# A smart target detection system using Fuzzy Logic and Background Subtraction

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**Abstract -** *In the proposed system, fuzzy logic has been used to model a robust Background Subtraction method for object detection. We first separate the background from the input static video using fuzzy logic. For this, the first few frames of the input video are used as a template for the background. After this, the objects in motion are identified and then, whether the moving object is a car or human is inferred based on the aspect ratio of the moving object. We implement target detection in static videos using background subtraction and fuzzy logic. In this project, we are using humans and cars as our targets. We first identify our targets - cars/bikes and/or humans if they are present in the video and then discriminate between the two to show accuracy i.e. whether the system can differentiate between cars/bikes and human. Thus, target detection as well as identification can be implemented using the proposed system.*

***Key Words***: Detection, Background Subtraction, Fuzzy Inference System, Fuzzy Logic, Background Modeling, Moving Object Detection, Aspect Ratio.

## 1. INTRODUCTION

### 1.1 About Target Detection and our System

Target detection has become increasingly important with respect to various security applications like bank surveillance, traffic surveillance, and residential area surveillance to check for intruders, etc.

Target detection has many applications apart from the security perspective but we chose to exploit its uses for security related applications like surveillance and remote monitoring, because it a crucial need of the present society where bank robberies, residential thefts, illegal hunting, industrial espionage, etc. are rampant.

Target detection in images and videos involves image processing. Various image processing techniques such as denoising, edge detection, background elimination and many others come into play when target detection in videos and images is to be performed.

The requirement of all these techniques makes target detection a bit complicated to implement for mediocre developers and even if a successful implementation is found, the speed of execution is an issue of concern. Since the complex image processing operations take an acceptably large amount of time to be performed, software's which are robust to the complexities of image processing and at the same time meet the "instant result" criterion of today's users , are the need of the present scenario.

We present a novel approach to detect targets in static videos using Fuzzy Logic and Background Subtraction. The intricacies of the proposed system will make it clear that we have wisely exploited the nature of surveillance applications. We are working only with humans and cars as our targets, but animals, or other immobile objects can also be used in place or in conjunction with humans and cars.

### 1.2 Overview of our Target Detection System

As is seen the architecture, first a video is given as input to our system. The video may be captured through a live camera or it may be an already recorded static video.

First, the frames are extracted from the video using a suitable frame extracting software. Denoising techniques are then applied to the frames to reduce blurring. This helps in accurate pixel intensity calculation so that there is little confusion in classification of pixels in the later stages.

Then, RGB (Red Green Blue) values of each pixel are through RGB channel separation.

The first N frames of the video are used as a template for background modeling. The larger the value of 'N', the more accurate will be the classification of background pixels. The redundancy of the intensities of the pixels in the 'N' frames is captured and it is used as a model for the background. But the major requirement here is that the target object should not be present in the first 'N' frames that we have chosen for background modeling. The background model is prepared by applying fuzzy logic on the RGB values obtained. The output after applying fuzzy logic on the pixel intensities is a fuzzified value for each pixel. We can then set thresholds

based on the fuzzified values for classifying each pixel as background or foreground one.

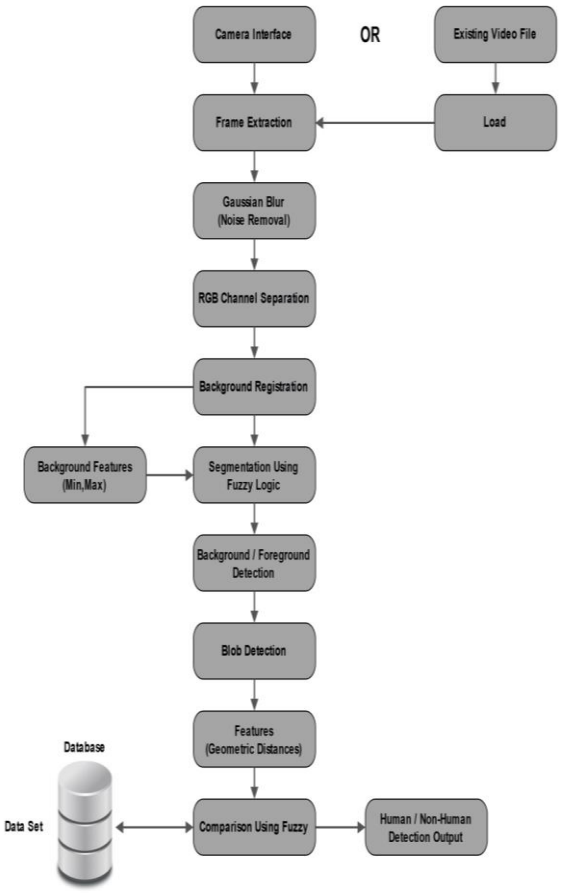


Fig.1.2 Proposed System Architecture

Once the background model is prepared, the subsequent frames are assessed for performing background subtraction. This is done by again performing fuzzification on the pixels in the frames, then comparing the fuzzified values with the threshold values set during the background modeling stage. This will be explained in detail in section

After the background is subtracted, the moving objects are detected in the foreground. Initially, after background elimination, only the silhouettes of the moving objects are obtained. The aspect ratio of the silhouettes is calculated by drawing a rectangular blob around the silhouettes i.e. the aspect ratio is the ratio of width of the rectangle to the height of the rectangle. If the aspect ratio is less than 1, the target is identified as human, otherwise it is assumed to be a car. The thresholds to be referred for car and human classification are also specified as there can be moving objects other than cars or humans too in the video like street dogs, cats, etc.

Thus, our targets are detected successfully. However, there are certain limitations of our application.

## 2. Limitations

2.1 Challenges to Smart Eye : If there is not enough contrast between the background and foreground, or between the target and background, our application cannot separate the background and detect those targets. Ex. If The human is wearing clothes of those colors which match some part of the background, there are chances that the human may not be detected successfully. This is the only glitch in our application as of now.

2.2 Requirements to be satisfied by the input videos :

1. The input videos must be of a high resolution.
2. There should be enough contrast between the foreground and background.
3. The videos must be shot by a stationary camera i.e. the position of the camera should remain constant throughout the video shoot.
4. The target should appear after 3 seconds at least after the start of the video.

2.3 Use of Fuzzy Logic in our system :

Fuzzy Logic is based on “degrees of truth” which can lie between 0 and 1 as opposed to Boolean Logic, in which only two distinct values are used 0and 1.

## 3. CONCLUSIONS

We have implemented a smart target detection system using fuzzy logic and background subtraction. Our system can detect targets accurately given that contrast is maintained between the target and background. This works well for static as well as real videos being shot by a live camera. Background separation using fuzzy logic is a robust and new method to detect targets .The only limitation being the requirement of contrast between background and intensity difference.

## 4. Future scope

1. We have used static videos for target detection. Our system can also be used to detect targets in live videos being captured by live camera. This has application in traffic surveillance, detect hunters and keep track of endangered animals in wildlife sanctuaries.
2. An android app can be built which will show the alerts generated by our target detection system on mobile phones this way, remote monitoring is possible The alert is generated when a forbidden target is detected in the input e.g. humans in a no entry server room

3. Advanced feature extraction methods can be applied to detect targets of myriad categories. E.g. immobile things like call phones, laptops, etc.

## 5. ACKNOWLEDGEMENT

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