Report

Automatic Object Tracker Using MATLAB

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Abstract

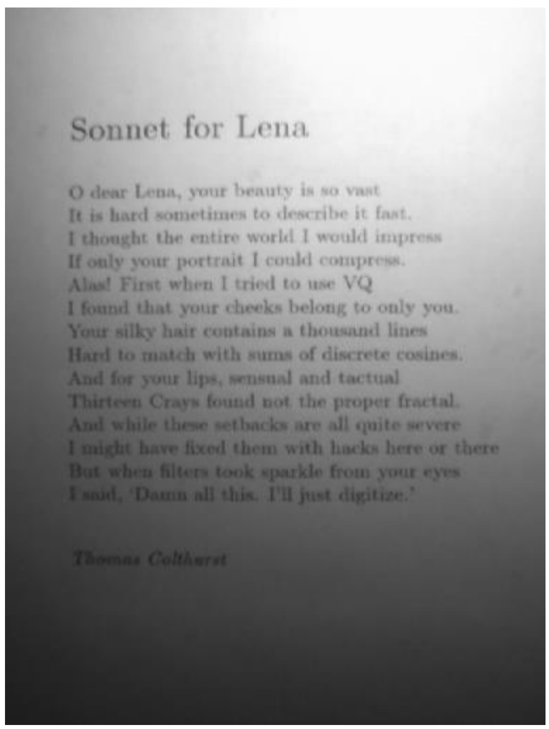
The proposed design tracks an object in videos, which plays an important role in computer vision. In this project, we performed an automatic object tracking using MATLAB. Adaptive thresholding was also used to eliminate the uneven lighting conditions. Algorithm works by detecting the edges using the High Pass Filter and apply adaptive filters. We demonstrate the effectiveness of this approach by experimenting with a simple video.

Introduction

Thresholding

Poor light gradients in the image makes the image detection very difficult. There are many techniques developed to threshold the image. Non-adaptive thresholding do not take the image into consideration for thresholding.

For example, the following image is taken into consideration. As it apparent from the image that there is non-uniform lighting condition across the page, which makes the thresholding difficult



Sonnet for Lena

O dear Lena, your beauty is so vast
It is hard sometimes to describe it fast.
I thought the entire world I would impress
If only your portrait I could compress.
Alas! First when I tried to use VQ
I found that your cheeks belong to only you.
Your silky hair contains a thousand lines
Hard to match with sums of discrete cosines.
And for your lips, sensual and tactual
Thirteen Crays found not the proper fractal.
And while these setbacks are all quite severe
I might have fixed them with hacks here or there
But when filters took sparkle from your eyes
I said, 'Damn all this. I'll just digitize.'

Thomas Colthurst

Figure 1: Image containing Lighting Conditions.

So, we use Adaptive Thresholding to mitigate this problem.

Adaptive Thresholding

Adaptive Thresholding takes the non-uniform lighting conditions into consideration while thresholding the image. There are basically two types of adaptive thresholding:

1. Global Thresholding.
2. Local Thresholding.

Global Thresholding

Global Thresholding takes only one threshold value for the entire image. So the thresholding for the Figure 1 using Global Thresholding gives results somewhat like following:

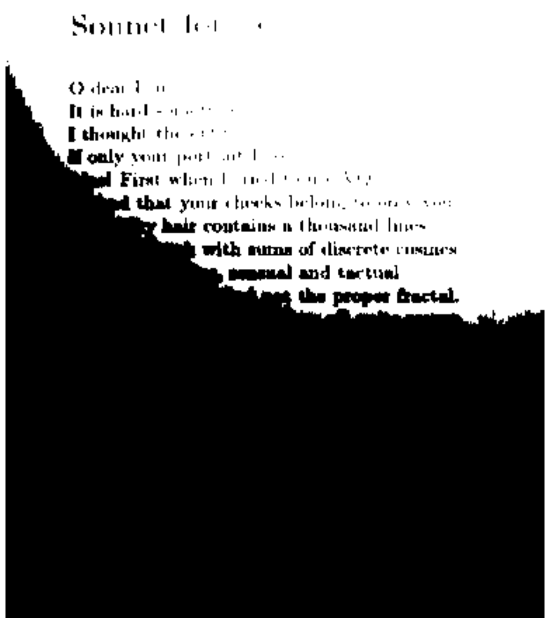


Figure 2: Global Thresholding

So Figure 2 shows that Global Thresholding do not help for strong illumination gradient.

Local Thresholding

Local Thresholding calculates the unique threshold for each pixel. It takes neighboring pixel intensity to calculate the thresholding value for each pixel.

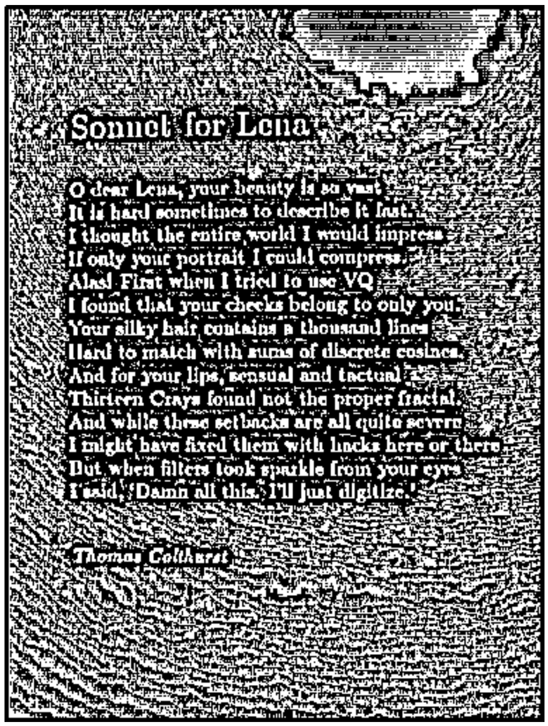


Figure 3: Using the mean of a 7×7 neighborhood

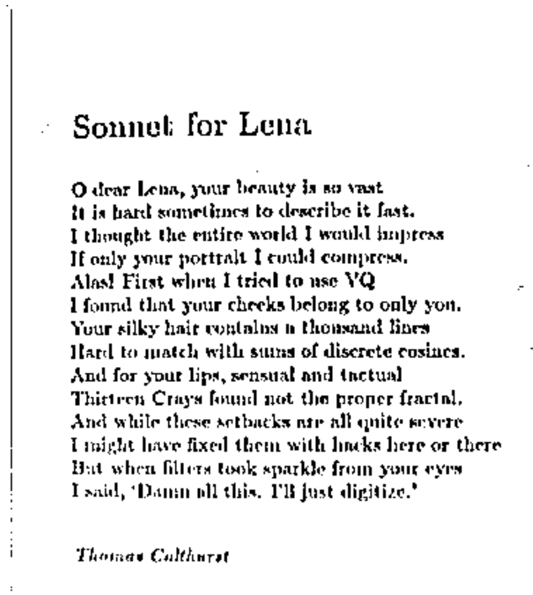


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Figure 4: The result for a 7×7 neighborhood and C=7

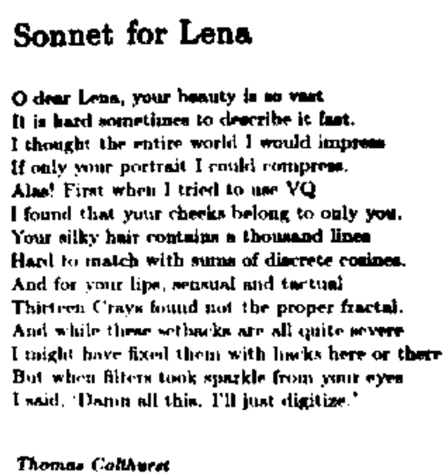

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Figure 5: The result for a 7×7 neighborhood and C=10

Object Detection

We use neighboring pixel cluster method to identify any object. The location of the object in the image can be calculated based on the pixel values. Basic Flowchart for detecting any object is shown as follows:

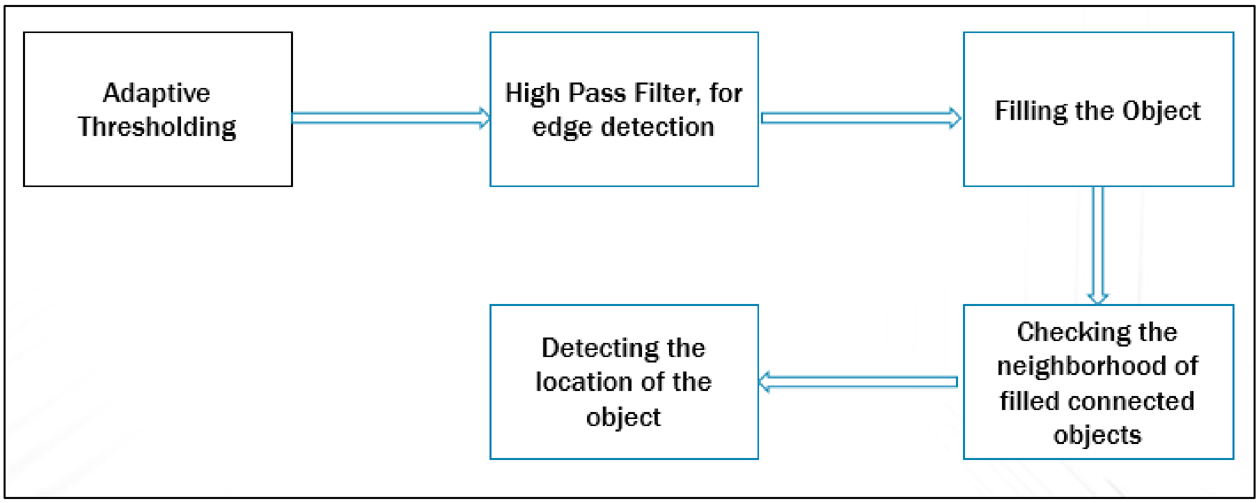

Figure 6: Flowchart for Object Detection

Any Grayscale or colored image is first converted into black and white image. To convert into black and white image we need to implement the adaptive thresholding. Here, adaptive thresholding is used for this purpose, then High Pass Filter is applied on the image to detect the object boundaries.

Once the object boundaries are detected we fill the object with all the '1' so that we can detect the cluster of pixels having the same intensity. It can be said that it is obviously an object.

Source Code

adaptivethreshold.m

```
function bw  = adaptivethreshold(image)



[rows, cols, dim] = size(image);

if(dim > 2)

    im1 = rgb2gray(image);

else

    im1 = im;

end



im2 = imfilter(im1, fspecial('average',7), 'replicate');



%Edge Detection

sim = im2- im1- 10;



bw = im2bw(sim, 0);

end
```

object_detect.m

```
%Fnction to detect the single object in the image

%Input Arguments : Image Matrix

%Output          : Object Array, Start_location, End Location



function [output, start, end_a] = object_detect(data_input)



    %Adaptive Thresholding Function

    snap_z1 = adaptivethreshold(data_input);

    %Filling the detected image

    snap_z = imfill(snap_z1, 'holes');

    [rows, cols] = size(snap_z);



    %Checking Connected pixels

    for i=2:rows-1

        for j=2:cols-1

            if((snap_z(i+1,j)   ||   snap_z(i-1,j)   ||   snap_z(i,j-1)   ||
snap_z(i,j+1)) == 1);

                data(i,j) = 1;

            end

        end

    end

    [rows, cols] = size(data);
```

```
%Array Adjustment

j1 =0;

a = data;

for j=1:cols

    if(data(:,j) == 0)

        a(:,j-j1) = [];

        j1= j1+1;

    end

end

i1 =0;

d = a ;

for i=1:rows

    if(d(i,:) == 0)

        a(i-i1,:) = [];

        i1= i1+1;

    end

end


%padding zeros srounding the detected object array

d = padarray(a,[5 5]);


%Applying high pass Filter to restore the original image
```

```
    filter = [1, 1, 1; 1 -8 1; 1 1 1];

    output = imfilter(d, filter);

    %Marker Location Caluclation

    [rows_d, cols_d] = size(data);

    [rows_a, cols_a] = size(a);

    start = [rows_d- rows_a, cols_d - cols_a];

    end_a = [rows_a, cols_a];

end
```

EE253_Project.m

```
clear;

clc;

close all;

clear all;


% Creating The Video Object

v = VideoReader('Desktop111.wmv');


for i=1:25

%Starting the timer

tic;


%Reading the image fram to process the object detection

snap = read(v, i);

subplot(2,1,1);

imshow(snap);

title('Original Image');
```

```
%object Detection algorithm
[out, start_add, end_addr] = object_detect(snap);

%Marker location calculation
marker = [(start_add(1,2)+end_addr(1,2)/2), start_add(1,1) + end_addr(1,1)/2];

a = insertMarker(snap,round(marker));

subplot(2,1,2);
imshow(a);
title('Processed Image');

%creating the bounding box around the object
rectangle('Position',                              [start_add(1,2),start_add(1,1),
end_addr(1,2),end_addr(1,1)],'EdgeColor','r','LineWidth',2 );
fprintf('Time for one frame processing is %f Seconds\n', toc);

close all;
end
```

Conclusion

Object detection was achieved using adaptive thresholding during non-uniform illuminative conditions using MATLAB.

Future Expansions

- Multiple object detection.
- Hardware Acceleration using GPUs.

Applications

- Face Detection
- Automatic Target Detection in Guided Missiles
- Security Systems

References:

1. https://www.mathworks.com/discovery/object-detection.html

2. http://homepages.inf.ed.ac.uk/rbf/HIPR2/adpthrsh.htm