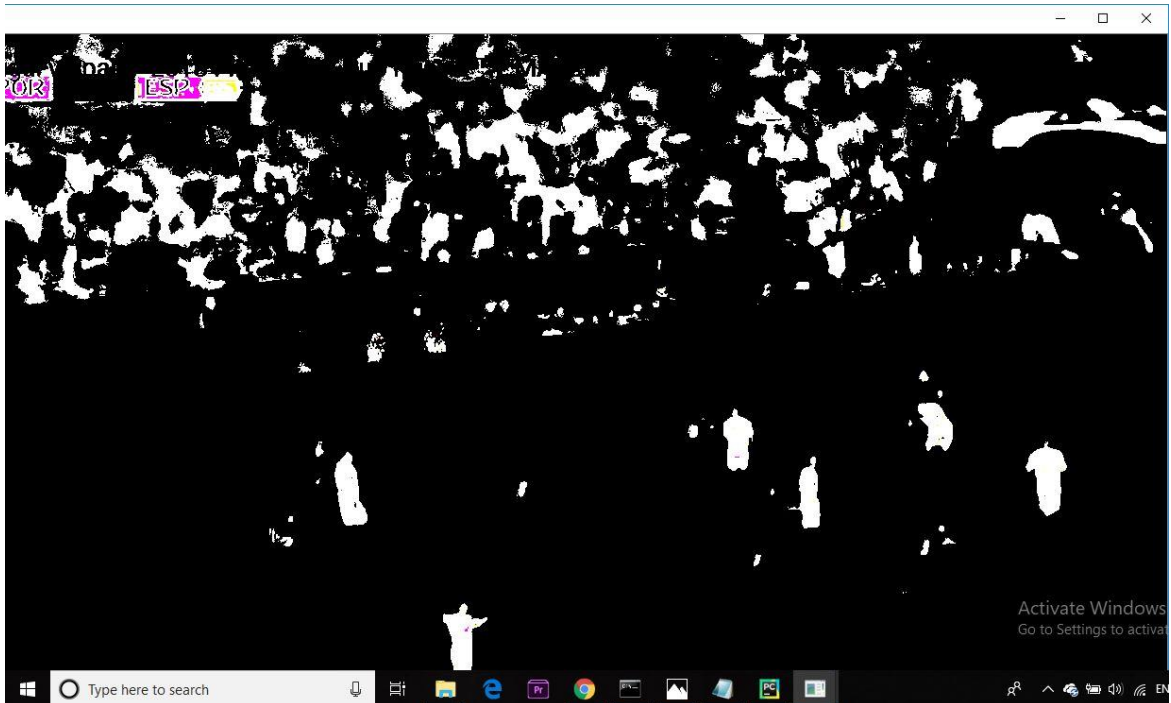
2. We find the pixels in our original frame in range of the t-shirt color



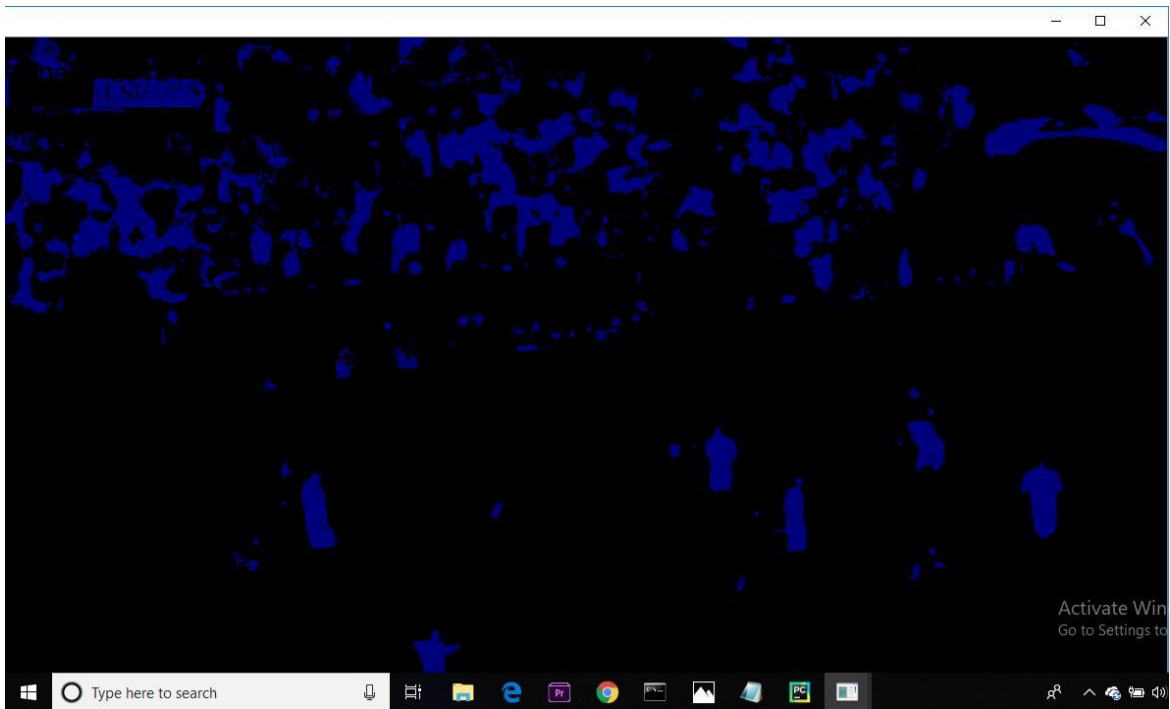
After bitwise anding this frame with the original image we get the following



3. We perform thresholding on the previous result, and perform morphological operations to connect any holes in the t-shirts



4. We perform bitwise anding between our transformation matrix and the previous image after thresholding and morphological processing. So we get the desired transfer color only in the areas that need to be colored.



5. We add this new mask to our original image, to get the new colored frame

