Grenze International Journal of Engineering and Technology, Jan Issue

Review on Classification of Natural & Synthetic Images

Nilesh S. Wadhe[1] and Dr. Nidhi Tiwari[2]
[1]PhD Scholar, Department of Electronics & Communication Engineering, SAGE University, Indore
nilesh.wadhe07@gmail.com
[2]Associate Professor, Department of Electronics & Communication Engineering, SAGE University, Indore
nidhitiwari.vlsi@googlemail.com

***Abstract*—The classification of image system mainly focuses on photographic and non-photographic i.e. natural & synthetic images. The semantic description-based on classification of images is a more interesting and significant problem in involuntary image identification. An algorithm for natural and synthetic image classification system has been established. In order to adventure the difference, the color pattern and spatial correlation of pixels in natural and synthetic images, some of the features are removed from the database of images. If these features are used alone, they have low accuracy but when it combined together and used for image classification forms a more multifaceted and appropriate classification and their exactness can be improved. Proposed image classification for natural and synthetic images algorithm will be use these low-level features of images such as edge map, color map, threshold ratio, nearest neighborhood & energy level for classification of the images into synthetic and natural.**

***Index Terms*— Natural Image, Synthetic Image Color map, Edge map, Energy Level, Threshold value and nearest neighborhood.**

I. INTRODUCTION

Differentiating between a photograph and a graphic is always a simple task, for human being. It is often just matter of a glance. But unfortunately, it is not simple task for a computer, there is no simple and easy feature are available to extract and process the images. The amount of colors, edge map, edge location, energy level, & threshold ratio is taken from the raw image data available in different ways. These features are collected together to build a solid classifier. If it is used individually, they can lead to poor or incorrect results. The main motive of proposed system i.e. image classification is used to separate images into dissimilar classes [1].

The ideal systems are able to distinguish different images with no unwillingness like a human being. Unfortunately, sometimes the classification task is more complicated and unclear even for a human. The entirely images are created by digital means, are increasing is more important. These types of synthetic images are more important for recording and provides visual evidences. The correct classification for these images such as icons, maps, figures and charts are more important. The images which are downloaded from of the internet, are not used for just communicate the contented but also used for decoration, formatting and alignment. The image classification system can improve image examination and recovery engines and act as an input filter for down streaming for internet processing as well as image sympathetic systems [2].

In another side, it is very frequently a natural image describe the actual objects and subjects. They usually have textures, smooth angles, larger variety of colors but less saturated by making these problems are more

Grenze ID: 01.GIJET.8.1.5_1

challenging [3]. In this paper, a binary classifier is creating for image classification. The natural and synthetic image classification system involved in these two classes. The image is used as an input to the classifier which abstract and examine few related features and syndicate them in order to produce a sub image classification system for natural and synthetic images.

II. LITERATURE REVIEW

The study about Neural Network Architecture (NNA) technique for the image classification system is mentation. The outline consists of a mixture between impersonators of two pairs of human eye and dissimilarity arrangement auto-encoding. This elaborate many multifaceted images but this method, the system gradually progresses the MNIST models. The MNIST is the open source database which is used for the training set. It also trials with street view house number dataset images where the result was enhanced because the human eyes cannot be differentiating into it [4].

According to, the journal in which the image classification system is based on assembly of a convolutional neural network (CNN). In the training the balanced number of face images and non-face images was used by stemming extra face images from image database. The image classification method is skilled with 120 image datasets and the auto-stage training gives 81.6% recognition rate [5].

The researcher used Decision Tree (DT) techniques for image classification. This method has number off datasets which are situated under every hierarchical classifier. It can be calculating the membership for every class. The classifier which is used has few denials of the classes at the intermediary stages. This method required the three parts, the number one is to find the terminal nodes, second is the placement of class & the third one is apportioning of the nodes. This method is very easy and high efficiency [6].

In this paper the Support Vector Machine (SVM) active learning is used which was very aggressively increasing at that time. It was proposed an idea in which by combining the spatial information of the image from a sequential process spectral. It will used three different strategy, the number one is Euclidean distance which calculate the training samples from the part of spatial. The second one strategy is built on the Parzen window technique & lastly, it combines the spatial entropy. The output gives that the two images have very high resolution in terms of its efficiency [7].

In proposed system fast image classification is done by increasing the Fuzzy Classifiers. It was a very easy way to distinguish between known and unknown class. This method is very easy by boosting Meta information where local representative can be found. It was tested on big data sets of images and equated with the bag-of-features of image model. The result gives improved classification and more accuracy [8].

The image classification system is more important steps for object detection and image analysis. A lot of image classification methods has been proposed up to the date. The various studies have been conducted in order to conclude about the best satellite image classification technique. It is hard to decide any one technique as the best technique among all, because the results and its accuracy depend on a number of number of factors [9].

Over the last few decades, there is a constant modification in the conventional methods & invention of new image classification techniques which gives maximum accurate results. Every classification system has its advantages and disadvantages. The research now concentrates on combining the desired features of the methods in order to increases the efficiency. The soft classifiers are used because the hard classifier can't handle the problem for mixed pixel. But the, soft classifier have some its own disadvantages. Presents a study that combines the desirable features of a soft classifier and the hard classifier. By making the use of LSMM, a soft classifier and SVM, a hard classifier and compared the results with the ones produced by LSMM and SVM separately. The results show the combination of both classifiers which produces better results when compared to either of them [10].

In another study, which was directed on PoISAR data combined the Markov random field smoothness constraint with supervised Softmax regression model. The experiments conducted during this study proved that the mixture of supervised and unsupervised algorithms which produced good results [11].

By combining the fuzzy logic and neural networks are used to design a system which can be detected the face and fingerprints of the person. Which is used to determine the authenticity of the person. This type of system was used for security purposes [12].

The challenge of image classification from huge dataset is used in the recent research work. The support vector machine (SVM) classifier shows to be very effective in the image classification system [13].

The paper gives the brief information about the novel fuzzy decision tree, in which the node discriminations are used via binary SVMs [14].

A Spatial Contextual Support Vector Machine is used for image classification system. The various methods of image classification system have advantages and disadvantages. Some techniques are the combined together to form classifier for image classification system. The classifier is more efficient if they can be used properly. Image Classification is more important to analyzed the pattern from the image datasets [15].

Image classification is not the new field for researchers. Many researchers proposed the different approaches for image classification. Martin Szummer and Rosalind W. Picard, described the Indoor & Outdoor image classification system which is based on nearest neighbor classification. They split the images into n blocks and extract color and texture features from different blocks and mixed them in order to exploit spatial properties related to the image. Their work shows 90 % accuracy on the dataset. An additional approach using neural network has been tried but without any improved results [16].

Another binary classification system has been proposed, where advanced structures like DCT coefficients obtained with the JPEG compression and edge directions are evaluated. The accurateness obtained was 94 percent for the best case in their test [17] & [18].

The WebSeek search engine performs the classification constructed on the data extracted from the color histograms related to the images [19].

The system described in this paper was not only uses some data from the image content, but also from the image context. The image content features which used the number of colors, the fraction of impure colors (not red, green or blue and not black, white or gray), the image shape (squareness), the neighbor variation (fraction of neighbor pixels having the equal color) and the color dispersion (distance of the mean color in the sorted color histogram). Moreover, the filename portion of the image URL is evaluated. If it contains words which are generally linked with the specified image class, then it is considered for the classification. Unfortunately, it is not easy task to assess the system accuracy [19] & [20].

The authors claim an accuracy rate of 92.3 percent for Web graphics and 91.4 percent for Web photographs. However, the definition of what they consider photographs and graphics is not clear. Also they don't specify exactly what specifies photographs and graphics [19] & [20].

The Vailaya et al. proposed a system to classify break images into dissimilar classes such as city/landscape, indoor / outdoor, and sunset / mountain / forest scenes. A Bayesian framework has been used to distinct the images in a classification hierarchy. The reported accuracy is 95.3 percent for city against scenery classification, 90.5 percent for indoor versus outdoor classification, and 96.6 percent for sunset against forest / mountain classification [21] & [22].

III. IMAGE DATASET

In order to create the database of images the JPEG format are used. The selection of JPEG format is because of the assumption, since images can be crushed in to the different way, according to the format, the classification algorithm has to be adjusted for multiple factors which have taken into the compact or changed palette and the noise will be added while resizing or compressing the images & the mixed dataset of images can't used with a single classification system.

The general formats used for synthetic images are *GIF* and *PNG* formats but it is not as much of used for encrypting photographs. For the communications of exact color images on the web, particularly photographic images the JPEG format is a good choice. The images are downloaded from internet & the images are capture using the digital camera [24] & [25]. The images reshaped into 256*256. After resizing balanced dataset are created by selecting 1000 synthetic & 1000 natural images. The images can be labeled as natural and synthetic images. The important steps in direction to classify an image is to extract the features from the underdone data of images. The mutual features will be combined into different ways in according to their classification methods.

IV. IMAGE FEATURES & THEIR EFFECTS

The features which is used in this classification system are color map, edge map, energy level, threshold ratio & nearest neighborhood classifier. The important steps to classify an image is excerpt the numerical features from the database of an images. To increase the performance and accuracy these features are combine to gather. In the following section of the paper I will describe & analyzed the effect of this single feature which classifying the images such as natural & synthetic images.

V. EFFECTS OF FEATURES

For the natural and synthetic images, the color transitions from pixel to pixel have different models i.e. for photographic and graphical images. Photographs describe the things of the actual world, which is not mutual to obtained regions of continual color such as context, because objects tend to be shaded and texture. During this process i.e. selection of a photograph, some noise is mixed into the subject which creates the neighbor pixels into the different RGB values. It is probable to exploit the simple features which is related to colors by removing and evaluating the features related to the image. The photograph images have more colorful than graphic images. Because the synthetic images tend to have big unchanging area with the same color. On the internet, in specific, graphics with some colors are common because they wrapping better. From the given image, the number of different colors of an image is extracted, but it cannot be straight used as metric, since the raw dataset of images is also reliant on from the size of the image. Therefore, sharp metric is used, between the number of different colors and the total pixels [27] & [28]. Color map for the input image is plot in black & white histogram of image which is calculated for the color image protracted histogram is used. The figure 1 & 2 show the color map for natural & synthetic images.

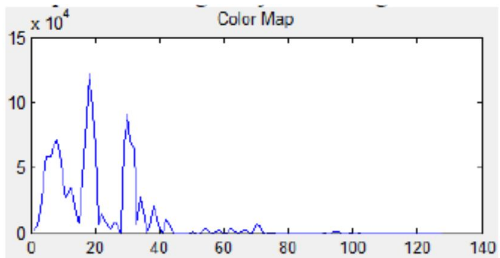

Figure 1

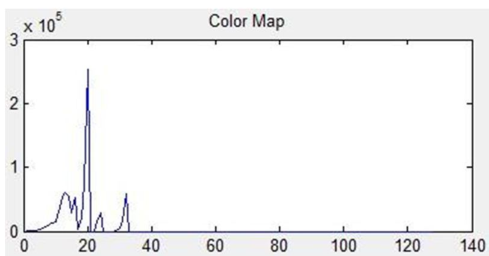

Figure 2

For the edge map, the edges of an images are collected from edge location and the edge maps are created. The following figure 3 & 4 explain the edge maps of natural & synthetic images.

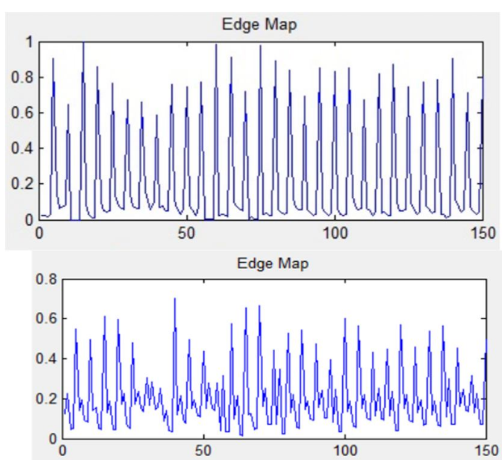

Figure 3 & 4

The color maps & the edge maps are then taken to achieve the high-level accuracy. The analysis of color maps & the edge maps of 1000 images is separately done for natural & synthetic image. If the number range of an image of color map is present in between 0 to 50 then the image is said to be synthetic & if the number of ranges is stretched than 50 images then said to be as natural image. The edge map shows very small difference in the number for natural & synthetic image. The point observed in natural image is greater structures the performance of image sub-classification method is increased & the accurateness is achieved up to 96%.

A. Energy Level

The image is converted into gray scale and the valuation of energy level is start. The rangfilt function can be used for texture analysis which gives the array of an image as returns, also each output pixel contains the range i.e. maximum value to minimum value of 3-by-3 neighborhood around the corresponding pixel in the input image. The image if have any dimension then the output image has the same size as that off input image. By using DWT, the overall energy is calculated. Then the correctness of image is twise which used to find out Single-level discrete 2-D wavelet transform. This a single-level 2-D wavelet perform the decomposition with specific wavelet. DWT2 is used to compute the estimate coefficients matrix and details coefficients matrix i.e. horizontal, vertical & diagonal which is obtained by a wavelet disintegration of the input matrices of an image. One set of DWT features is used in this work, which is vector quantity, it contains energies of wavelet coefficients which calculates in sub-bands of a successive scales [34] & [35]. For calculating the wavelet features the Harr wavelet is obtained from image and then it transfers into 4 sub-band images according the scale.

The maximum 8 scales can be calculated for DWT design at the next scale & Sub-band image i.e. *aLL* can be used for the given image. The sub-bands must have at least 8 by 8-point dimensions then and then only Harr wavelet can be calculated for the image. In the upcoming level the energy of three i.e. *dLH*, *dHL* and *dHH* can be calculated, at the sale which is present in ROIs.

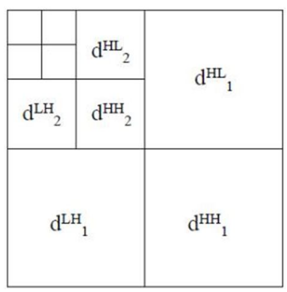

Fig 3 Sub-band Image

The ROIs are focused in consecutive scales in direction match to the sub-band image sizes. In the given scale, if the ROI scale contains at least 4 points then the energy can be calculated. The output of this technique is a vector, which contains the energies of wavelet coefficients and can be calculated in sub-bands at consecutive scales. The three-energy levels i.e. e1, e2, e3 for different natural & synthetic images can be calculated.

The natural images which are directly capture by using digital camera are chosen for the analysis, & the energy level are calculated for natural images are e1=55.36, e2=109.71, & e3 = 218.43.

The synthetic images are the part of some groups like a Logos, Maps, Chart, Drawing, & Windows Screen shoot. The energy belongs to each category is shown in following table.

TABLE I: ENERGY LEVEL

Energy	Logo	Maps	Drawing	Win App Screen Shot
E1	10.33	22.11	23.26	22.89
E2	20.65	44.22	45.14	45.78
E3	91.57	88.45	90.02	91.57

From the given analysis it is found that if the energy level is greater called as natural image otherwise called as synthetic image.

B. Threshold

The threshold of these images is calculated using the OTSU method. The strength of gray level images is expressed in L gray level i.e. 1, 2, ……. L. The amount of points with gray level at I is consider as x_i and the entire number of points can be expressed as $X = x_1 + x_2 + \cdots + x_L$. The histogram of gray level image is considered as occurrence distribution of probability.

$$P(i) = xi / X,\ x_i \leq 0,\ \sum_{i=1}^{L} x_i = 1.$$

The image pixels are separated into two parts i.e. C_0 & C_1 for foreground and background by the threshold t. Where C_0 represents the pixels with levels [t + 1, ……. L]. The probabilities of the class and average can be denoted as,

$$\omega_0 = \omega(t) = \sum_{i=1}^{L} p(i)$$

$$\omega_1 = 1 - \omega(t) = \sum_{i=t+1}^{L} p(i)$$

$$\mu_0 = \sum_{i=1}^{t} \frac{i.p(i)}{\omega_0} = \frac{1}{\omega(t)} \sum_{i=1}^{t} i.p(i)$$

$$\mu_1 = \sum_{i=t+1}^{L} \frac{i.p(i)}{\omega_1} = \frac{1}{1 - \omega(t)} \sum_{i=t+1}^{L} i.p(i)$$

The complete mean can be represented as

$$\mu_T = \sum_{i=1}^{L} i \cdot p(i)$$

We can find that, $\mu_T = \omega_0\mu_0 + \omega_1\mu_1$

Where ω_0 and ω_1 denotes the probabilities for foreground parts and background parts. Beside μ_0, μ_1 & μ_T are refers to the mean in gray level of the foreground, background and the entire gray level image. The class between variance ${\sigma_\beta}^2$ of the two classes C_0 & C_1 variance is given by [16]

$${\sigma_\beta}^2 = \omega_0 (\mu_0 - \mu_T)^2 + \omega_1 (\mu_0 - \mu_T)^2$$

The separate degree ŋ of the class, in discrimination analysis is ŋ $= max{\sigma_\beta}^2$. Finally, maximizing ${\sigma_\beta}^2$ to choose the optimal threshold t. $t^* = argmax{\sigma_\beta}^2$.

If the circulation of period i.e. C_k(K = o, or 1) is skew or heavy- tailed, Props function can be used. It is known that the mean value is robust and the estimate value equated with average gray level. Remember that the mid value is replace of the average value and may be obtained optimal threshold which is very accurate to presence of heavy-tailed C_k circulation used for the equate with this threshold which is selected by OTSU method [36]. Therefore, we can change the total mean i.e. μ_T with the complete medium m_T level of all the point in the entire gray level images. Likewise, for the whole image mean value μ_T the mean value μ_0 & μ_1 can be replace by medium gray level i.e. m_0 , for foreground part i.e. C_0 and the background part C_1 respectively.

The class between variance ${\sigma_\beta}^2$ of the two classes C_0 & C_1 can be rewritten as.

$${\sigma_\beta}^2 = \omega_0 (m_0 - m_T)^2 + \omega_1 (m_0 - m_T)^2$$

And the threshold t^* is chosen by maximizing ${\sigma_\beta}^2$ therefore, $t^* = argmax{\sigma_\beta}^2$.

The threshold calculated by using OTSU method is shows the better results in the image classification system. The threshold of 1000 natural images and 1000 synthetic images calculated. If the number present in between 0.0001 to 0.0002 called as synthetic image & if the number present in between 0.0005 to 0.0006 called as natural image.

VI. Conclusion

The correctness rate of color map of image shows 88% for natural images & 87% for synthetic images. The edge map shows the low level of accuracy as equated to the color map. Combined results of these two i.e. color map & edge map also be calculated which gives the results having the correctness of 87% for natural & synthetic images. The three steps of energy levels are calculated from the images and combined together to assess the class of image which shows 80% accuracy for natural and 85% for synthetic images. The threshold is calculated using OTSU method gives the error rate of 37 percent. The algorithm with all the features taken combine together & finding the best match which has increased the accuracy up to 90%.

References

[1] Chunxiao Zhang; Yongmei Hu; and et al; “The application of Wavelet in Face Image Pre-processing,” 4th International Conference on Bioinformatics and Biomedical Engineering (iCBBE), 2010; 978-1-4244-4713-8/102010 IEEE, 2010.

[2] N. N. Khalsa, Dr. V. T. Ingole, “Optimal Image Compression Technique based on Wavelet Transforms,” International Journal of Advanced Research In Engineering & Technology (IJARET), (ISSN: 0976-6499 online), Volume 5, Issue 3, March-2014.

[3] Nikkoo N. Khalsa, Dr. Vijay T. Ingole, “Novel method for classification of Artificial and Natural images,” International Journal of Scientific & Engineering Research, France (ISSN 2229-5518), Volume 5, Issue 3, March-2014.

[4] Gregor, K., Danihelka, I., Graves, A., Rezende, D. J., & Wierstra, D. (2015). DRAW, “A Recurrent Neural Network For Image Generation”. https://doi.org/10.1038/nature14236.

[5] Rastegari, M., Ordonez, V., Redmon, J., & Farhadi, A. (2016). “XNOR-net: Image net classification using binary convolutional neural networks”. Lecture Notes in Computer Science (Including Subseries Lecture Notes in Artificial Intelligence and Lecture Notes in Bioinformatics), 9908 LNCS, 525–542. https://doi.org/10.1007/978-3-319-46493-0_32.

[6] Kamavisdar, P., Saluja, S., & Agrawal, S. (2013). “A survey on image classification approaches and techniques”. International Journal of Advanced Research in Computer and Communication Engineering, 2(1), 1005–1009. https://doi.org/10.23883/IJRTER.2017.3033.XTS7Z.

[7] Pasolli, E., Melgani, F., Tuia, D., Pacifici, F., & Emery, W. J. (2014). “SVM active learning approach for image classification using spatial information”. IEEE Transactions on Geoscience and Remote Sensing, 52(4), 2217–2223. https://doi.org/10.1109/TGRS.2013.2258676.

[8] Korytkowski, M., Rutkowski, L., & Scherer, R. (2016). “Fast image classification by boosting fuzzy classifiers”. Information Sciences, 327, 175–182. https://doi.org/10.1016/j.ins.2015.08.030.

[9] Kalra K., Goswami A.K., Gupta R., “A Comparative Study of Supervised Image Classification Algorithms for Satellite Images”, International Journal of Electrical, Electronics and Data Communication, ISSN: 2320-2084, Volume-1, Issue-10, Dec-2013.

[10] Tangao Hu, Wenyuan Wu, Lijuan Liu, “Combination of Hard and Soft Classification Method Based on Adaptive Threshold”, IGARSS 2014.

[11] Haixia Bi, Jian Sun, Zongben Xu, “Unsupervised PolSAR Image Classification Using Discriminative Clustering”, IEEE Transactions on Geoscience and Remote Sensing, Volume 55 Issue 6.

[12] G. Prabhakar Reddya, Y. Deepika, K. Sai Prasad, Dr. G. Kiran Kumar, “Fuzzy Logics associated with Neural Networks in the Real Time for Better World”, International Conference on Advancements in Aeromechanical Materials for Manufacturing (ICAAMM-2016).

[13] Jianxin Wu, "Efficient Hik SVM Learning For Image Classification", IEEE Transactions On Image Processing, Vol. 21, No. 10, October 2012.

[14] Lizhen Lu, Liping Di, Senior and Yanmei Ye, “A Decision-Tree Classifier for Extracting Transparent Plastic-Mulched Landcover from Landsat-5 TM Images”, IEEE Journal Of Selected Topics In Applied Earth Observations And Remote Sensing, Vol. 7, No. 11, November 2014.

[15] Cheng-Hsuan Li, Bor-Chen Kuo, Chin-Teng Lin and Chih-Sheng Huang, “A Spatial–Contextual Support Vector Machine for Remotely Sensed Image Classification”, IEEE Transactions On Geoscience And Remote Sensing, Vol. 50, No. 3, March 2012.

[16] M. Szummer and R.W. Picard. Indoor-Outdoor Image Classification.

[17] H.J. Zhang. Scheme for visual feature-based image indexing. Proceedings of SPIE, 2420:36, 1995.

[18] A. Vailaya, A. Jain, and H.J. Zhang. On Image Classification: City vs. Landscape.

[19] J.R. Smith and S.F. Chang. Searching for Images and Videos on the World-Wide Web. IEEE Multi-Media, 1997.

[20] N.C. Rowe and B. Frew. Automatic caption localization for photographs on World Wide Web pages. Information Processing and Management, 34 (1):95–107, 1998.

[21] A. Vailaya. Semantic classification in image databases. PhD thesis, Michigan State University. Dept. of Computer Science & Engineering, 2000.

[22] Vailaya, M. Figueiredo, A. Jain, and H.J. Zhang. Bayesian framework for hierarchical semantic classification of vacation images. IEEE Trans. on Image Processing, 10(1):117–130, 2001.

[23] Vailaya. Semantic classification in image databases. PhD thesis, Michigan State University. Dept. of Computer Science & Engineering, 2000.
[24] Vailaya, M. Figueiredo, A. Jain, and H.J. Zhang. Bayesian framework for hierarchical semantic classification of vacation images. IEEE Trans. on Image Processing, 10(1):117–130, 2001.
[25] MM Gorkani and RW Picard. Texture orientation for sorting photos ’at a glance’. Pattern Recognition, 1994. Vol. 1-Conference A: Computer Vision & Image Processing., Proceedings of the 12th IAPR International Conference on, 1, 1994.
[26] E.C. Yiu. Image classification using color cues and texture orientation, 1996.
[27] Bradshaw. Semantic based image retrieval: a probabilistic approach. Proceedings of the eighth ACM international conference on Multimedia, pages 167–176, 2000.
[28] R. Schettini, C. Brambilla, G. Ciocca, A. Valsasna, and M. De Ponti. A hierarchical classification strategy for digital documents. Pattern Recognition, 35(8):1759–1769, 2002.
[29] V. Athitsos, M.J. Swain, and C. Frankel. Distinguishing photographs and graphics on the world wide web. Proceedings of the IEEE Workshop on Content-Based Access of Image and Video Libraries, pages 10–17, 1997.
[30] R. Lienhart and A. Hartmann. Classifying images on the web automatically. Journal of Electronic Imaging, 11:445, 2002.
[31] Hegerath, T. Deselaers, and H. Ney. Patch-based object recognition using discriminatively trained gaussian mixtures. In British Machine Vision Conference, volume 2, pages 519–528, June.
[32] Laptev. Improvements of object detection using boosted histograms. In British Machine Vision Conference, volume 3, pages 949–958, June.
[33] S. Lazebnik, C. Schmid, and J. Ponce. Beyond bags of features: Spatial pyramid matching for recognizing natural scene categories. In IEEE Computer Society Conference on Computer Vision and Pattern Recognition, volume 2, pages 2169–2178, New York, June 2006.
[34] Oliva and A. Torralba. Modeling the shape of the scene: a holistic representation of the spatial envelope. International Journal of Computer Vision, 42(3):145–175, 2001. Conference on Computer Vision and Pattern Recognition, volume 2, pages 2126– 2136, New York, June 2006.
[35] J. Zhang, M. Marszałek, and C. Lazebnik, S. Schmid. Local features and kernels for classification of texture and object categories: a comprehensive study. International Journal of Computer Vision, 73(2):213–238.
[36] G. Griffin, A. Holub, and P. Perona. Caltech 256 object category dataset. Technical Report UCB/CSD-04-1366, California Institute of Technology, 2007.
[37] H. Zhang, A. Berg, M. Maire, and J. Malik. SVM-KNN: Discriminative nearest neighbor classification for visual category recognition. In IEEE Computer Society
[38] Anshu Dhabhai, Yogesh Kumar Gupta, “Empirical Study of Image Classification Techniques to Classify the Image using SVM: A Review”, International Journal of Innovative Research in Computer and Communication Engineering (An ISO 3297: 2007 Certified Organization) Vol. 4, Issue 10, October 2016.
[39] Siddhartha Sankar Nath, Girish Mishra, “A Survey of Image Classification Methods and Techniques”, 2014 International Conference on Control, Instrumentation, Communication and Computational Technologies (ICCICCT) 604, July 2014.
[40] Mr. S.V.S.Prasad , Dr. T. Satya Savithri & Dr. Iyyanki V. Murali Krishna, “Techniques in Image Classification; A Survey”, Global Journal of Researches in Engineering: F Electrical and Electronics Engineering Volume 15 Issue 6 Version 1.0 Year 2015, Double Blind Peer Reviewed International Research Journal (USA), ISSN: 2249-4596 & Print ISSN: 0975-5861.
[41] M. K. Bashar, “Exploring Duplicated Regions in Natural Images”, Selected article for IEEE Transaction on Image Processing” 2010.
[42] Chopra, S. Kaur, H. Kaur, A; “Selection of best wavelet basis for image compression at decomposition level 5”: IEEE 2nd International Conference on Computer Technology and Development (ICCTD), 2010.