

A Hybrid Approach for Detection and Removal of Raindrops Using k-means Clustering and Hough Transformation

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Abstract

The vision system hired various tasks such as steering; information gathering can be unfavorably exaggerated by ruthless climate conditions such as rain, haze. Rainy weather condition raindrops twig to a frame glass can substantially abolish the scene visibility. Spotting and eliminating rain drops assist many computer visualization bids. To address this problem we introduced hybrid approach for raindrops detection and removal from video. In our approach we use K-means clustering, canny edge detector, Hough transformation and hybrid Otsu plus median filter for the effective reclamation of Rain drops from the video. We use Otsu algorithm at the detection phase and the median filter at the removal phase for fast retrieval of the raindrop from the image. Segmentation of image is perform by k-means clustering results in highest correct clustering rate. In detection process, we implement the Otsu algorithm and Hough transformation algorithm to know the exact location of the raindrop and edge detection is done by using canny edge detector. The detected region is filtered by using median filter method. The estimation of performance is done by using the parameters like accuracy and time.

Keywords: Canny Edge Detector; Image Segmentation; K-means Clustering; Median Filter; Otsu Algorithm; Raindrops Detection

Introduction

In rainy seasons raindrops probably stick to screens, protecting guards and camera lenses. Navigation, data collection and surveillance used outdoor vision system and opposed by bad climate situations such as flood, haze and snow. These sticky raindrops block and mislead some areas of the image and performances of many applications such as tracing, feature detection, audio correspondence that are tainted. A vision system where top-mounted vehicle sensor with no wipers is available and where a hand-held camera is used in such type of system this problem is occurred. Raindrops twig to a windscreen degrade the visibility of a scene. To address this problem, algorithm has been proposed which are k-means clustering, Hough transformation and OTSU to detect and remove the raindrops so that the system can be preprocessed and performance is enhanced. Otsu and median filter algorithm are applied for the fast retrieval of Rain droplets from the single image. The objective of our research is to propose a system which detect and remove the raindrops using K-

means clustering and Hough transformation. For that we are planning to implement K-means and hybrid Otsu plus median filter noise removal algorithm, so that image can be pre-processed and the performance is enhanced.

In research field many papers analyze the presence of raindrops from their local spatial-temporal derivatives. Identifying raindrops from image is very challenging because the raindrops have different shape. We are using the Hough circle transformation to know the exact location of the object and the OTSU algorithm is also help to find the position of it.

Unlike rainproof Objects, adherent raindrops are transparent, their appearance and thus depending on the environment the intensity values varies. They feel pain from blur to the camera due to their propinquity. Most raindrops generate dirty look. The paper consists of the detail information about raindrops detection and removal techniques, these are organized as follows. The proposed methodology of effective and accurate segmentation technique of rain drop recognition and elimination is described using K-Means clustering, Hough transformation, Otsu and median filter. Finally we analyze the result which depends on the best performing parameters and conclude.

Related work

In the literature, I refer a few papers the first one among them is raindrop recognition and elimination using k-means clustering which is proposed by Dr. S. Naganandini Sujatha. In the first approach author Ramesh Kanthan and Dr. S. Naganandini Sujatha proposed algorithm which is used to recognize the rain droplets using clustering and shape modelling of raindrops. In his work they used K-Means clustering and Median filter to retrieve rain droplets from image. This system is advantageous because it is profligate compared with other droplet recognition patterns. Limitation of this method is that K-Means Algorithm is used for clustering results in lower correct clustering rate [9]. In the second approach, the author Robby T. Tan [16] presented an involuntary method which requires input as single image. Method used by them require two basic clarifications: one among them is images with enhanced visibility have more contrast than images flabbergasted by bad weather; second, variations of air light hinge on the distance of objects from viewer, tends to be smooth. They develop a cost

function on observations in the Markov random field framework.

In the third approach, author Dereck D. Webster and toby presented the techniques which are applied for raindrop recognition in color imagery using feature descriptor. Author comprises shape; saliency and smoothness information isolated the overall scene context. But this method does not work with enhanced shape feature information and enhanced segmentation for detection of raindrop from image [17].The author Manu B. N proposed a new technique which effectively uses the L0 gradient minimization methodology to eradicate the raindrops. The minimization method can comprehensively control in what way many non-zero ascents are caused in the image. The method which is proposed by author is independent of local features but instead locates important edge universally. These methods remove raindrops successfully under dense rain circumstances while stabilizing the information of image [10].In this approach, the author Firas and Fawzi offered novel algorithm which is established on two in effect method to get hold of a substantial method to partition the color image into significant constituencies. They first apply the Otsu method for gray channel image, after that new modified image undergoes from some compassionate of falsehood. To solve this problem they use the median filter in the second phase [4].

Methodology

Proposed approach is shown in figure. The rain video dataset are implemented as input. The collected input images are subjected to pre-processing. In this step we have implemented the frame conversion, resize and YCBCR color transformation. To perform clustering input must be in gray scale form. To convert image into gray scale form YCBCR color space is used. YCBCR gives truthful gray constituent. It will use to restructure the imaginative RGB color image once raindrop detection and removal process is over. Then we perform the frame selection in this step, the single frame is selected from the number of frame. K-means clustering algorithm is used for image segmentation. The detection is performing after image segmentation, in detection process, we implement the Otsu and Hough transformation method to discover the raindrop and edge detection by canny edge detector. The detected region is filtered by using median filter method. After that we estimate the performance using the parameters like accuracy, sensitivity and time.

Otsu and median filter

Otsu is most popular and simple thresholding method. To escalation capabilities of Otsu method we have to use multidimensional material as a result noise can be controlled which is present in the image. Another way to increase its ability is to use multilevel thresholding as a replacement for of bi-level thresholding. So we can take out objects if images are more complex. Uses of

these two methodologies compromise different compensations, where real domain images commonly contain in cooperation types of image complications. In our paper, we use multidimensional information and multilevel thresholding together. Even though it require longer execution time but it can obtain acceptable segmentation result when it is applied to noisy images.

Median filter is used to remove noise from an image or signal. To improve the results of later processing reduction of noise is important pre-processing step. Median filter reserves edges while removing noise and it is generally used in digital image processing. Median filter run signal entry by entry, and substitute each entry with the median of neighbouring records. The window is called pattern of neighbours ", which slides, entry by entry, over the entire signal. For 1D signal, the most obvious window is just the first few preceding and following entries, whereas for 2D signals such as images, more complex window forms are possible. The median is simple to define if the window has an odd number of entries: median is the middle value after all the entries in the window are arrange in ascending order. There is more than one possible median for even number of entries. To calculate the median of each window widely held of computational energy and time is consumed. Because the median filter have to process single entry in the signal, for large images. It is critical to calculate the efficiency of median by defining how fast the algorithm can work. Naïve defined applications to sorts each and every entry in the window which is required to recognize median, selection of algorithms can be more in effect: in these cases, histogram medians can be far more efficient because it is simple to update the histogram from window to window, and finding the median of a histogram is not particularly time-consuming.

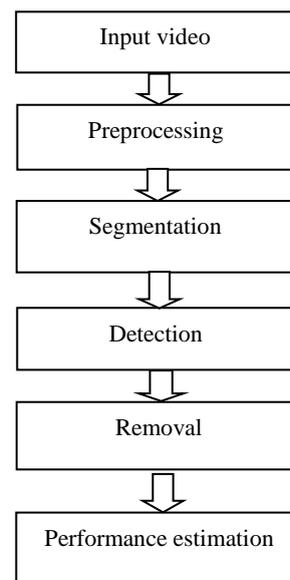


Fig. 1: Process Flow

k-means Clustering

K-means is algorithms make out the legendary clustering problem. It is easy to classify a given data set using K-means clustering into definite number of clusters. In this algorithm the k-center is to be determined for each data set. The unlike location causes the different domino effect due to that centres should be placed in a cunning way. The idea is to place center faraway from other center. After that we have to fit the points into a given dataset and equate it with nearby center. Then check for remaining data points. If there are no awaiting data points then our first step is completed. Next we have to re-calculate centroids as barycentre of the clusters and follow the same procedure. A new mandatory has to be done when we have these k new centroids flanked by the same data set points and immediate new center. Centres change their position in anticipation of no more changes are completed. This algorithm is used to diminish a square off blunder function.

Algorithm:

1. Randomly hand-picked center of cluster.
2. Calculate the distance between each data point and cluster center.
3. Allocate data point to center of cluster whose distance smallest from center of entire cluster center.
4. Use previous step to calculate new cluster center
5. Calculate the distance among data points and new-fangled group of center.
6. If relocation of data points are not occurring then stops, else repeat from step 3.

Hough Transformation

The Hough transform is used to split up the features within an image. Because wanted features must be definite in some parametric form is required. The standard Hough transform retains many applications despite its domain boundaries. This method is beneficial because it is even-tempered of slits in feature border representations and noise in image is unpretentious. Hough transform used to allow a feature to show of hands for a definite position, configuration or topping of the shape using already defined look-up table.

In Digital Image Processing Hough circle transform is basic technique which is used to identify circular objects. The circle Hough Transform is a feature extraction technique for spotting circles. The resolution of the technique is to find circles in deficient image inputs. The circle candidates are produced by “voting” in the Hough parameter space and then select the local maxima in a so-called accumulator matrix. The circle can be described by using following in a two-dimensional space

$$(xi - a^2) + (yi - b^2) = r^2 \tag{1}$$

Where (a, b) is the center of the circle, and r is the radius. If a 2D point (x, y) is fixed, then the constraints can be found according to (5).The parameter space would be three dimensional, (a, b, r). And all the constraints that satisfy (x, y) would lie on the surface of an inverted right-angled cone whose apex is at (x, y, 0). In the 3D space, the circle parameters can be recognized by the crossing of many conic surfaces that are defined by points on the 2D circle. This process can be divided into two stages. The first stage is fixing radius then find the optimal center of circles in a 2D parameter space. The second stage is to find the optimal radius in a one dimensional parameter space.

Algorithm:

1. Each A [a, b, r] = 0;
2. Convert the image to grayscale form, apply canny operator.
3. Choose all to be expected circles in accumulator.
4. Accumulator provides the circle Hough space.
5. The extreme chose circle of Accumulator gives the circle.



Fig.2: Raindrops

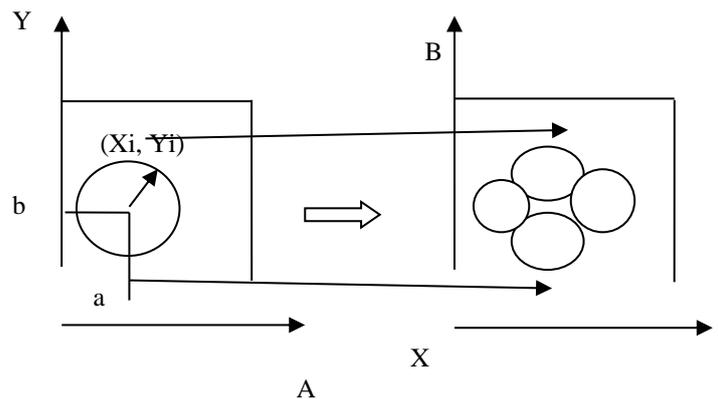


Fig. 3: Hough Circle Transform

Results and Discussion



Fig 4: Video frames

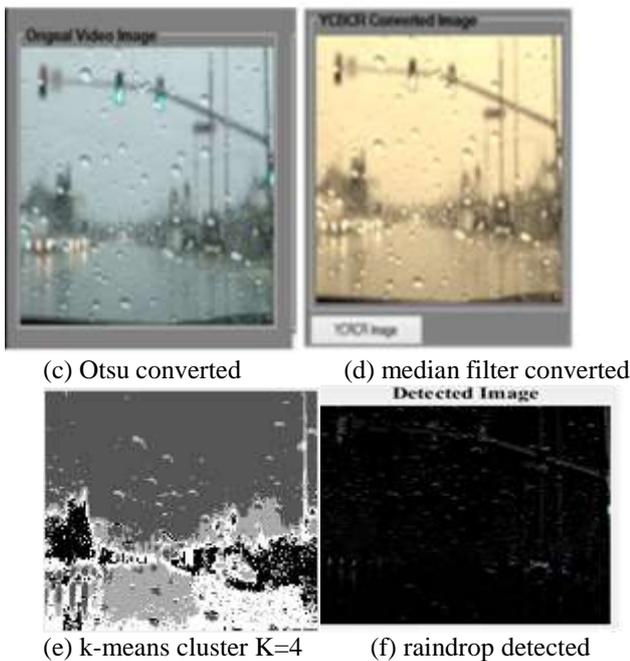


Fig 5: Results of Steps for Raindrop Detection

“Fig. 5”, shows the results that we have done until now. In our work we presented the techniques for raindrop detection and removal using k-means and Hough transformation. For experimental results we take the five frames and take one of the five frames randomly and start processing on them. “Fig. 4” shows the experimental results which contains original image, YCBCR converted image, Otsu converted image, median filter applied image, segmented image and raindrop detected image. Regions classifications are performed by K-Means clustering and detection of edges is done using the canny edge detector with the boundary information. Hough circle transform recognized the object boundaries. 2D Median filter is used to remove the raindrops with kernel size 3 is elaborated on the output image. It removes the raindrop with the hypothesis of the size has to be set 3×3 .

Conclusion

The developed algorithm is based on Otsu and median filter gives better result than existing approach. The k-means clustering algorithm results in highest correct

clustering rate. We implement the Otsu and Hough transformation to identify the raindrop in the image. A detected region filters by using median filter. The performance is estimated by using the parameters like accuracy, sensitivity, time.

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