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Score Level Fusion Based Approach for Water Leak Detection in Infrared Images

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Abstract: Identification of water region plays an important role in many of the industrial and agricultural applications. Detection of water and non-water region will be tedious if manual methods are adapted. To tackle this, this article presents a detailed image processing based method to detect water and non-water region using infrared Tau 2 640 camera. An algorithm is developed to identify the water and non-water regions in a remote area using Tau 2 640 camera mounted quad copter. A series of experiments is carried to detect the water regions. Results of the experiments present the effectiveness of the proposed algorithm.

Keywords: water regions, infrared, water detection, Tau 2 640

I. INTRODUCTION

With the development of technology for infrared (IR) sensors in last decades, many image processing applications based on IR images has emerged. IR image is generated by detecting radiation in the long-wave electromagnetic spectrum. The intensity value of a pixel in an IR image represents the emitted IR radiation intensity i.e., the temperature of an object. IR images can provide all weather information, which is not observed by the human with naked eye. Therefore, IR images are widely used in surveillance, industry, military and other fields. Infrared thermography is used in various fields, from clinical diagnostics to industrial preventive and in agriculture also in predictive evaluation [2-4]. In these cases, it is important to reveal oddities and irregularities in the distribution of the analyzed bodies' temperature as these are indicators of anomalous, and therefore undesired, situations. For example, areas of higher temperature than the standard conditions may identify infections or muscle injuries in the medical field, or damaged isolators and overheated joint, signs of incipient failure, in the industrial field, or high temperature in the regions are the sign of absence of water level in that particular area. This research article focuses towards developing algorithms for identifying water resources using Tau 2 640 Flir infrared camera. Water is an essential element without which any living species goes extinct. This research work mainly focuses on providing an invention which helps in detecting/ identifying the underground water resource present which can be mapped and tapped to the reservoir. This saved water can be fed to the people during summer season or to the farmers for the agriculture purpose during drought period. The quad copter technology thus used will cover the maximum area autonomously whereas yielding a real-time detection of the water bodies using the infra-Red cameras and the image classification algorithms.

II. LITERATURE SURVEY

This section presents some of the state of the art feature extraction techniques with relevant applications for infrared object recognition. Since this article focuses on the object recognition in the infrared images, our study is restricted to feature extraction of conventional object recognition approaches and few works on infrared images. The main aim of object recognition is to locate and identify instances of an object from the infrared images captured from Tau 2 640 flir camera with the help of features extracted from the images. In literature most of the works on feature extraction techniques are classified into two categories like edge-based type and patch based feature types. From the survey it is clear that some approaches use combination of edge-based type and patch based feature type [5-9].

A. Edge Based Approaches

This method uses the edge map of the image and identifies the objects in the image in terms of edges [5, 6, 10-11]. Considering edges as features is advantageous because of many reasons, as they are largely invariant to illumination conditions and variations in objects' colors and textures. They also represent boundaries of the object well and represent the data efficiently in the large spatial extent of the images [10]. The main two deviations in these techniques are: use of the complete contour (shape) of the object as the feature [12-17] and use of collection of contour fragments as the feature of the object [5, 6, 11, 18-24]. Hamsici [12] the whole shape of the contour of the edges to get a foothold in the recognition of a set of points of contact between them. Schindler [16] considered the super-pixels, such as segmentation based approaches. They are considered to be close to the contours of the surrounding areas from the very

beginning to get the contours of the closure. Ferrari[21] at the edges of the object detection offers the best of contemporary methods used in the most advanced edge detection method. After the closure of the contours of the edges to form a network connected across the small gap between them. [19] Ren is significantly more difficult because of the presence of background information in the natural images; the contours of the objects are used to complete a triangulation. All of these techniques require additional computation intensive treatment and are often sensitive to the choice of a variety of practical outlining parameters of note. The other problem with such a feature for testing and validation of images, is available to match the contours of even an incomplete image and therefore the entire contour of the degree is generally low [15].

B. Patch Based Approaches

The patch based feature extraction approach has been in use since more than two decades [25], and edge-based features are relatively new in compared patch based technique. Moravec [25] considered local maxima of minimum intensity gradients, he called it as corners and selected a patch around these corners. This work is enhanced by Harris [26], which made the new detector less sensitive to noise, edges, and anisotropic nature of the corners proposed in [25]. In its regular form, such as the features of the object templates [27] in order to use the same size of a rectangular or square in local areas. Such features are effective for multi-scaling (the appearance of a variety of material). The following may not be suitable due to the size of the fixed patch. The size of the patch is small; it is big but may not cover the most important local feature. Such a feature is a short list of information may be lost. The size of the patch is large on the other hand, it may not be present simultaneously with other images or more than one separate covers. Another shortcoming of many small rectangular patches needs to be overcome in order to assess the attributes and the material. Both of these are computationally expensive and memory intensive. The images have a variety of features such as robustness, use of smaller or larger features, better and faster learning capabilities, and requiring less storage [28].

III. PROPOSED MODEL

The paragraph of the article presents the different steps involved in the proposed model. The first step in the proposed model consists of enhancing the infrared images. The main aim of enhancing the infrared images are, different with visible images captured IR camera, IR images are typically low contrast, contains blurred edges and lot of noise in it. One of the main reasons for low-contrast and blurred edges is that generally foreground and background have similar temperature. Low contrast and blurred edges will generate low quality infrared images. Also, the read out sensors of the IR cameras with low signal to noise ratio will generate low signal and high noise. This noise will further degrade the quality of the IR image. Analyzing such low quality images is a challenging task. It is desirable to adopt an effective IR image enhancement technique to generate an IR image with high contrast, clear details and less noise. To enhance an IR image, two problems need to be addressed. The first one is to enhance both global and local contrast of an image. Next problem is to suppress the noise in the IR image. Though there are few techniques like contrast adjustment based methods and multi scale decomposition based methods, they will only improve the contrast of the IR image but they will not eliminate the noise present in the image. But in this paper we present a new IR image enhancement technique, which will not only improve the global and local contrast of the IR image but also suppresses the noise in the IR image. Generally, infrared image is composed of low frequency component and a sequence of high frequency components with multi-scale edge preserving filter. Then different strategies are proposed to deal with the LF and HF components.

A. Image Enhancement

In this section we briefly introduce an edge preserving smoothing filter, i.e., weighted least squares (WLS) filter. The filter can smooth the image at the same time preserving the main edges. The WLS filter has been used in various image processing applications. The filter can make a good compromise between the blurring and the sharpening when compared with other filters. The WLS filter tries to seek an output image I that is a smooth version of original image S and is as similar as possible to original image S . The filtering image I can be defined as

$$I = \arg \min \{ \|I - S\|_2^2 + \lambda (\alpha_x \|D_x I\|_2^2 + \alpha_y \|D_y I\|_2^2) \} \quad (1)$$

The data term $\|I - S\|_2^2$ is for generating output image as similar as possible to original image S , while the rest term i.e., the regularization term tries to generate a smooth version of the original image by minimizing the partial derivatives of the output image. The α_x and α_y are roughly equal $\alpha_x \approx \alpha_y = \alpha$ and they give a degree of control over the affinities by non-linear scaling the gradients. λ is the regularization parameter, which is for the balance between the two terms. If we increase the value of λ , we would obtain a smoother image I . According to eq (1), one can obtain the filtering image I .

$$I = G_\lambda(S) = (E + \lambda H)^{-1} S \quad (2)$$

Where E is identity matrix and $H = D_x^T \alpha_x D_x + D_y^T \alpha_y D_y$

B. Proposed Image Enhancement System

The proposed framework is shown in Figure 1. This framework involves three main steps, which consist of image decomposition, component enhancement and image construction. Image decomposition step is to decompose the original image into a LF component and a sequence of HF components. Each component is enhanced according to its characteristic in component enhancement step. Finally, the enhancement IR image is constructed with the enhanced LF component and a sequence of HF components in image construction step.

- 1) *Image Decomposition* :Different components of an image have different characteristics. Making full use of the characteristics of the image components can effectively enhance the IR image. In this paper, we used the WLS filter to decompose the original IR image into the LF and HF components. As mentioned in previous section, a larger λ would result in a smoother filtering image when applying WLS filter. Thus, we can obtain a sequence of progressively smooth images by progressively creasing the parameter λ . We can calculate the HF components from the differences of two smooth images. Finally, the IR image is decomposed into a LF component and a sequence of HF components. Specifically, for an original IR image S, we can obtain C filtering images I_i , $i = 1, 2, \dots, C$ with C different parameters λ_i , $i = 1, 2, \dots, C$.

$$I_i = G_{\lambda_i}(S) \quad (3)$$

where $\lambda_{i+1} + 1 > \lambda_i$. The sequence of HF components i.e., detail images D_i are calculated as:

$$D_i = I_i - I_{i+1} \quad (4)$$

Herein, HF components actually are the differences of two filtering images. The smoothest filtering image I_C will be considered as the LF component of the original image. Figure 2 gives the framework of image decomposition using WLS filter.

- 2) *Component Processing* :In this part, we will introduce the procedure of processing LF and HF components. Firstly, non local means method is applied to the HF components to eliminate the noise. Then, a method based on local standard deviation is adopted to improve the local contrast of IR image. Finally, Plateau histogram equalization is employed to the LF component to enhance the global contrast. The schematic of component processing is illustrated in Figure 3.
- 3) *Non-Local means filter for HF components* :Non-local means, which was proposed by Buades [22], is a powerful tool for image denoising. Many applications use non local redundancy to suppress noise, eliminate artifacts in image processing. Different with conversional "local mean" filters(such as median-based filter, Gaussian smoothing filter and the neighborhood filters), which calculate the weighted mean value of a region(or patch) as output, non-local means filtering takes a mean of all pixels in the image, weighted by how similar these pixels are, to the target pixel [22]. As a result, it can better keep the edge while eliminate noise. IR image contains a lot of noise due to the limitation of IR cameras. The LF component represents the general profile of the IR image, while the HF components are accompanied by strong noise, since noise would be considered as detail information in the decomposition process. In order to suppress noise and preserve the edges, nonlocal means filter rather than median-based filter is employed.
- 4) *Local Contrast Enhancement for HF components* :The high-frequency components represent the details of the IR image. The local contrast of IR image depends on the local standard deviation of the HF components at a local region. A region with high local standard deviation is with more details and vice versa. To improve the local contrast, we adopt a strategy, in which the detail gain is proportional to the local standard deviation. Each pixel in the enhanced HF component is calculated by:

$$D_i(i, j) = \mu(i, j) + c(i, j) \times (D_i(i, j) - \mu(i, j)) \quad (5)$$

where $\mu(i, j)$ and $\delta(i, j)$ is the mean value and standard deviation of the intensity of a patch centered at (i, j) respectively.

- 5) *Image Reconstruction* :After we obtain the enhanced LF and HF components, the resultant image can be generated by integrating those enhanced components. Figure 4 shows the schematic of image construction. Once the image acquisition stage is completed, the input images are subjected for k means clustering by fixing the k value to 2. Since the main objective of the proposed model to find the water and non water region, k (different number of clusters) is fixed to 2. The features are extracted in order to differentiate between water and non water region. Classification of regions is based on set of features that are extracted the captured images.

$$\begin{aligned} \text{Variance} &= \frac{1}{mn-1} \sum_{x=0}^{m-1} \sum_{y=0}^{n-1} (I(x, y) - \text{Mean})^2 \\ \text{Mean} &= \frac{1}{mn} \sum_{x=0}^{m-1} \sum_{y=0}^{n-1} I(x, y) \end{aligned} \quad (6)$$

$$\text{Standarddeviation} = \sqrt{\text{Variance}} \quad (7)$$

Where m = number of rows and n = number of columns in the image.

Also with the above mentioned features like variance, mean and standard deviation, we have defined pixel intensity features like Horizontal features and Vertical features. MeanHorz is calculated as the average intensity of each row in the image.

$$\text{Variance}_{\text{Horz}} = \frac{1}{m-1} \sum_{x=0}^{m-1} (\text{Mean}_{\text{Horz}} I - \text{Mean}) \quad (8)$$

$$\text{Mean} = \frac{1}{m} \sum_{x=0}^{m-1} \text{Mean}_{\text{Horz}} I \quad (9)$$

$$\text{Standarddeviation} = \sqrt{\text{Variance}^2} \quad (10)$$

Mean_{vert} is calculated as the average intensity of each row in the image.

$$\text{Variance}_{\text{vert}} = \frac{1}{n-1} \sum_{x=0}^{n-1} (\text{Mean}_{\text{vert}} I - \text{Mean}) \quad (11)$$

$$\text{Mean} = \frac{1}{n} \sum_{x=0}^{n-1} \text{Mean}_{\text{vert}} I \quad (12)$$

Above mentioned features are extracted and a knowledge base is developed for the identification of water and non-water region. Once the construction of the knowledge base is completed, knearest neighbor classifier will be trained with the extracted features. All the different stages in the proposed model are diagrammatically shown in the following diagram fig. 3.

Figure3: Block Diagram of the proposed model

IV. EXPERIMENTAL SETUP

This section describes the details of the experiments conducted to demonstrate the working of the proposed algorithm. We have conducted a series of experiment to demonstrate the effective of the proposed approach. The proposed algorithm is implemented in MATLAB 2012a. The sample of the captured image and processed output image is as shown in the following figure. To evaluate any algorithm, datasets are required to examine the efficiency of the proposed algorithm. In the proposed model, image acquisition process is carried out with the help of Tau 2 640 flir camera. Dataset is composed of around 500 different set of images and images are captured in different time intervals to identify the wetness in the ground.

Following are the few dataset samples, taken in different time intervals

Figure 4: Few dataset samples, taken in different time intervals

Once the dataset is developed, the proposed algorithm is evaluated in two different sets of experiments by dividing the dataset in the ratio of 60% for training 40% for testing and vice versa. Details of the experiments are as shown in the following table. In the above mentioned issue, the proposed algorithm is tuned to detect the presence of water and non-water region. At the outset this problem looks like two class problem, which can be reduced to single class problem like whether the water contents are there or not in the given region. Which means the running time of the algorithm will be reduced from n to $n/2$ where n = complexity of the algorithm. To evaluate the proposed algorithm, the well-known metrics like precision, recall and f-measure are applied on the proposed algorithm. The details of these metrics are presented in the following diagram.

Table 1 : Classification results of the proposed model

Sl No.	Dataset	Precision	Recall	f- measure
1	Tau 2 640 Flir Camera	1	0.875	0.9333

V. CONCLUSION

Currently machine learning is used in many applications which including computer vision [29-34], bioinformatics [35-41], brain-machine interfaces [42-47], medical diagnosis [48-53], natural language processing [54-59], recommender systems [60-64], sentiment analysis [65-68], software engineering [69-73], structural health monitoring [74-76], syntactic pattern recognition [77-82]. In this article, a method of identification of water and non-region using Flir Tau 2 640 infrared camera is presented in this paper. The proposed algorithm consists of image processing technique for identification of process. A detailed experiment is conducted to demonstrate the efficiency of Flir Tau 2 640 infrared camera. Results of the experiments reveals that Flir Tau 2 640 infrared camera can be used for detection of water and non-water regions in the ground.

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REFERENCES

- [1] Milgram D.L., Rosenfeld A. (1981) Object detection in infrared images. In: Bloc L., Kulpa Z. (eds) Digital Image Processing Systems. Lecture Notes in Computer Science, vol 109. Springer, Berlin, Heidelberg.
- [2] Panda, D. P., "Segmentation of FLIR Images by Pixel Classification", University of Maryland, Computer Science TR-508, Feb. 1977.
- [3] Zi-Jun Feng, Xiao-Ling Zhang, Li-Yong Yuan, and Jia-Nan Wang, "Infrared Target Detection and Location for Visual Surveillance Using Fusion Scheme of Visible and Infrared Images," Mathematical Problems in Engineering, vol. 2013, Article ID 720979, 7 pages, 2013. doi:10.1155/2013/720979

- [4] Xiaodong Li, Nabil Aouf, SIFT and SURF feature analysis in visible and infrared imaging for UAVs, Cybernetic Intelligent Systems (CIS) 2012 IEEE 11th International Conference on, pp. 46-51, 2013.
- [5] Opelt, A. Pinz, and A. Zisserman, "Learning an alphabet of shape and appearance for multi-class object detection," International Journal of Computer Vision, vol. 80, pp. 16-44, 2008.
- [6] Z. Si, H. Gong, Y. N. Wu, and S. C. Zhu, "Learning mixed templates for object recognition," in Proceedings of the IEEE Conference on Computer Vision and Pattern Recognition, 2009, pp. 272-279.
- [7] R. Fergus, P. Perona, and A. Zisserman, "A sparse object category model for efficient learning and exhaustive recognition," in Proceedings of the IEEE Conference on Computer Vision and Pattern Recognition, 2005, pp. 380-387.
- [8] Y. Chen, L. Zhu, A. Yuille, and H. J. Zhang, "Unsupervised learning of probabilistic object models (POMs) for object classification, segmentation, and recognition using knowledge propagation," IEEE Transactions on Pattern Analysis and Machine Intelligence, vol. 31, pp. 1747-1774, 2009.
- [9] J. Shotton, "Contour and texture for visual recognition of object categories," Doctoral of Philosophy, Queen's College, University of Cambridge, Cambridge, 2007.
- [10] J. Shotton, A. Blake, and R. Cipolla, "Multiscale categorical object recognition using contour fragments," IEEE Transactions on Pattern Analysis and Machine Intelligence, vol. 30, pp. 1270-1281, 2008.
- [11] I. A. Rizvi and B. K. Mohan, "Improving the Accuracy of Object Based Supervised Image Classification using Cloud Basis Function Neural Network for High Resolution Satellite Images," International Journal of Image Processing (IJIP), vol. 4, pp. 342-353, 2010.
- [12] O. C. Hamsici and A. M. Martinez, "Rotation invariant kernels and their application to shape analysis," IEEE Transactions on Pattern Analysis and Machine Intelligence, vol. 31, pp. 1985-1999, 2009.
- [13] L. Szumilas and H. Wildenauer, "Spatial configuration of local shape features for discriminative object detection," in Lecture Notes in Computer Science vol. 5875, ed, 2009, pp. 22-33.
- [14] L. Szumilas, H. Wildenauer, and A. Hanbury, "Invariant shape matching for detection of semi-local image structures," in Lecture Notes in Computer Science vol. 5627, ed, 2009, pp. 551-562.
- [15] M. P. Kumar, P. H. S. Torr, and A. Zisserman, "OBJCUT: Efficient Segmentation Using Top-Down and Bottom-Up Cues," IEEE Transactions on Pattern Analysis and Machine Intelligence, vol. 32, pp. 530-545, 2009.
- [16] K. Schindler and D. Suter, "Object detection by global contour shape," Pattern Recognition, vol. 41, pp. 3736-3748, 2008.
- [17] N. Alajlan, M. S. Kamel, and G. H. Freeman, "Geometry-based image retrieval in binary image databases," IEEE Transactions on Pattern Analysis and Machine Intelligence, vol. 30, pp. 1003-1013, 2008.
- [18] Y. N. Wu, Z. Si, H. Gong, and S. C. Zhu, "Learning Active Basis Model for Object Detection and Recognition," International Journal of Computer Vision, pp. 1-38, 2009.
- [19] X. Ren, C. C. Fowlkes, and J. Malik, "Learning probabilistic models for contour completion in natural images," International Journal of Computer Vision, vol. 77, pp. 47-63, 2008.
- [20] A. Y. S. Chia, S. Rahardja, D. Rajan, and M. K. H. Leung, "Structural descriptors for category level object detection," IEEE Transactions on Multimedia, vol. 11, pp. 1407-1421, 2009.
- [21] J. Winn and J. Shotton, "The layout consistent random field for recognizing and segmenting partially occluded objects," in Proceedings of the IEEE Conference on Computer Vision and Pattern Recognition, 2006, pp. 37-44.
- [22] V. Ferrari, T. Tuytelaars, and L. Van Gool, "Object detection by contour segment networks," in Lecture Notes in Computer Science vol. 3953, ed, 2006, pp. 14-28.
- [23] K. Mikolajczyk, B. Leibe, and B. Schiele, "Multiple object class detection with a generative model," in Proceedings of the IEEE Conference on Computer Vision and Pattern Recognition, 2006, pp. 26-33.
- [24] R. C. Nelson and A. Selinger, "Cubist approach to object recognition," in Proceedings of the IEEE International Conference on Computer Vision, 1998, pp. 614-621.
- [25] H. P. Moravec, "Rover visual obstacle avoidance," in Proceedings of the International Joint Conference on Artificial Intelligence, Vancouver, CANADA, 1981, pp. 785-790.
- [26] M. Varma and A. Zisserman, "A statistical approach to material classification using image patch exemplars," IEEE Transactions on Pattern Analysis and Machine Intelligence, vol. 31, pp. 2032-2047, 2009.
- [27] P. M. Roth, S. Sternig, H. Grabner, and H. Bischof, "Classifier grids for robust adaptive object detection," in Proceedings of the IEEE Computer Vision and Pattern Recognition, Miami, FL, 2009, pp. 2727-2734.
- [28] Kwong Wing Au, Saad J. Bedros, Keith L. Curtner, "Object classification in video images", US7646922 B2, 2010.
- [29] Vinay Kumar Jain, Shishir Kumar, Steven Lawrence Fernandes, (2017). Extraction of Emotions from Multilingual Text Using Intelligent Text Processing and Computational Linguistics, Journal of Computational Science, Vol. 21, pp. 316-326
- [30] VaradrajPrabhuGurupur, Hong Lin, Roshan Joy Martis., (2017). A Novel Fusion Approach for Early Lung Cancer Detection using Computer Aided Diagnosis Techniques, Journal of Medical Imaging and Health Informatics
- [31] SyediaTahseen Fatima Bokhari, Muhammad Sharif, MussaratYasmin., (2017). Fundus Image Segmentation and Feature Extraction for the Detection of Glaucoma: A New Approach, Current Medical Imaging Reviews, Vol.13
- [32] S. M. Naqi, Muhammad Sharif, MussaratYasmin, (2017). Lung Nodule Detection Using Polygon Approximation and Hybrid Features from Lung CT Images, Current Medical Imaging Reviews, Vol.13
- [33] N Sri Madhava Raja, V Rajinikanth, Suresh Chandra Satapathy., (2017). Segmentation of Breast Thermal images using Kapur's Entropy and Hidden Markov Random Field, Journal of Medical Imaging and Health Informatics
- [34] V Rajinikanth, N Sri MadhavaRaja, Suresh Chandra Satapathy., (2017). Otsu's Multi-thresholding and Active Contour Snake Model to Segment Dermoscopy Images, Journal of Medical Imaging and Health Informatics
- [35] Jamal Hussain Shah, Zonghai Chen, Muhammad Sharif, MussaratYasmin., (2017). A Novel Biomechanics Based Approach For Person Re-identification By Generating Dense Color Sift Salience Features, Journal of Mechanics in Medicine and Biology

- [36] VaradrajPrabhuGurupur, Nayak Ramesh Sunder, SeifedineKadry.,(2017). A Novel Nonintrusive Decision Support Approach for Heart Rate Measurement, Pattern Recognition Letters
- [37] Muhammad Sharif, Muhammad Attique khan, Muhammad Faisal, MussaratYasmin.,(2017). A Framework for Offline Signature Verification System: Best Features Selection Approach, Pattern Recognition Letters
- [38] Javeria Amin, Muhammad Sharif, MussaratYasmin.,(2017). A Distinctive Approach in Brain Tumor Detection and Classification using MRI, Pattern Recognition Letters
- [39] Jamal Hussain Shah, Muhammad Sharif, MussaratYasmin.,(2017). Facial Expressions Classification and False Label Reduction Using LDA and Threefold SVM, Pattern Recognition Letters
- [40] Arunkumar N, Ramkumar K., Venkatraman V., EnasAbdulhay, (2017). Classification of focal and non-focal EEG using entropies, Pattern Recognition Letters, Vol. 94, pp. 112-117
- [41] RakeshRanjan, Rajeev Arya.,(2017). A Fuzzy Neural Network Approach for Automatic K-Complex Detection in Sleep EEG Signal, Pattern Recognition Letters
- [42] Roshan Joy Martis, Hong Lin, VaradrajPrabhuGurupur., Editorial: Frontiers in Development of Intelligent Applications for Medical Imaging Processing And Computer Vision, Computers in Biology and Medicine
- [43] G. JoseminBala, "Similarity Descriptor and Local Descriptors Based Composite Sketch Matching" Advances in Intelligent Systems and Computing - Springer, Switzerland, Vol. 436, No.1, pp. 643-649, March (2016)
- [44] G. JoseminBala, "Sparse Representation Based Face Recognition Under Varying Illumination Conditions" Smart Innovation, Systems and Technologies, Springer Verlag, Germany, Vol. 2, No. 3, pp. 469-476, May (2016)
- [45] V. Rajinikanth, Suresh Chandra Satapathy, S. Nachiappan.,(2017). Entropy based Segmentation of Tumor from Brain MR Images - A study with Teaching Learning Based Optimization, Pattern Recognition Letters, Vol. 94, pp. 87-95
- [46] G. JoseminBala.,(2017). A Novel Decision Support for Composite Sketch Matching using Fusion of Probabilistic Neural Network and Dictionary Matching, Current Medical Imaging Reviews, Vol. 13, No. 2, pp. 176-184
- [47] G. JoseminBala.,(2017). A Comparative Study on various State of the Art Face Recognition Techniques under varying Facial Expressions, The International Arab Journal of Information Technology, Vol. 14, No. 2
- [48] Sumarga Kumar SahTyagi, Deepak Kumar Jain, PranabMuhuri, (2017). Thermal-Aware Power-Efficient Deadline Based Task Allocation in Multi-Core Processor, Journal of Computational Science Vol. 119, pp. 112-120
- [49] G. JoseminBala, "Image Quality Assessment Based Approach to Estimate the Age of Pencil Sketch" Advances in Intelligent Systems and Computing - Springer, Switzerland, Vol. 436, No.1, pp. 633-642, March (2016)
- [50] Shishir Kumar, Neha Jain, (2017). Rough Set Based Effective Technique of Image Watermarking, Journal of Computational Science, Vol. 119, pp. 121-137
- [51] Javeria Amin, Muhammad Sharif, MussaratYasmin, Hussam Ali, (2017). A Unique method for the Detection and Classification of Diabetic Retinopathy using Structural Predictors of Bright Lesions, Journal of Computational Science, Vol. 119, pp. 153-164
- [52] G. JoseminBala.,(2016). Fusion of Sparse Representation and Dictionary Matching for Identifications of Humans in Uncontrolled Environment, Computers in Biology and Medicine, Vol. 76, pp. 215-237
- [53] G. JoseminBala.,(2016). ODDROID XU4 Based Implementation of Decision Level Fusion Approach for Matching Computer Generated Sketches, Journal of Computational Science, Vol. 16, pp. 217-224
- [54] BaisakhiChakraborty, Varadraj P. Gurupur, AnanthPrabhu G.,(2016). Early Skin Cancer Detection Using Computer Aided Diagnosis Techniques, Journal of Integrated Design and Process Science, Vol. 20, No. 1, pp. 33-43
- [55] BushraShabbira, Muhammad Sharifa, WasifNisara, MussaratYasmina.,(2016). Automatic Cotton Wool Spots Extraction in Retinal Images Using Texture Segmentation and Gabor Wavelet, Journal of Integrated Design and Process Science, Vol. 20, No. 1, pp. 65-76
- [56] Muhammad Waseema Khan, Muhammada Sharif, MussarataYasmin.,(2016). A New Approach of Cup to Disk Ratio Based Glaucoma Detection Using Fundus Images, Journal of Integrated Design and Process Science, Vol. 20, No. 1, pp. 77-94
- [57] MussaratYasmin, Muhammad Sharif, IsmaIrum, WaqarMehmood.,(2016). Combining Multiple Color and Shape Features for Image Retrieval, Institute of Integrative Omics and Applied Biotechnology Journal, Special issue on Advances in Pattern Recognition, Soft Computing, and Machine Learning, Vol. 7, No. 2, pp. 97-110
- [58] G. JoseminBala, "A Comparative Study on Multi-View Discriminant Analysis and Source Domain Dictionary Based Face Recognition" Advances in Intelligent Systems and Computing - Springer, Switzerland, Vol. 433, No.1, pp. 331-337, January (2016)
- [59] G. JoseminBala, "A Study on Face Recognition Under Facial Expression Variation and Occlusion" Advances in Intelligent Systems and Computing - Springer, Switzerland, Vol. 397, No.1, pp. 371-377, January (2016)
- [60] G. JoseminBala, "A Novel Technique to Recognize Human Faces Across Age Progressions" Advances in Intelligent Systems and Computing - Springer, Switzerland, Vol. 397, No.1, pp. 379-385, January (2016)
- [61] Steven Lawrence Fernandes, G. JoseminBala, "Analysing State of the Art Techniques to Recognize Faces under Multimodal Biometrics" Advances in Intelligent Systems and Computing - Springer, Switzerland, Vol. 381, No.3, pp. 473-478, September (2015)
- [62] NudratNida, Muhammad Sharif, Muhammad UsmanGhani Khan, MussaratYasmin, Steven Lawrence Fernandes.,(2016). A Framework for Automatic Colorization of Medical Imaging, Institute of Integrative Omics and Applied Biotechnology Journal, Special issue on Advances in Pattern Recognition, Soft Computing, and Machine Learning, Vol. 7, No. 2, pp. 111-126
- [63] G. JoseminBala.,(2016). Developing a Novel Technique to Match Images Captured from Un-Manned Aerial Vehicle, International Journal of System Assurance Engineering and Management, pp. 1-9
- [64] G. JoseminBala.,(2016). Modified Feature Descriptor Based Approach to Recognize Surgically Altered Human Faces, International Journal of Applied Mathematics And Informatics, Vol. 10, pp. 1-9
- [65] G. JoseminBala.,(2016). Recognize Faces across Multi-View Videos and under Varying Illumination, Facial Expressions, International Journal of Circuits, Systems and Signal Processing, Vol. 10, pp. 7-18
- [66] G. JoseminBala.,(2016). Recognizing Faces Across Age Progressions and Under Occlusion, Recent Patents on Computer Science, Vol. 8, pp. 1-7

- [67] G. JoseminBala, "Recognizing Faces in Corrupted Images" *Advances in Intelligent Systems and Computing* - Springer, Switzerland, Vol. 397, No.1, pp. 511-518, January (2016)
- [68] G. JoseminBala, "Simulation Level Implementation of Face Recognition under Un-controlled Environment" *Advances in Intelligent Systems and Computing* - Springer, Switzerland, Vol. 381, No. 3, pp. 467-472, September (2015)
- [69] G. JoseminBala, "Recognizing Faces When Images Are Corrupted By Varying Degree of Noises and Blurring Effects" *Advances in Intelligent Systems and Computing* - Springer, Switzerland, Vol. 337, No. 1, pp. 101-108, January (2015)
- [70] G. JoseminBala, "Low Power Affordable, Efficient Face Detection In The Presence Of Various Noises And Blurring Effects On A Single-Board Computer" *Advances in Intelligent Systems and Computing* - Springer, Switzerland, Vol. 337, No. 1, pp. 119-127, January (2015)
- [71] G. JoseminBala.,(2015). Study on MACE Gabor Filters, Gabor Wavelets, DCT-Neural Network, Hybrid Spatial Feature Interdependence Matrix, *Fusion Techniques for Face Recognition, Recent Patents on Engineering*, Vol. 9, pp. 29-36
- [72] G. JoseminBala.,(2014). 3D and 4D Face Recognition: A Comprehensive Review, *Recent Patents on Engineering*, Vol. 8, pp. 112-119
- [73] G. JoseminBala., (2014). Development and Analysis of Various State of the Art Techniques for Face Recognition under varying Poses, *Recent Patents on Engineering*, Vol. 8, pp. 143-146
- [74] V Rajinikanth, "Segmentation Of Brain Tumor Based On Tsallis Multi-Thresholding and Level Set" *Lecture Notes in Electrical Engineering*, Springer Verlag, Germany
- [75] Muhammad Faisal, Hong Lin, MussaratYasmin, "Developing A Novel Unattended Infant Detection System for Vehicles" *Lecture Notes in Electrical Engineering*, Springer Verlag, Germany
- [76] Usha Desai, C. GurudasNayak, G. Seshikala, Roshan J. Martis, "Automated Diagnosis of Tachycardia Beats" *Smart Innovation, Systems and Technologies*, Springer Verlag, Germany
- [77] Steven Lawrence Fernandes, S. N. BharathBhushan, VinlalVinod, AjitDanti, Adarsh M. J, "A Novel Representation for Classification of User Sentiments" *Advances in Intelligent Systems and Computing* - Springer, Switzerland
- [78] S. N. BharathBhushan, AjitDanti, "A Novel Integer Representation Based Approach for Classification of Text Documents" *Advances in Intelligent Systems and Computing* - Springer, Switzerland, Vol. 469, No.2, pp. 557-564, August (2016)
- [79] RashmiRai V, et al., "Recognizing Images across Age Progressions: A Comprehensive Review" – in the Proceeding IEEE Xplore archived 2nd International Conference Electronics and Communication Systems (ICECS-2015) pp. 572 - 576 at Karpagam College of Engineering, Coimbatore, India on 26th to 27th February 2015
- [80] Vinusha, et. al., "A Brief Review On Techniques for Recognizing Images Under Varying Poses" in the Proceeding IEEE Xplore archived 2nd International Conference Electronics and Communication Systems (ICECS-2015) pp. 583 - 588 at Karpagam College of Engineering, Coimbatore, India on 26th to 27th February 2015
- [81] Ashwini G Pai, et. al., "Recognizing human faces under varying degree of Illumination: A comprehensive survey" – in the Proceeding IEEE Xplore archived 2nd International Conference Electronics and Communication Systems (ICECS-2015) pp. 577 - 582 at Karpagam College of Engineering, Coimbatore, India on 26th to 27th February 2015
- [82] Bishwas Mishra, et. al., "Facial Expression Recognition Using Feature Based Techniques And Model Based Techniques: A Survey" in the Proceeding IEEE Xplore archived 2nd International Conference Electronics and Communication Systems (ICECS-2015) pp. 589 - 594 at Karpagam College of Engineering, Coimbatore, India on 26th to 27th February 2015

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