International Journal Of Interactive Digital Media, Vol. 4(3), ISSN 2289-4098, e-ISSN 2289-4101
www.ijidm.org


# Masking Object for Extracting Moving Object in Hazy and Foggy Weather

Asniyani Nur Haidar Abdullah, Sarudin Kari, and Mohd Shafry Mohd Rahim

**Abstract**— Haze and fog has long been controversial topic, hampered in part by scattering air light and dense of the haze that prevents direct light to the camera. With the problem, over segmentation, detect false positive object and over detection will occurs during video processing. In this research, a new enhancement method is introduced to improve background modelling during haze and fog weather so that the accuracy rate of segmentation is higher in extraction and detection of moving object. The new enhancement method is extended from Gaussian Mixture Model (GMM). The aim of the development of background and foreground modelling is to deal with hampered in part by scattering air light and direct attenuation that can influence the whiteness of the image that would led to over segmentation and decrease the accuracy of detection.

**Index Terms**— Extraction, Moving Object, Haze, Fog, Video Processing.

## 1 INTRODUCTION

Active development in digital technologies led to a renewed interest in images and video processing. For instance, image and video analysis, detection, recognition and understanding are important research directions that can be explored. Image and video processing suffer from the effect of bad weather such as fog, haze, rain and snow, where it can degrade the performance of the computer vision. Computer vision is hampered in part by the scattering of light by suspended particles in the air. The resultant effects are light scattering known as airlight [1, 2] and light attenuation reaching the human visual system. Airlight increases the overall whiteness of the scene view, whilst light attenuation will decrease contrast of the images.

In order to identify moving objects in a video sequence, a few steps are needed to isolate the objects from the background, known as segmentation [3]. The initial step is to split an image into two complimentary set of pixels, known as the foreground and background pixels. Haze and fog degrades the view scene and be considered as noise. Hence it is difficult to detect moving objects in the foreground pixels due to the effect of airlight and contrast reduction which literally blends the scene into the background pixel. Therefore, it is important to find the best way to detect, classify and track an object in adverse weather.

Detection of moving object is to identify objects of interest in the video sequence and region surrounding the object's pixels. Improvement to the separation process between the object and the haze needs to be done and not over segmenting it. Subsequently, the object will be grouped into predetermine classes, such as cars, peoples and other miscellaneous objects. Finally, the object is tracked by approximating its movement and path in the image plane as it moves around the scene [4].

Section two will present previous works on segmentation in hazy and foggy environment. Section three will discuss the approaches to improve segmentation of moving objects surrounded within hazy and foggy environment. Section four shows some preliminary experiment results. Finally, we conclude our paper with future research steps which will be taken to improve the result.

- *F.A. Author is with the UTM VicubeLab, Universiti Teknologi Malaysia, Malaysia, Johore 81310. E-mail: asniyaninh.ab@ gmail.com*
- *S.B Author is with the Department Informatic, Universiti Teknologi Malaysia, Johore 81310. E-mail: sarudin@utm.my.*
- *T.C. Author is with the UTM VicubeLab, Universiti Teknologi Malaysia, Malaysia, Johore 81310. E-mail: shafry@ utm.my*

## 2 PREVIOUS WORKS

Some Some of the researcher uses many techniques to improve the contrast colour of the image. Dong et. al uses two-step technique to separate the moving object from the background, namely Dark Channel Prior (DCP) followed by background subtraction [5]. In this approach, over segmentation and speed of the detection can be further improved. In the method proposed by Gangodkar et. al, object detection in foggy and hazy environment is good and capable of avoiding false positive problem [6]. Unfortunately, this method cannot work on multiple moving objects and has the tendency to over segment. Yuk and Wong [7], uses Foreground Decremental Preconditioned Conjugate Gradient (FDPCG) and Foreground Incremental Preconditioned Conjugate Gradient (FIPCG) with DCP to segment moving objects. Nevertheless, this method performs poorly in occlusion detection and also inclines to over segmentation.

For noisy images, the methods proposed by [8, 9] cannot deal with over segmentation and inclines to over detection of moving object due to low quality of the images. On the other hand, Zubair et. al technique can overcome over-segmentation but still cannot totally eliminate the noise around the objects [10]. Ma et. al uses background subtraction to segment of the moving objects, yet still have to deal with over segmentation even though

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it can detect the objects [11]. Nonetheless, certain object cannot be detected easily due to edge problem. To alleviate the previous problem, Laugraud et. al improves the background subtraction method, which is able detect moving object with 63% accuracy [12]. Unfortunately, this method still suffers from time ordering and updating mechanism.

Shadow region is another issue in object segmentation which can be adequately surmounted in [13]. Nevertheless, the problem of over segmentation in bad weather still prevails. Another object segmentation technique which incorporates false positive detection was proposed by Amaluddin et. al [14], but nevertheless fails for high intensity images. Based on the reviews above, we can conclude that over segmentation and false positive detection occurring in foggy and hazy environment can be further improved. The suggested method was explained in section 3.

## 3 APPROACH

Our method uses a combination of multiple filter-based techniques to produce superior result. We adapted the method of Stauffer and Grimson [15] by incorporating the average filter and median filter for clustering moving objects' pixels and object extraction filters. The Gaussian Mixture Model (GMM) is an excellent method that can adapt to input images with variety of noises. Consequently, this means that the GMM has the ability to update the foreground pixels with new distribution values. Nevertheless the variation of fog and haze particles across frames will render GMM incapable to sharply estimate the object and background. The median filter allows GMM to update new pixel distribution to estimate the objects' and background pixels even though the objects are missing temporarily due to obscuration by the haze or fog. Subsequently, the average filter will assist the median filter during object pixel estimation in order to avoid over segmentation. For or extracting the connected components of the moving object, the Gaussian and Morphology filter is applied to the image. The combination of filtescan help to build structuring element of pixel object and eliminate noise of the images. To obtain the centroid of the object, blob analysis and bounding box techniques are applied to the pixel values. This is done in order to extract the connected component of the moving object despite the noise around the edge pixels. Finally, the Kalman Filter is applied to track and obtain the path of moving objects over time.

### 3.1 Background Modelling

Depth map of the background suffers from noise, fog and haze.

$$B\beta_0 = arg_{b+\beta_0} \min \left\{ \sum_{j=1}^{B+\beta_0} w_j > T \right\} \quad (3.1)$$

Where B is the background distribution for estimation background and $T$ is the value of the thresholding. A match is defined as a pixel value within 2.5 standard deviations of a distribution. If none of the K Distribution match the current pixel value, the least probable distribution go out. So, a new distribution with the current pixel as it mean value, an initially high variance and low prior weight is enter. The prior weight of the K distribution at times,$t$ is measured:

$$w_{k,t} = (1-\alpha)w_{k,t-1} + \alpha\left(M_{k,t}\right) \quad (3.2)$$

Where $\alpha$ is the learning rate and M_(k,t) is the match value either 1 or 0. Value of mean and variance that are unmatched remain the same and vise versa.

$$P\left(I_t\right)\beta_0 = \sum_{i=1}^{k} \omega_{i,t}\, G\left(I_t, \mu_{i,t}, \sigma_{i,t}\right)\beta_0 \quad (3.3)$$

Mathematically, haze and fog bring noise and higher intensity to the background pixel and foreground pixel. During the moving of object, chromatically different from the expected values in the background, but suffer from haze and fog weather. Then combination for Median and Average filter was applied to reduce the challenging in estimation moving objects.

First, median filter and average filter using 5X5 matrix to the centered of the pixel. Median Filter will sort all the pixel's object to cluster pixel object and finally average filter take place to go through row by column of the image to obtain all pixel's object that are missing. Nevertheless, pixel's object suffers from noise during cluster pixel's object. The equation is

$$f_{ij} = g_{ij} + w_{kl} + e_{ij}\ \boldsymbol{for}\ i,j = 1,\ldots,n \quad (3.4)$$

### 3.1 Extraction Moving Object

New formulation shows that, the object pixel still facing noise in the pixel image, e_ij. So, to overcome detection false positive object, Gaussian and Morphology filter are combined with Blob analysis and bounding box to calculate the exact center point of moving object during extraction of moving object. For eliminate noise, e_ij, Gaussian Filter was used and follow by morphology filter to build structuring element of pixel's object. Weight are calculated to make sure that e_ij to reduce noise and help to form structuring element of the object. Blob analysis and bounding box help to measure centroid of the pixel of so that the value of centroid can applied to Kalman Filter to track and obtain the path of moving objects over time. time.

## 4 RESULTS

Seven sets of video data were used in the experiments to evaluate the accuracy of the segmentation method. We compare our proposed method specifically with Amaluddin et. al [15] in the experiments, since both methods uses GMM technique. However, there are distinct differences between the two methods:

1. Median Filter and Average Filter were used in background modelling to harmonised the scene different intensities, hence making the proposed method adaptable

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to the scene better than GMM;

2. Gaussian Filter and Morphology Filter are combined with Blob Analysis to better extract the moving objects, thus reducing the objects' over detection

3. The Bounding Box technique is used to measure size of the pixels area and thus locating the image centroid

4. Kalman Filter is used to track the location of the objects over intervals using the pixel value from the centroid.

**(a)**

**Fig1** Segmentation object at 65 frame per second from Karlsure Data Set in fog environment.

**(b)**

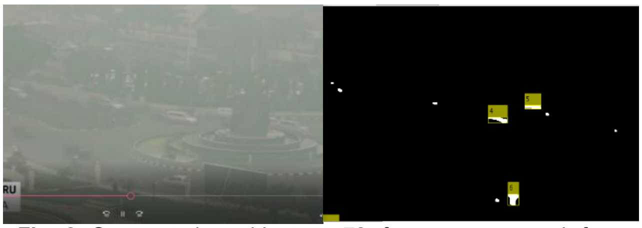

**Fig 2** Segmentation object at 72 frame per second from *Youtube* Data Set in Haze environment.

Table 1 Comparisons of the proposed Object of Interest Movement (OIM) and (Fitroh Amaluddin M. Aziz Muslim, & Agus Naba, 2015)

| Dataset | (Fitroh Amaluddin M. Aziz Muslim, & Agus Naba, 2015) | Purposed Method |
|---|---|---|
| **Fog** | 62.03% | 72.24% |
| **Haze** | 40.91% | 76.73% |

The Median and Average Filter can update new pixel values of the image and help to cluster objects' pixels despite the different region at the background. Afterwards, the combination of Gaussian and Morphology Filters are used to assist Blob Analysis to extract the objects' pixels. In other words, Gaussian and Morphology Filter support Blob Analysis to enhance the intensity around the objects' pixels cluster and help to fill the hole in order to get a substantial complete shape. Additionally, Blob Analysis and Bounding Box works in tandem to calculate the centroid of the object. Finally, Kalman Filter helps to find the moving objects for the next frame and converted all the identified moving objects into mask by using thresholding method.

## 4 Conclusion

In conclusion, we have proposed a technique named Object of Interest Movement (OIM) to extract moving objects in foggy and hazy weather using a combination of filters. The technique is used to enhance the background and foreground pixels and fill the holes in the region shape. The experimental results show that the proposed method can effectively extract the moving region. Additionally, the accuracy of objects counting can be significantly improved, and the time efficiency can meet the requirement of real- time processing.

In future work, we will improve the quality of the technique especially in the aspects of adaptability and flexibility. We will conduct further research on heavy fog and hazy weather that turned the natural colour of the environment into yellowish colour.

## Acknowledgment

The authors wish to thank Ministry if Eduction (MOE) and Research Management Centre (RMC) providing financial support of this research. This work was supported in part by a grant from University Grant Scheme (GUP); vot number Q.K130000.2538.11H68.

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**F.A. Author** obtained her bachelor degree in Software Graphic and Multimedia from Universiti Teknologi Malaysia, Johor Bahru. Currently; she is a Masters student at the Faculty of Computing, Universiti Teknologi Malaysia. She is a member of VCube group at, Faculty of Computing, Universiti Teknologi Malaysia. Her research interests include image processing, real time tracking and computer vision.

**T.C Author** obtained his his degree in Computer Science & Microprocessor System in Essex University, United Kingdom and Advanced Diploma at University of East Anglia, United Kingdom. He continued his master's degree in Computer Science at Universiti Teknologi Malaysia. His research interests include electronic, drone, marker-less augmented reality, real time interaction and human motion detection.

**S.B. Author** received his BSc in Computer Science from Universiti Teknologi Malaysia, Johor Bahru and MSc in Science Computer from from Universiti Teknologi Malaysia, Johor Bahru. He received his PhD in Spatial Modelling from University Putra Malaysia, Malaysia. He had been working in Universiti Teknologi Malaysia as a lecturer. He is currently a Senior Lecturer at the Falculty of Computing, Universiti Teknology Malaysia. His research interests include image and video processing, virtual reality, augmented reality, virtual manufacturing and robotics.

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