IJARCCE

ISSN (Online) 2278-1021
ISSN (Print) 2319 5940

International Journal of Advanced Research in Computer and Communication Engineering
ISO 3297:2007 Certified
Vol. 7, Issue 5, May 2018

Segmentation of Moving Object in Video for Smart Surveillance

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Abstract: The moving object detection deals with the detection of moving object in terms of moving person, vehicle, animal etc. It identify and detects the moving object and avoids the background challenges such as motion of the background, illumination variation etc. Such kind of work can be applicable in many useful for real-time computer vision applications like indoor-outdoor visual surveillance security systems, robotics, driver assistance system, traffic analysis, vehicle counting, navy, defence, army, target based object identification and surveillance of restricted zone. In this research work, the proposed method detects the moving person and handles the problem of background motion and illumination variation. It shows how a system can be developed by means of controlling the variance and standard deviation based threshold value. The proposed automatic threshold is used to trade-off with the difference between background and foreground pixel. It generates effective and appropriate threshold value for each pixel classification. It also classifies the moving pixels more accurately and improves the detection quality. The proposed work shows a significant improvement in the results of all considered video sequences and also compared with peer method i.e. DECOLOR. It presents the strength by eliminating various environmental and illumination effects.

Keywords: Background Subtraction Algorithm, Real Time, MATLAB.

INTRODUCTION

In real time, the detection of moving object or target based moving object detection is very crucial area of research in computer vision [1, 2]. It can be applied in various applications [1, 3, 4, 5] like indoor outdoor surveillance, target detection, traffic monitoring, traffic analysis, activity analysis, abandoned object detection, logo or packaging detection in packaging industry etc. It can also be applied in defence, army, port, coastal area, underwater surveillance *etc*. A very popular approach called background subtraction [3, 4, 6, 7, 8] is used for moving object is detection. Various researchers has extract foreground object by modelling of background and then using background subtraction they classify pixels as part of background or foreground.

Most method used for moving object detection in video frames are based on a simple idea focused on surveillance applications that using stationary camera, the disparity of background model pixel and corresponding pixel belonging to current frame is mainly indicative of foreground object. The idea behind this concept [1, 7, 8] is that no prior information is required to classify the state of a pixel as foreground object, their difference and suitable threshold is enough to classify the pixel state as foreground object.

In these applications, main goal is to detect the changes between consecutive frames. In background subtraction, one frame is considered as background frame or modelled background frame, also called training frame and other frame is test frame. The difference of these frames detects the changes. Using a suitable threshold value, a pixel is identified as part of foreground or background.

MAJOR CHALLENGES AND ISSUES

Apart from the above principles, in real time system there is problem of motion, illumination variation in real scene. In literature, T. Bouwmans [3], Toyama *et.al.* [10], change detection [11] have discussed various challenges available, and these crucial challenging issues are given as:

- Availability of noise in the image due to web cam or any transformation.
- **Camouflage**: A foreground pixel's characteristic is subsumed by background pixel. This causes difficult to distinguish between background and foreground.

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- **Bootstrapping**: In some cases, background frames are not available, and then it is very difficult to model the background.
- **Illumination variation**: In many indoor-outdoor surveillance applications, illumination changes gradually or sudden, which causes various false detection present in detection process.
- **Foreground aperture**: The foreground region has uniform colored region and changes inside the foreground region caused by various illumination or motion issues, the possibility of false negative increases.
- **Motion in background**: Due to dynamic nature of background like moving tree leaves, spouting or floating water or moving banner of flag in background, detects many false positive pixels.

MOTIVATION

Since last some couple of years, based on available literature on background subtraction technique, now a days the background is not static, because of the motion in background, illumination change in background scene, recording is taken by handheld devices (mobile or camera) or various videos are taken from internet. The ideal background subtraction work on the following basic principle:

- Camera is in static position.
- Variation caused by illumination is constant.
- Background scene is static.

But, in real life, background is not static, it is dynamic due to various issues discussed in challenges and issues section. Therefore, according to literature, the video frame can be divided into three parts:

- Background: Part of static scene which is also visible.
- Artifacts: Changes in the image scene due to shadow, environmental changes, sudden or gradual change in light and cloud covers the sun.
- Object: Interesting portion of scene i.e. pedestrian, vehicle or any motion based real object.

The development of an effective method that deals with dynamic background or illumination changes in video frames is still open and challenging problem of computer vision. Another feature of background subtraction approach is modelling of background is again a challenging and open issue of the above mentioned research area. Therefore, to develop a robust method that could be applicable in real-time based problematic video scenes is required whose execution time is less and having low memory requirement. Apart from above problems, still there are following other issues [1, 3]:

- Lack of a common moving object detection framework.
- Lack of significant scientific progress.
- Absence of single realistic large scale dataset.

FLOW CHART

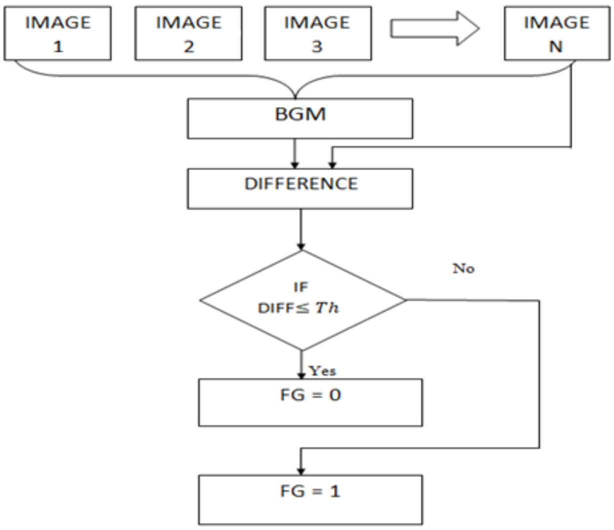

Fig. 1: Flowchart

IJARCCE

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EXPERIMENTAL SETUP AND RESULT ANALYSIS

In this research work, it describes the experimental work in terms of qualitative and quantitative analysis. It also proposed a comparative analysis of proposed method and DECOLOR method. and also explored about benefits and limitations of the proposed work. The experimental section depicts the efficacy of our work and proposed simulation results has been carried out on various publicly available video datasets as given below.

1. Microsoft's Wallflower Dataset
2. I2R Dataset

These datasets consist of problematic real-time video sequences. Due to issues of multi- background, it is very critical task. All implementation, experimental analysis work have been carried out on MATLAB 2017a and Windows 8.1 operating system having hardware configuration of Intel (R) Core (TM) i5 processor with CPU 1.70 GHz speed. This work has applied on gray format of each pixel and uses a frame processing technique, where a single frame is processed at a time then next frame will be processed. This model presents a shape based silhouette of moving object. This method is mainly used for predicting moving object that represent the shape of motion in video frames.

Table 1: Description of frame sequences: row-wise

Dataset	Sequences	Frame size	Frame type	Availability of required no. of background frame
Microsoft's Wallflower	Camouflage	160x120	Color	Yes
Microsoft's Wallflower	Foreground Aperture	160x120	Color	Yes
Microsoft's Wallflower	Waving Trees	160x120	Color	Yes
I2R	Water Surface	160x128	Color	Yes

QUALITATIVE RESULTS

The proposed model shows a significant improvement in the results of all sequences. It presents the strength by eliminating various environmental and illumination effects. The visual results show that the proposed method outperforms as compared to the considered peer method (DECOLOR) in the terms of qualitative analysis as depicted in following Table.

Table 2: (a) Qualitative results of I2R dataset's water surface frame sequence.

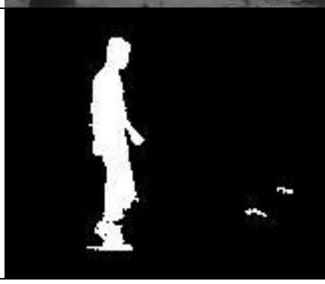
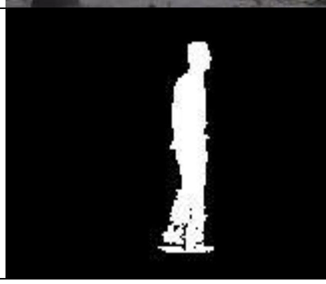
I2R Dataset: Water Surface Frame Sequence			
Frame Number	Frame 1487	Frame 1502	Frame 1527
Original Frame			
Proposed Output			

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Table 2: (b) Qualitative results of I2R dataset's water surface frame sequence.

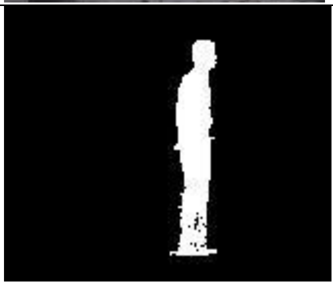
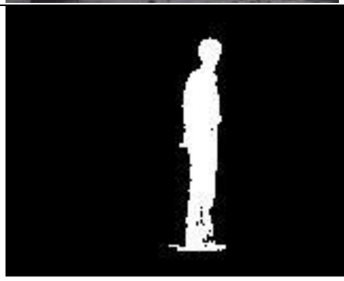
Frame Number	Frame 1530	Frame 1535	Frame 1542
Original Frame			
Proposed Output			

Table 2: (c) Qualitative results of I2R dataset's water surface frame sequence.

Frame Number	Frame 1551	Frame 1557	Frame 1561
Original Frame			
Proposed Output			

Table 2 (a),(b) and (c) shows the qualitative results of Water Surface frame sequence. In these tables, some frames are shown which clearly depicts the visual results in terms of qualitative analysis.

Similarly, Table 3 shows the visual results of proposed method and DECOLOR method over Microsoft's Wallflower dataset and I2R's Water Surface dataset. First column of table 2 represents frame number of considered sequence. Second column shows the original frame and third frame represents the ground truth of considered sequence and given by dataset community. Fourth column consists of DECOLOR results and last column represents the proposed results of each considered frame sequence. As per visual observation, the DECOLOR results are having poor detection quality whereas the detection quality of proposed method is better against the considered peer method. These visual observations are also available in the table 3 as given below. It consists both methods i.e. DECOLOR method and proposed method.

 DOI 10.17148/IJARCCE.2018.7556

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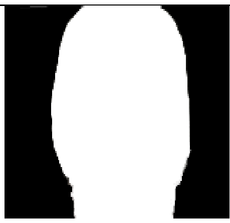
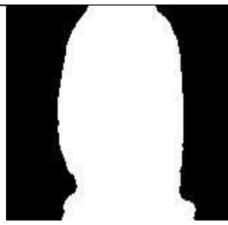
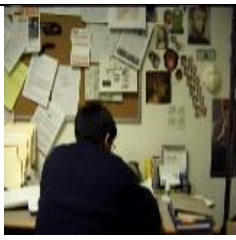
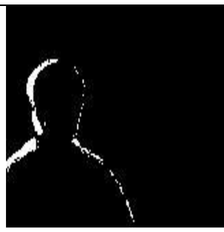
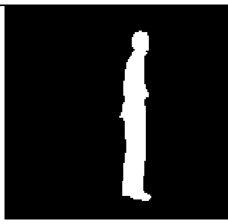
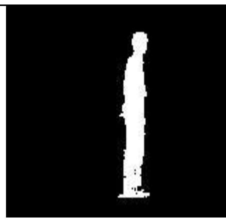
Table 3: Qualitative results of Wallflower and Water Surface frame sequences

Frame Sequence	Original Frame	Ground Truth	DECOLOR	Proposed
Waving Trees (Frame No. 247)				
Camouflage (Frame No. 251)				
Foreground Aperture (Frame No. 489)				
Water Surface (Frame No. 1547)				

QUANTITATIVE ANALYSIS

This quantitative measurement and analysis section measures the performance for the following parameters.

1. Error measurement
2. Precision-recall
3. F-Measure
4. Accuracy
5. Running Time

ERROR MEASUREMENT

The error measurement can be summarized using the following parameters.

- False negative (FN) error is the number of false negative error,
- False positive (FP) error is the number of false positive error,
- TPR is the true positive rate,
- FPR is the false positive rate respectively.

The following indexes are used for total error analysis shown below.

$$FP\_Error = \frac{FP * 100}{row \times column} \quad (1)$$

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$$FN\_Error = \frac{FN * 100}{row \times column} \quad (2)$$

$$Total\_Error = FP\_Error + FN\_Error \quad (3)$$

PRECISION-RECALL

To evaluate the precision, recall and F- measure with these parameters. Precision is the average value of pixels whereas recall is the average value of pixels that are shown in Eq. (4) and Eq. (5). F-measure has been calculating the harmonic mean of precision and recall that are shown in eq. (6).

$$Precision = \frac{\sum TP}{\sum (TP + FP)} \quad (4)$$

$$\text{Recall} = \frac{\sum TP}{\sum (TP + FN)} \quad (5)$$

$$\text{F-Measure} = \frac{(1+\alpha) * (\text{Pr}ecision * \text{Re}call)}{\text{Pr}ecision + \text{Re}call} \quad (6)$$

The maximum average value has been compared as state-of-art methods that can be shown in Fig. 2 (Precision – recall curve). Another performance metric is also evaluated for foreground detection.

ACCURACY

The accuracy simply refers, how closely a computed value agreed with the real or true value.

Accuracy = (TP + TN)/ (TP + FP + FN + TN) (7)

The accuracy also used to measure the detection quality of the object.

RUNNING TIME

The running time is the execution time for running the program of proposed method and DECOLORS method. In this work we, have computed whole time for executing on one dataset using a single method. This work mainly shows running time in term of frame per second.

Table 4: Precision, Recall and F-Measure of Proposed Work

Sequence	Precision		Recall		F-Measure	
	DECOLOR	Proposed	DECOLOR	Proposed	DECOLOR	Proposed
Camouflage 251	0.6665	0. 9806	0.1681	0.9496	0.2685	0.9648
Foreground Aperture 489	0.4330	0.9421	0.0190	0.6607	0.0363	0.7767
Waving Trees 247	0.6508	0.9947	0.9235	0.8801	0.7635	0.9339
Water Surface 499	0.0446	0.9860	0.0232	0.9242	0.0305	0.9541

IJARCCE

ISSN (Online) 2278-1021
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Table 5: Error Analysis of Proposed method with DECOLOR

Sequence	FP Error		FN Error		Total Error	
	DECOLOR	Proposed	DECOLOR	Proposed	DECOLOR	Proposed
Camouflage 251	3.0260	0.9271	29.9271	2.4844	32.9531	3.4115
Foreground Aperture 489	0.5729	0.8438	22.6406	7.0521	23.2135	7.8958
Waving Trees 247	9.5156	0.1198	1.468	3.0625	10.9844	3.1823
Water Surface 499	2.7197	0.0635	5.3564	0.3662	8.0762	0.4297

Table 6: Runtime and Accuracy based analysis

Sequence	Running Time		Accuracy	
	DECOLOR	Proposed	DECOLOR	Proposed
Camouflage 251	2.0468	0.9153	0.5670	0.9635
Foreground Aperture 489	1.9802	0.9661	0.7543	0.9153
Waving Trees 247	2.1804	0.9635	0.8222	0.9661
Water Surface 1547	2.6804	0.0185	0.8971	0.9955

RESULT ANALYSIS

The precision-recall curve depicts quality of true detection and false detection as shown in Fig 2. In this figure, black curve shows the proposed result and red curve shows the DÉCOLOR result. The proposed curve covers more area as compare to the red curve. It signifies that the proposed results are much better than DECOLOR method.

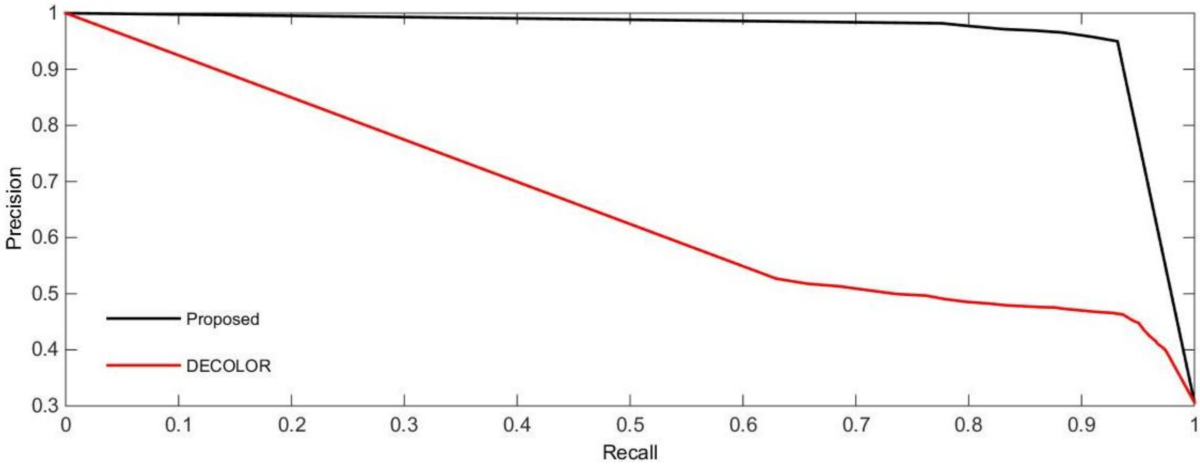

Fig. 2: Precision-recall curve for proposed method and DECOLOR method

The ROC- curve is presented in Fig.2, where the Y-axis shows true positive rate (TPR), and X–axis shows the false positive rate (FPR). The TPR represents the proportion of all foreground pixels. The FPR depicts the proportion of background pixel which by mistake misclassified as part of the foreground.

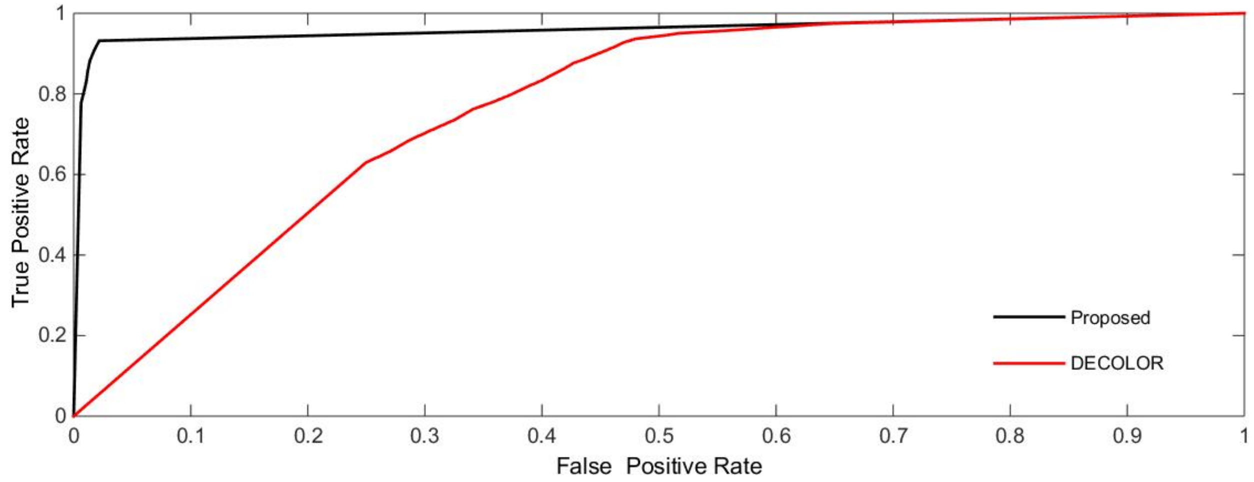

Fig. 3: ROC curve for proposed method and DECOLOR method

OBSERVATIONS

Based on above experimental results and analysis, the following observations are obtained from Table 2-6.

For each video frame, we can summarize the visual observation as given below.

- In case of Waving Trees dataset, lots of tree leaves have been detected as foreground using DECOLOR. But in case of proposed method the results are much better than DECOLOR.
- In case of camouflage sequence, due to illumination variation of monitor screen and moving body along with similar color patter of screen and T-shirt, the DECOLOR method gives poor performance whereas proposed method gives outranking performance. The proposed method detects object much better.
- In case of Foreground Aperture sequence, DECOLOR is not generating better results as it is not appropriate for illumination variation related issue but the proposed method generates better results as compare to the DECOLOR method.
- In case of Water Surface video frames, the DECOLOR is not handles the motion of spouting sea water in the background. But the proposed background subtraction method easily classified the moving pixels. The proposed method accurately classified the pixels and reduces the false classification or false alarm rate as compare to DECOLOR method.
- As per above key points, the proposed method has minimum classification error as compare to considered peer method.
- As per above key points, the proposed method has maximum F-measure as compare to DECOLOR method. It indicates the detection quality of the proposed method.
- The precision-recall curve in Fig. 4.1 depicts that outranking performance of the proposed method and similarly, in case of Camouflage, Foreground Aperture, Water Surface sequence, the average performance is better as compare to peer method.
- Similarly, in ROC curve, the area under roc curve represents outranking performance of a method. In Fig. 4.2, the average performance of proposed method. In case of Waving Trees sequence, the proposed method generates the outranking roc-analysis and it also handles moving tree leaves of the background in better way.

ADVANTAGES

The main advantage of proposed work:

- The proposed method is similar to traditional methods but it has fast execution speed that may allow its applicability for real-time applications
- Ability to deal with challenging cluttered background scene.
- Low computational cost and easy to implement.
- Does not require any external parameter as used in various methods.

- Better performance against peer methods.
- The proposed method running speed is fast as compare to considered peer method i.e. DECOLOR method.
- The proposed work can be applicable for real-time based applications in video surveillance system. Whereas DECOLOR is not practically applicable for real-time based problems.
- The proposed method has the ability to handle the problematic cluttered background of Microsoft's Wallflower and I2R's Water Surface.

LIMITATIONS

Apart from above contributions toward the detection quality of the proposed work, this work has some limitations which are mentioned below.

- This work performs well with colored video frames but does not generate good results in thermal video frames. In high motion or variation in background, the distribution of pixel value is too either high of too low, but in thermal environment the distribution is low. This limitation shows its applicability towards colored video frames.

CONCLUSION

The proposed method shows how a system can be developed by means of controlling the variance and standard deviation based threshold value. The proposed automatic threshold is used to trade-off with the difference between background and foreground pixel. It generates effective and appropriate threshold value for each pixel classification. It also classify the moving pixels more accurately and improves the detection quality. The proposed threshold is mainly used to classify the moving and non-moving pixels. Such kind of work can be applicable in many useful for real-time computer vision applications like indoor-outdoor visual surveillance security systems, robotics, driver assistance system, traffic analysis, vehicle counting, navy, defense, army, target based object identification and surveillance of restricted zone.

FUTURE WORK

In the further extension of this work, we will work for target based moving object detection in real-time colored video in complex scenes. Such work is very helpful for transportation and target detection using satellite or some tracking based IOT device. This kind of work is very helpful to catch the unauthorized vehicle identification. It is also applicable for border surveillance system.

REFERENCES

[1] A. Yilmaz, O. Javed, and M. Shah. "Object Tracking: A Survey", ACM Computer Survey 38, 4, Article 13, Dec. 2006.
[2] D. K. Panda, and S. Mehar, "Robust Real-Time Object Tracking Under Background Clutter", International Conference on Image Information Processing, IEEE, 2011.
[3] T. Bouwmans, and E. Zahzah, "Robust PCA via Principal Component Pursuit: A Review for a Comparative Evaluation in Video Surveillance", Special Issue on Background Models Challenge, Computer Vision and Image Understanding, CVIU 2014, Vol. 122, page 22–34, May, 2014.
[4] Ka Ki Ng, and E. J. Delp, "Background Subtraction Using a Pixel-Wise Adaptive Learning Rate for Object Tracking Initialization", Visual Information Processing and Communication II, Proceedings of SPIE Digital Library, Vol. 7882, Jan, 2011.
[5] C. Stauffer and W. E. L. Grimson, "Adaptive background mixture models for real-time tracking", IEEE Computer Society Conference on Computer Vision and Pattern Recognition, June, 1999.
[6] D. S. Lee, "Effective Gaussian mixture learning for video background subtraction," IEEE Trans. Pattern Analysis Machine Intelligence, Vol. 27, Dec. 2005.
[7] M. Haque, M. Murshed and M. Paul, "A Hybrid Detection Technique from dynamic background using Gaussian mixture models", IEEE, 10th Workshop on Multimedia Signal Processing, May, 2008.
[8] K. Yadav, K. Singh "Object Detection in Dynamic Background for Visual Surveillance Applications", 2nd Int. Conf. on Computing for Global Sustainable Development (9th IndiaCOM-2015), IEEE, pp. 1601-1606, March, 2015.
[9] K. Yadav, and K. Singh, "A combined approach of Kullback-Leibler divergence method and background subtraction for moving object detection in thermal video", Infrared Physics and Technology, vol. 76, page 21–31, May, 2016.
[10] K. Toyama, J. Krumm, B. Brumitt and B. Meyers, "Wallflower: Principles and Practice of Background Maintenance", IEEE Computer Society Press, Seventh International Conference on Computer Vision, Kerkyra, Greece, pp. 255-261, 1999.
[11] N. Goyette, P. M. Jodoin, F. Porikli and P. Ishwar, "changedetection.net. A new change detection benchmark, database," in Proc. IEEE workshop on changedetection at CVPR, pages 1-8, 2012.
[12] I2R Dataset, http://perception.i2r.a-star.edu.sg/bk_model/bk_index.html.
[13] K. K. Hati, P. K. Sa and B. Majhi, "Intensity Range Based Background Subtraction for Effective Object Detection", IEEE Signal Processing Letters, Vol. 20, No. 8, pp. 759-762, 2013.