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Efficient Human detection and tracking system in Videos using Fuzzy logic

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Abstract-To detect human in a video containing other moving objects like vehicles, animals, etc is a challenging task. This paper proposes a Fuzzy logic based algorithm to successfully detect human from background frames by designing a robust model. Human detection is an important step in applications like human centric surveillance, recognition of activity in restricted areas, people counting, person tracking and identification etc. Inaccurate detection of human in applications like this may lead to increase in the number of false alarm. The proposed method will work in both indoor and outdoor sequences .The method proposed consists of 4 main steps,Background subtraction to detect moving objects, Extraction of features, Feature Aggregation using FIS and Human detection.
Keywords-Motion detection,Background subtraction,Feature extraction,Fuzzy inference system,Human contour detection.

I. INTRODUCTION

Human detection in videos has been considered as an important matter of concern in the field of computer vision. There are many algorithms proposed for this purpose. In any algorithm, the first step is always to detect the moving objects from background frames. However, not all the moving objects are of importance to us, if it is a human surveillance system. In outdoor videos there may be many moving objects present apart from humans like animals, vehicles, etc. These moving objects need to be classified for successful detection of human because the system might fail due to non-human activities.

Thus, this paper presents a novel approach for human identification. This paper is summarized as follows. Section II explains the previous methods used for human detection. Section III gives the proposed method that is implemented. In Section IV, the algorithm and steps used have been discussed in brief with all the 4 steps explained in detail. Section V discusses the experimental results obtained by the method. Section VI gives the conclusion with future scope. Section VII shows the list of reference papers.

II. METHODOLOGY USED IN EXISTING TECHNOLOGIES

In 1ST method, fuzzy based logic is used and post processing of the video frames is not needed which reduces the complexity of the system. The method fails if there is any occlusion [1]. The other method is also fuzzy based classification scheme based on moving blob as a feature clue. The method fails to recognize if the objects are far away [2]. The third method is based on the shape features like compactness ,eclipse parameter, speed and direction of motion. Poor segmentation and low efficiency are the drawback of this system [3]. The other method is by using a Fourier descriptor followed by ANN and SVM. The method is invariant to geometric transformation and has a good noise tolerance The optimal number of FD has to be selected first because then the system might become too specific for an application [4]. The other method is based on the HSV histogram which is a robust colour based model. The method uses a pre-processing filter for reducing the shadow effect. The method yields good result in low light condition but fails when the foreground and background colours are same [5].

III. PROPOSED METHOD

We propose a system in which a human can be tracked efficiently using fuzzy based rule.FPV Claro TV is used to capture the video frames continuously and the obtained frames are further processed using MATLAB. Using background subtraction method the foreground objects are recognized from the background frames. Different features are calculated and are aggregated using

Fuzzy Inference System [FIS].The FIS gives a single value vector based on the extracted features. These values are used to distinguish human from other detected foreground objects. The 4 steps used in proposed method are:

1.Background Subtraction using Fuzzy algorithm
2.Feature Extraction of detected moving objects
3.Feature aggregation using FIS
4.Human detection

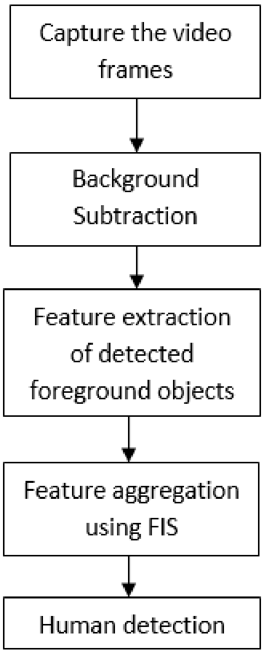


Figure 1 .Flowchart

Figure 2. FPV Claro TV

IV.ALGORITHM AND STEPS

3.1 Motion Detection

A fixed camera is used to acquire the video frames. From the acquired frames a background model is formulated for different conditions .The different foreground objects are detected using background subtraction .The moving objects are extracted by detecting their motion in the video.Many algorithms used for background subtraction use gray scale model that requires converting the RGB video frames into gray images which may lead to loss of necessary information .Hence, in our method we directly use colour images to easily distinguish between foreground and background objects .The main advantage of using colour images is that the colour of any object is invariant to changes in brightness level. Based on the RGB values of the image a fuzzy rule based algorithm model is designed having 27 different rules.Using these 27 rules the fuzzified pixel value is obtained. This model helps us to easily obtain the moving objects from the background frames.

Low Green

Red \ Blue	L	M	H
L	VL	L	M
M	L	M	M
H	L	M	H

Med Green

Red \ Blue	L	M	H
L	L	L	M
M	L	M	M
H	M	M	H

High Green

Red \ Blue	L	M	H
L	L	M	H
M	M	M	H
H	H	H	VH

Figure 3. Fuzzy rule for Background subtraction

Figure 4. Silhouette after background subtraction

3.2 Feature Extraction

After detecting the moving objects their contour is generated using simple edge detection algorithm.The silhouette obtained is binary so that change in texture of clothes doesn't affect the silhouette .The next step is to calculate the three features one by one of all the contours detected.

3.2.1 Centroid Feature

First all the points of single contours are separately stored in an array. The y coordinate of the centroid is calculated after finding the leftmost and the rightmost pixel of the contour. The x coordinate of the contour is found after finding the topmost and bottom-most pixel of the contour. Then the distance of every third point of the contour from the centroid is calculated. This feature extraction method is explained below.

Centroid(Xc,Yc)= {(x1-x2)/2,(y1-y2)/2 **(1)**

- Where x1 and x2 are the topmost and bottom-most pixel of the contour and y1 and y2 are the leftmost and rightmost pixel of the contour.

Distance(D)=sqrt[(Xc-Xi)^2+(Yc-Yi)^2] **(2)**

- Where Xc and Yc are the x and y coordinates of the centroid and Xi and Yi are the x and y coordinates of the i[th]pixel of the contour.
- All the distance values are stored in a one dimensional array

P={D1,D2,D3,………..Dn} **(3)**

3.2.2 Angle Vector Feature

To find the angle of a point with the centroid ,every third point of the contour is taken and its distance is calculated from the centroid using distance formula. Now the distance of the next point of the contour from the centroid is found out and finally the distance between the two adjacent points is found . Using these three distances the angle of the concerned point is found by applying cosine rule. This method is explained below.

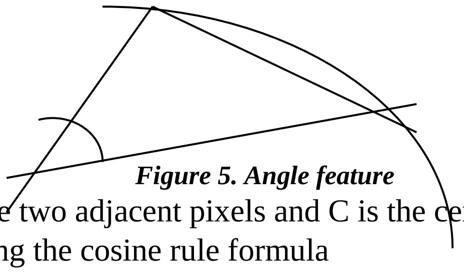


Figure 5. Angle feature

- Where A and B are the two adjacent pixels and C is the centroid
- The angle is found using the cosine rule formula

ang=acos((d1^2+d2^2-d3^2)/(2*d1*d2)) **(4)**

- The angles of the points are stored in a one dimensional array.

Q={ang1,ang2,ang3,……….ang(n)} **(5)**

3.2.3 Ratio of Chord to Arc

This is the third feature which is to find the ratio of length of chord joining two adjacent points and the length of arc joining the points. The length of the chord is nothing but d3 which is found already and the length of arc is found using the formula.

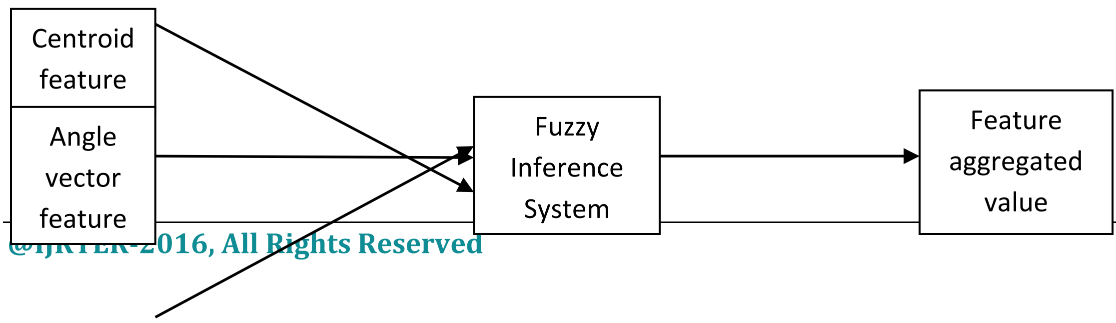
S=d4*ang

- Where d4 is the average of d1 and d2.
  d4=(d1+d2)/2
- Now the ratio of chord to arc is taken
  R=d3/S
- All the ratios found are stored in a single one dimensional array

T={R1,R2,R3,…………..Rn}

3.3 Feature aggregation using FIS

An FIS is used for feature aggregation of the features extracted from the image. All the three features namely centroid feature, angle vector feature and ratio of chord to arc are given as input to the FIS system. All three features have same vector length and hence each vector values are given to the input of the FIS. The output of the FIS system is a single aggregated value based on the rules defined in the FIS system.The Fuzzy based rule system in FIS has many fuzzy rules in it.After feature aggregation we get a single value which is then used for human detection.



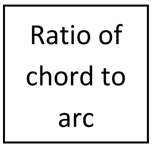


Figure 6. FIS system for feature aggregation

3.4 Human Detection

We apply the above steps to different human postures and also other moving objects like different animals and vehicles. After that the values obtained in all the three features and after aggregation of features are studied in detail. Based on the study a set of fuzzy rule is defined to successfully detect human being from the input video and reject all the other moving contours. Thus, by doing this the extra time required to create a database of different moving objects and then comparison of each moving contour with the database is saved. Human is detected successfully. After successful detection of human everything else present in the foreground of the image is rejected and considered as background and only human is tracked by encapsulating it in a blue box.

V. EXPERIMENTAL RESULTS

After fixing the camera at a particular location the first few frames were acquired and considered as background. Then continuosly the frames were extracted from the video and processed. For testing purpose 20 video frames were taken containing different moving objects like human, animals and vehicles. The videos were taken by using FPV Claro TV camera. The results obtained were promising as human was detected at a high rate even in the presence of other moving objects. The proposed method removes shadows and also takes care of the occlusion problem which might trigger false alarms.

VI. CONCLUSION AND FUTURE SCOPE

In this method an efficient background subtraction algorithm was formulated using fuzzy logic to successfully detect motion in the video. Also unique features were extracted so as to distinguish human and other moving objects easily. No database was created for the algorithm which is one of the highlights of the proposed method. This not only makes our method different but also faster than the other methods used previously. Though the method doesn't work efficiently when the number of objects increase in the video. In future work there is scope for improvement on both algorithmic and experimental aspects of the method.

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