Journal of Scientific & Industrial Research
Vol. 80, February 2021, pp. 122-128

An Adaptive Tracking for Moving Targets in Shadows and Poor Illuminations

Karthika Pragadeeswari C[1]* and Yamuna G[2]
[1]Alagappa Chettiar Government College of Engineering and Technology, Karaikudi 630 004
[2]Faculty of Engineering and Technology, Annamalai University, Chidambaram 608 002

Received 22 May 2020; revised 16 November 2020; accepted 01 December 2020

Tracking is an interesting area of research. It has to meet several challenges in real-time. There is a more noteworthy possibility of missing the objective. Again, the target may be single or multiple. Each one is having its speed. The biggest obstacle is when the target meets the shadow of some object or itself, the intensity of the target changes severely. This results in missing the target. In this proposed paper, an adaptive algorithm using the Difference method with normalized values indexed with Vegetation parameters (NDVI) is utilized to differentiate the target from shadows followed by tracking the desired object which may be moving at different speeds by an improved optical flow algorithm. Thus, this proposed method aims to follow the object along with challenging illuminations and in the presence of shadows. This is particularly useful to follow the objects successfully on both internal and out-of-doors scenes in shadows. Examination and comparison of various videos in MAT Lab with standard data set indicate that this method yields a better tracking result with state of art methods.

Keywords: Indoor and outdoor scenes, Normalized difference vegetation index, Optical flow, Poor illumination, Shadow

Introduction

Moving article location is usually the primary step in detecting the object which is in motion. This application includes robotized photographic scouting, audiovisual ordering, and humanoid device communication. The identification of irregular movement must be discovered, which is the objective in numerous observation framework. This objective can be accomplished when the framework has a low bogus location rate. The undertaking of programmed object recognition is profoundly respected for an assortment that incorporates video observation, remote detecting, common foundation, submerged identification, and driver help frameworks.

Many looks into moving item identification have been proposed for distinguishing moving articles from the foundation, for example, frame differencing, background subtraction, and optical flow.[1] Every one of the numerous identification approaches has its downsides. Transient differencing can't extricate different highlights. Background subtraction is exceptionally delicate to change in a light which has numerous challenges when the objective moves with shadows. Even however optical stream is having a high calculation cost, it is having high exactness and is relevant to ongoing calculations without particular equipment. The technique proposed in this paper is a strong calculation for different brightening and tried in different areas. This technique is created to toil for equally interior and open-air passages. The method entails dual algorithms; a single algorithm is vegetation index which is to distinguish the shadows from the desired target. This algorithm entails numerous apparatuses that receipt into justification about approximately ecological situations. Yet, stirring item detection methods are frequently pretentious by aspects such as gumshoe, brightness variations, etc.

Besides, various components cause various outcomes. Target in the nearness of shadows[2] is a significant assignment in picture handling when managing indoor and open-air pictures. Shadow happens when articles impede well-lit from the light source. Shades give ironic data around the item forms just as sunlit directions. Once in a while, the first picture of a specific article can't be perceived.

Shadow Formation

A shadow happens when an item is mostly or completely blocked by direct light from a wellspring of enlightenment. Shades frequently corrupt the photographic nature of pictures. Portions of the suspicious of shadows[3] are considered as listed. The frame is spatially even. On no account adjustment cutting-edge the surface exclusive the gumshoe place.

*Author for Correspondence
E-mail: bk.karthika1969@gmail.com

The light picture is near being steady in gumshoe areas, the shadow is a likeness picture, and pels exclusive its districts have various hues. A percentage of the properties[4] are extricated from pictures which can be utilized to recognize an article, the foundation and shadow are listed. A shadow with lower magnificence (lighting up) conversely with the establishment pixels and this differentiation changes effectively between neighbour pixels. All RGB assessments of a shadow are lower than the establishment in the relating pixel. In hue-saturation-value (HSV) concealing space, the colour and submersion parts of shadow pixels are to some degree smaller than the establishment.

Moreover, gumshoe formation is estimated by the shadow formation model.[5] Shadows show up on a surface when light from a source (or different sources) can't arrive at the surface because of a deterrent by an article. The object has two sorts of shadows. One is self-shade and the other is the cast list. The first type[6] is that object itself and another is thrown shadow. The piece of a cast shadow[7] is a shadow with lower superbness (illuminating) then again with the foundation pixels and this separation changes adequately between neighbour pixels. All RGB appraisals of a shadow are lower than the foundation in the relating pixel. In HSV disguising space, the shading and submersion parts of shadow pixels are somewhat more modest than the foundation. Umbra[8] speaks to the shadow district where the essential light source is clouded and obscuration is the area around the edge of a shadow where the light source is simply not entirely obscured.

Detection Approach

The shadow revelation[9] cycle contains two testing subtasks: recognizing the shadowed region and restoring the edification in that region. The area task incorporates some degree of picture seeing to choose if a pixel is faint in the light of a shadow or the reflectance at the looking at scene point. Accomplishing this endeavour requires making a couple of doubts about the shadowed surfaces in the scene and moving toward the customer for specific signs. The recovery task is in like manner testing, as it attempts to abstain from any noticeable differences between the 'at first lit' and the restored bits of the photos. Also, texture-based, chromaticity based[10], physical methods and geometry-based methods[11], physical methods work well for real-time and texture-based methods are robust to illumination changes is studied. When applying these techniques to color images[12], energy function concepts are utilized to remove shadows that work well even in complex circumstances, like water and a poor intensity roof.

From the above knowledge acquired from various methods, including gradient method[13] all the features are incorporated. The physical methods[8,9] are used for real-time situations, the texture methods[10,11,14,15] is reliable for illumination changes. In the colours videos, the shadows are detected through YCBCR[16] very sharply distinguish the shadow from non-shadow regions and the gradient method is applied to measure the histogram of various intensity values. Also, texture method[17] can predict even under noisy environments.

The framework[18] emphasizes the standardized distinction vegetation record. Evacuation of individual tree crowns in a high-resolution satellite imagery[19] that for extricating vegetation zone from a satellite, a couple of unearthly files called normalized difference vegetation index (NDVI) and saturation index (SI) are accessible.

Extraction from morphological operators[20] proposed a methodology for building. This strategy uses both spaces-based and spectral characteristics of a picture scene for building acknowledgment. Regularly a picture scene comprises characteristic locale (vegetation and soil) and synthetic districts (structures and streets). Utilization of this proposed index (other worldly assets) kills the opportunity of the sleuth presence of a structure locale. A Survey[21] of NDVI showed that it can be applied for differentiating the vegetated areas from non-vegetated areas. By that, we propose this specialized index parameter to differentiating the shadow from non-shadow areas. For better tracking, Improved Lucas Canade is applied. In Yasmin beham *et al*. (2019)[(22)], the method is applied to darker illumination static objects. Then further development with the algorithm works with shadows and determination of computation time for tracking in real-time. Using that, this proposed algorithm presents better results in presence of shadows with high accuracy.

Materials and Methods

This particular research method is designed in the flowchart as in Fig. 1. Any video is taken as an input. The frames can be considered as an image. In each frame of the video moving object is identified as a target. Segmentation of the desired target can be done

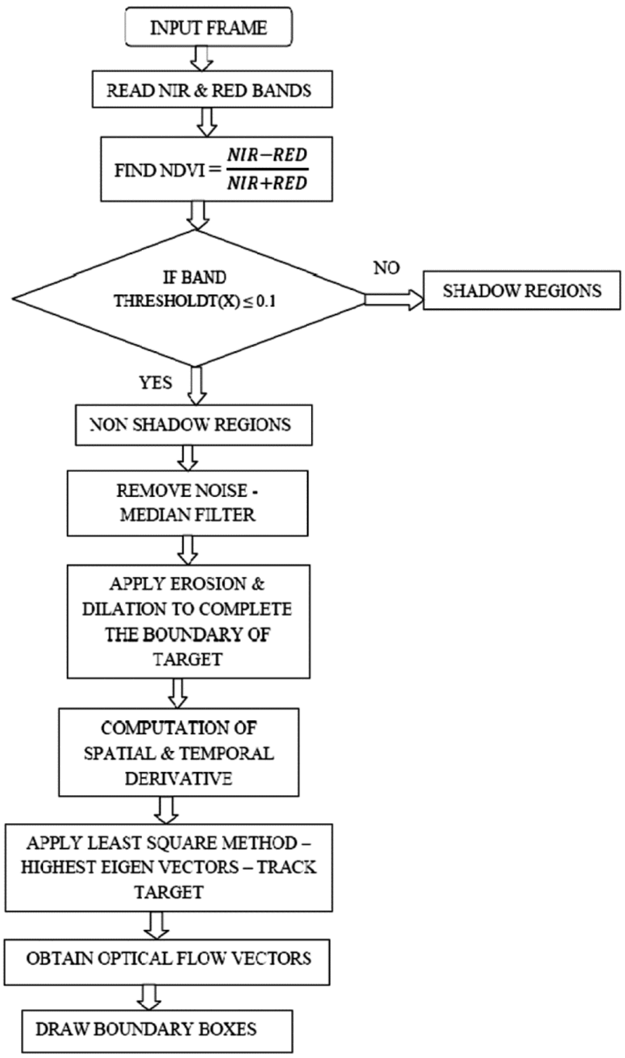

Fig. 1 — Block diagram of Implemented Method

using NDVI which is to segment the shadows from moving objects. NDVI can be calculated by some statistical preliminaries like finding the correlation strength and the amount of information which are the prediction models to determine the uncertainty.

Principal Component Analysis (PCA)

PCA plays out a direct change on a set of associated random vectors to describe them in another space with the end goal that they are uncorrelated. The newly-organized space is identified with the first by pivot about the cause, with the end goal that the new arrange axes are lined up with the predominant directions of scattering (head segments) of the information, as deduced from its covariance grid. Eigen vector with most elevated Eigen esteem comparing to Dimensionality decrease implies cut the unnecessary measurements. To get the principal components, get the information and take the mean qualities. After that, deduct the mean followed by adding at that point, it gives zero. At that point, find the covariance framework with the variance between n variables by the Eq. 1 as follows

$$COV(X,Y) = \sum_{i=1}^{n} \frac{(x-\bar{x})(y-\bar{y})}{(n-1)} \quad \ldots (1)$$

Principle Eigen vector would have the direction in which the variable strongly correlates. Then do dimensionality reduction when $p<n$, where p is the least significant Eigen value and the dimensionality can be reduced.

Entropy

The selective information measures the quantity of data gained, on a regular, in sketch models from a given dispersal. It quantifies the vulnerability and arbitrariness. Consider X be an irregular variable having some range x dictated by likelihood mass capacity as given in Eq. 2.

$$P(X=xi) = fi \quad \ldots (2)$$

where fi is a positive real number and the total of entire values should be equal to one. Jordan[23] presented the ratio vegetation index (RVI) to appraise the vegetation thickness in a given locale. Since assimilation is high in the dark red band which is also low in the NIR, Jordan evaluated vegetation thickness from Eq. 3 utilizing the proportion

$$RVI = \frac{\rho_{NIR}}{\rho_{red}} \quad \ldots (3)$$

where the variables reflect the reflectance values in NIR and red bands.

The main issue here is that the ratio swerves to infinity when ρ_{red} drives to zero. So, a better approach is to Normalize the reflectance parameters which index is defined as to find a ToA (Top of Atmosphere) using Eq. 4 reflectance between nearest infrared and red bands.

$$NDVI = \frac{\rho_{NIR} - \rho_{red}}{\rho_{NIR} + \rho_{red}} \quad \ldots (4)$$

where the parameter represents is the spectral reflectance.

Since the ratio is normalized the value lies between −1 to 1. The positive ratio confirms the presence of shadows and the negative confirms the non-shaded region.

Negative characteristics are normal for fogs, day end, and other non-vegetated, non-savvy surfaces, while positive characteristics confirm vegetated (shadowed) surfaces. Vegetation[20] list is characterized to segregate the shadow and non-shadow regions from each other. Shadow (vegetation) is a contrast from centers by its retention factor. It is a dimensionless sum, to find the qualification in reflectance of near-infrared (determinedly reflect) to the reflectance of evident light (firmly assimilates). After recognizing focuses from the shadowed district, separating is used to detach the shadow zone from other and Median channels are utilized. The statistically center value filter channel is a kind of irregular filter. This works successfully by eliminating pepper and salt clamor in a picture. The rule unseats the shadowy degree of every single picture element by its average dim levels in the area. It is used to expels the commotion in the picture. At that point, morphological administrators are applied. It processes picture dependent on shapes. Every pixel is balanced depending on different pixels in its local which assists with evacuating clamor and increment brilliance in the picture. It is the blend of disintegration and expansion. Disintegration expels pixels on object limits. The expansion adds pixels to the limits of the object in a picture.

Results and Discussion

This segment gives insights concerning the after-effects of movement following in presence of shadows. It additionally depicts the utilization of optical stream idea continuous applications like video reconnaissance. By utilizing the proposed calculation, the objects can be followed in presence of both self, cast, umbra, and penumbra shadows in both indoor and outdoor environments. Our main aim is to track the objects moving in shadows.

Sample 1: Indoor Environment

In this sample 1, an indoor environment with a single man moving to create a shadow is a simple case. The video for this particular study is represented in Fig. 2 is taken from the standard PETS dataset. This video RGB (240*300) is cut to have 96 frames and the frame rate was 24 frames/sec. In the below, a random frame is taken as an input frame as in Fig. 2(a). There are so many traditional tracking

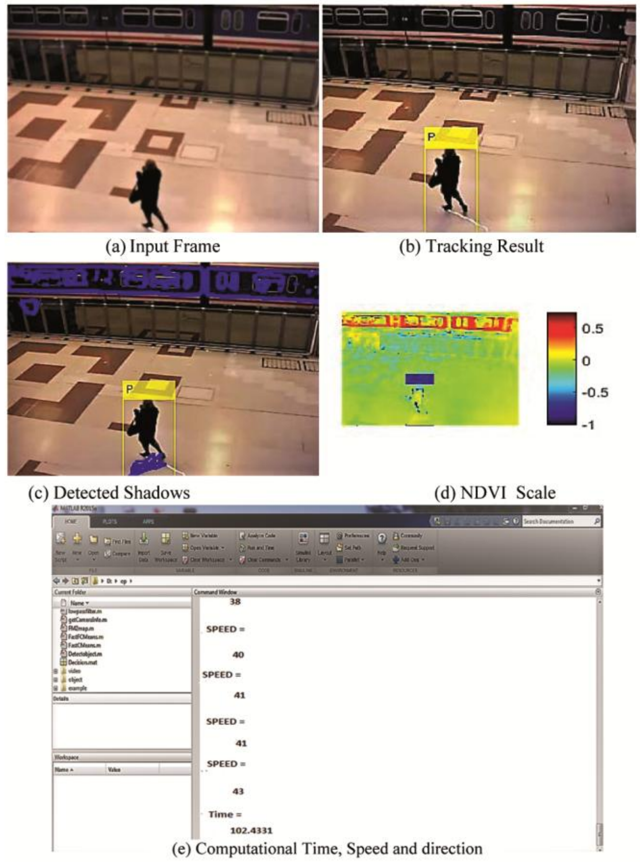

Fig. 2 — Detection and Tracking Result of Standard Moving video Indoor Environment

algorithms as discussed. The improved version of optical flow tracking has a high correlation index selected with the highest Eigen values. This adds robustness for tracking the target. The tracking result is shown in Fig. 2(b).

Next shadow, poor illumination, and darker areas detected are done with the help of the NDVI algorithm as shown in blue circles in Fig. 2(c). The vegetation index values are displayed in Fig. 2(d). Negative values represent non-shadows. Yellowish blue represents medium-scale intensities. Dark yellow represents a darker intensity.

The speed of the moving target goes on increasing if the person goes in forward direction and doesn't take any deviation and the computation time of the algorithm is 102.4331 ms for 96 frames as calculated in Fig. 2(e) and the average computational time is 1.0670 ms which is lower than traditional method.[24]

Sample 2: Outdoor Environments

Sample 2 is outdoor environment with cars moving in the shadow of trees. The video sample 2 as in

Fig. 3 is taken from the standard PETS dataset. This video RGB (360*640) is cut to have 127 frames and the frame rate was 24 frames/sec. A random frame is taken as an input frame as in Fig. 3(a). Two cars are moving on the road.

The improved flow vectors of optics for tracking provides a better result for multiple tracking moving objects. The targets are two cars and the chasing outcome of two cars in yellow boundary boxes is shown in Fig. 3(b). Next shadow, poor illumination, and darker areas detected are done with the help of the NDVI algorithm as shown in blue lines in Fig. 3(c).

The vegetation index values are displayed in Fig. 3(d). The blue colour shows the darker non-shadow areas of the object. Light blue represents dense vegetation. Greenish-yellow shows the Shadows. With that, 127 frames are taken and the required speed values of the target are revealed in Fig. 3(e). Negative speed values indicate that the object (car) takes a deviation from their direction and their computation time is 152.8030 ms and the average computational time is 1.203 ms which is lower than the traditional method.[24]

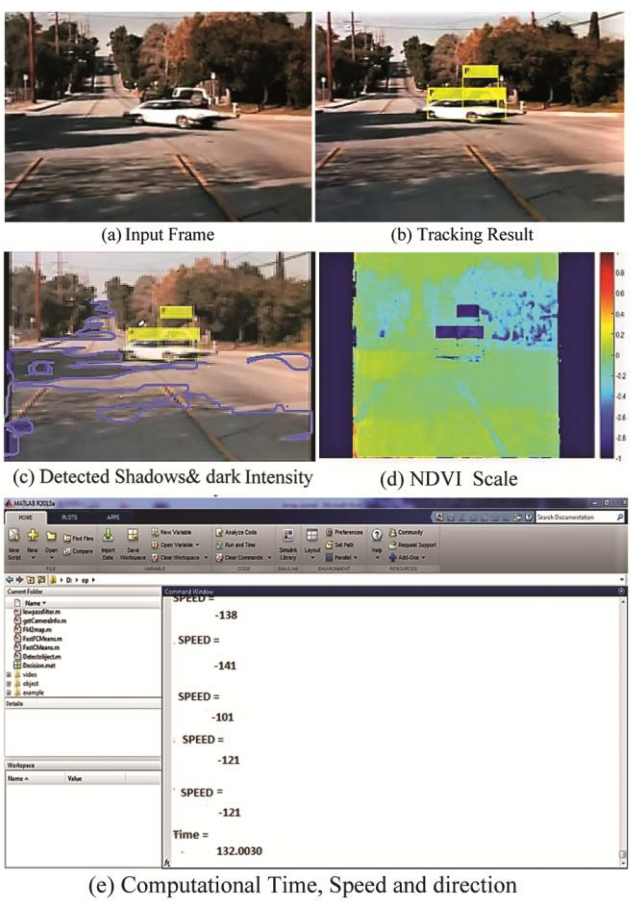

Fig. 3 — Detection and Tracking Result of Standard video Outdoor Environment

Sample 3: Outdoor Real-time video

In this sample 3, an outdoor environment with a real scene on road is taken. The video sample 3 as in Fig. 4 is taken from real-time. This video RGB (288*352) is cut to have 78 frames and the frame rate was 24 frames/sec. A random frame is taken as an input frame as in Fig. 4(a). Two men are moving on the road. The optical flow tracking provides a better result for multiple tracking moving objects. The targets are moving in a different direction and the tracking result of two persons is shown in yellow boundary boxes as shown in Fig. 4(b). The shadow, poor illumination, and darker areas are detected and

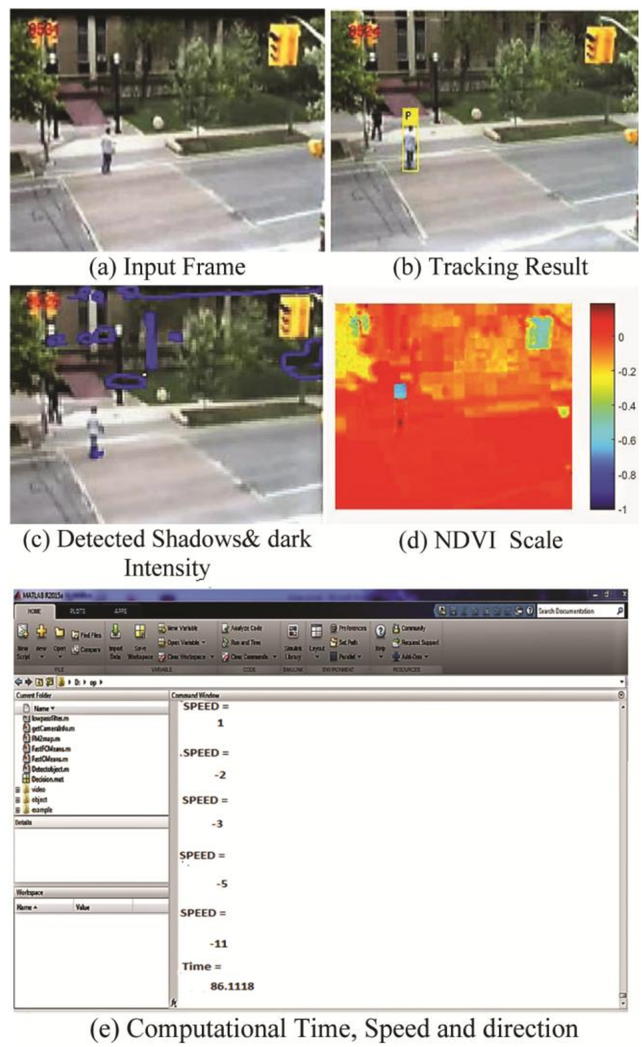

Fig. 4 — Detection and Tracking Result of Real-time Moving video Outdoor Environment

done with the help of the NDVI algorithm as shown in blue lines in Fig. 4(c). The vegetation index values are displayed in Fig. 4(d). The dark red colour indicates soil.

Yellowish red indicates trees. Greenish-yellow shows the Shadows. The above sample 3 video contains 78 frames and the speeds of the targets are shown in Fig. 4(e). Forward going target has positive values and deviation from their path has negative speed values. The computation time of the algorithm is 86.1318 ms and the average computational time is 1.104 ms which is low than the traditional method.[24]

NDVI system is applied to identify the vegetation areas[21] from others. This method is used for satellite images. There it is to identify the location of buildings from others. Even buildings painted in green colour can be deeply differentiated from green vegetative areas. Since NDVI values for green colour paint is different from green vegetation, it can be defined clearly. The same technique is used in our application to differentiate the shadows and darker areas from others.

As the aim is to track the target under all conditions, this method detects the shadows and is not interested in removal. As from the literature of detection approaches, this method is tested for colour images, and combined YCbCr, Chromaticity, texture methods in the NDVI technique. NDVI values are used for identifying the shadows, green vegetation, and darker intensities as the same technique is implemented for identifying vegetation and non-vegetation areas.[21]

Conclusions

Trailing the moving target is done in successive video outline taken from the fixed camera. In each successive frame primarily, the mean vectors are assessed and follow the formation of optical stream vectors. Improved Lucas-Canade calculation has been favoured for the valuation of the optical stream because of its high precision. The dislocation and speed of the dynamic object can be determined which helps in finding the speed and direction of the moving target. This powerful calculation likewise bolsters online, recorded video, and standard datasets. This proposed work successfully tracks the dynamic objects in indoor and outdoor environments. Shadows create challenges in the tracking environment. Shadows may occur in both indoor and outdoor environments. This NDVI method helps to track the moving objects along with shadows both in indoor and outdoor environments with higher accuracy. The optical flow technique with the improved optical flow has high positive tracking results in real-time applications that the previous methods fail to achieve. The computation time is also reduced compared to traditional methods.

References

1 Shin J, Kim S, Kang S, Won Lee S, Paik J, Apidi B & Abidi M, Optical flow based real time object tracking using non prior training active feature model, *Comput Vis Image Underst*, **3(11)** (2005) 204–218.

2 Thakur R, Chadda S & Kaur N, A review on shadow detection and removal techniques algorithms, *Int J Comput Sci Tech*, **1(3)**(2012), 536–541.

3 Gurav G, Limkar M B & Sanjay M, Hundiwale, Study of different shadow detection and removal algorithm, *Int J Res Electron Commun Technol*, **2(1)** (2014) 26–29.

4 Chondagar V, Pandya H, Panchal M, Patel R, Sevak D & Jani, A review: shadow detection and removal, *Int J Com Kput Sci Inf Technol*, **6(6)** (2015) 5536–5541.

5 Murali S, Govindan V K & Kalady S, A survey on shadow detection techniques in a single image, *Inf Technol Contl*, **47(1)** (2018) 75–92.

6 Mahajan R & Vajpayee A, A survey on shadow detection and removal based on single light source, *Proc Int Conf Intellt Systs Contl*, 2015.

7 Mogare S, A survey on various shadow detection and removal methods algorithms, *Int J Recent Trends Eng Res*, **3(2)** (2016).

8 Vrushali V. Jadhav & Shailaja B. Jadhav, Survey on shadow detection and shadow removal, *Int J Adv Res Comput Engg Technol*, **1(5)** (2016) 154–157.

9 Singh N & Maxton A A, A survey on shadow detection methods, *Int J Adv Res Comput Engg Technol*, **4(3)** (2014) 1220–1224.

10 Garg P & Goyal K, Detection and removal of shadow using chromaticity, *Int J Comput Sci Inf Technol*, **4(5)** (2014) 5745.

11 Asaidi H, Aarab A & Bellouki M, Shadow detection approach combining spectral and geometrical properties in highway video-surveillance, *Int J Comput Applns*, **17(53)** (2012) 40–44.

12 Kumar S & Kaur A, Shadow detection and removal in colour images using matlab, *Int J Engg Sci Technol*, **9(2)** (2010) 4482–4486.

13 Shoaib M, Dragon R & Ostermann J, Shadow detection for moving humans using gradient-based background subtraction, *Int Conf on Acous Spch Signl Proc*, 2009, 773–776.

14 Arulraj & Geetha B G, Region growing combined with color based shadow detection and removal from remote sensing images, *Int J Adv Eng Technol*, **2(7)** (2016) 827–829.

15 Guowen M & Yang J, Shadow removal using retinex theory, *Int J Adv Res Comput Eng Tech* **4(3)** (2014) 25–28.

16 Deb K & Suny A, Shadow detection and removal based on YCbCr color space, *Smat Comput Rev*, **1(4)** (2014) 23–33.

17 Guo L, Du M, Moving cast shadow detection based on region intrinsic image with entropy minimization, *Proc Int Conf Comput Sci Net Technol*, (2012) 2126–2130.

18 Ünsalan C & Kim L B, Linearized vegetation indices based on a formal statistical framework, *Proc IEEE Trans Geosci Remotsens*, **7(42)** (2004) 1575–1585.

19 Usman S K & Ravi Raja A, Shadow removal of individual tree crowns in a high resolution satellite imagery, *Int J Mod Trends Sci Technol*, **9(2)** (2016) 86–90.

20 Singh D, Maurya R, Shukla A S, Sharma M K & Gupta P R, Building extraction from very high resolution multispectral images using NDVI based segmentation and morphological operators, IEEE, (2012).

21 Guerrero F J D T, Corona A H, and Kretzschmar T G, A comparative study of NDVI values between north and south facing slopes in a semiarid mountainous region, *IEEE J Sel Top Appl Earth Obs Remote Sens*, (2012).

22 Beham G Y, Karthika C & Yamuna G, Object tracking in shadows, *Proc Int Conf Rec trends Challges Healthcare Infm* 2019, 377–383.

23 Jordan C F, Derivation of leaf area index quality of light on the forest floor, *Ecology* **4(50)** (1969), 663–666.

24 Denman S, Chandran V, & Sridharan S, Adaptive optical flow for person tracking, *Proc Digi Imgg Comput Technol Appl*, DICTA IEEE, 2005.