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Abstract. In the Indian population, a larger part is under the subsistence level. Most of the people are living in areas of poor sanitation and have very little access to good medical facilities. From time to time, they don't have the notice to go to a physician at the absolute time. The condition has been defined as a skin disorder or disease wherever there is a failure to induce the right identification and treatment in time typically ends up in advanced stages. Skin diseases tend to be itchy and cover the body easily. Among them, Psoriasis exists as a chronic inflammatory disease characterized by scaly patches on the skin. The proposed system focuses on SVM segmentation and scaling of 2D processed skin pore images of Psoriasis. The Feature Scaling Technique uses color, contrast, and image texture along with a combination of SVM classification features to diagnose and come up with a treatment solution. This computer-assisted image processing system removes erythematous from the psoriasis image for analysis and determination of growth rate. Therefore, earlier identification cuts back the symptoms of the illness and helps in developing a condition that indulges the strategies to live along with the disease condition called Psoriasis.

Keywords. Support vector machine, Psoriasis, Computer-assisted system, 2D processing

1. Introduction

In the Indian population, most people come below the poverty level. There are many individuals living in unsanitary conditions. The majority of illnesses and ailments prevail in such areas. These individuals possess access to medical facilities and awareness to go to doctors at the right time for early diagnosis and treatment. In the case of skin disorders, even more, awareness is less and individuals fail to address the disease conditions which leads to awful consequences at a high rate. Psoriasis, a form of skin disorder is illustrated by the development of red, scaly patches that occur in the elbows, knees, trunk, and scalp. This disorder also causes itchiness and irritation to the skin. Psoriasis can be defined as a chronic disease condition with no cure. The growth occurs in cycles, development is from a couple of weeks to months. Psoriasis is assumed to be condition in which the skin regenerates at high rate compared to normal. This nature of Psoriasis is mainly due to the changes in the immune system that redefines the state of skin cells. Within seven days, the life cycle change causes the growth of the cells at a rapid rate on the surface of the skin. During the interval of 28 to 30 days, the normal skin matures. Psoriasis lesions cause damage to the additional skin nearby forming patches, and redness leading to the spread of the lesions. These psoriasis patches in severe conditions

differ from smooth localized red patches to patches all over the skin surface. The different types of psoriasis can be defined as Plaque, inverse, guttate, pustular, and erythrodermic. Plaque psoriasis is the common form that produces red patches with a silver-white line made up of dead skin cells in that region of skin. Treatment for psoriasis lesions is not defined to be specific. In general, visual perception is the diagnostic tool of dermatologists. Different forms of treatment, topical and systematized ways and measures for the disease control but working of appropriate medication for the right person occurs with time. The Image examination technique is broadly useful for medical science, and it's great to use especially within the skin protection field that enables us to identify patches on the body, quantify precious areas by disease, find the affected area's boundaries, to fix the affected area's color, to define size and shape of diseased portion and also to identify the portion correctly. Computer-aided technology is an advanced pathway for the analysis of the severity of the lesions of psoriasis by defining the score of variations /severity. These scores were stated to be of prior clinical importance. The assessment of the severity of Psoriasis based on computer systems is predominantly increasing to define a precise and reliable severity score and also to observe the variations in the lesions which is a significant part of clinical practice. Improper acquisition of data and varied illumination increases the difficulty in the process of identification. The lack of availability of a psoriasis image dataset is defined as the biggest obstacle to the identification of the lesions and their variations. If the problems are resolved, a method of identification is defined that leads to early detection of the disease. Hence, a definite method of psoriasis identification and growth rate determination using the Feature Scaling Technique and SVM classification. Treatments are available to control symptoms. Therefore, earlier identification can reduce the symptoms of the disease and helps in the adaptation of lifestyle habits and strategies that defines a better life to live with psoriasis.

2. Literature Survey

Research is the creation of the latest knowledge and utilization of existing knowledge. Sanapathi Tharangini, Gurajala Rama Krishna et. al., (2018) describe a computer-based early skin cancer detection system. This is an efficient diagnosis method compared to the conventional process called Biopsy. Image processing techniques and image segmentation is performed using Particle Swarm Optimization. Classification of the malignant melanoma obtained from the Dermoscopic images is analyzed by the Hidden Markov model. Separation of the cancerous region from the healthy skin and extraction of GLCM features from the segmented images. Depending on the features, the skin images are classified into cancerous and non-cancerous. From the results, the proposed technique successfully detects skin cancer from images and gives better accuracy [4].

Rashid, M H O. et. al., (2018) introduce a way for tumor detection from MRI images. The MRI brain Input image consists of numerous noises which are removed using morphological operations for exact segmentation. In this study, the anisotropic filter is employed for its higher performance. The Support vector machine (SVM) classifier is applied for the image segmentation process that classifies the pixels into two categories. The unsupervised learning-based kernel is used in SVM for classification. Finally, the proposed system is ready to notice the tumor accurately [5].

Saifudeen Safeer M., et. al., (2017) propose a study that reveals the progression of the stages of mastitis stated as the Viterbi path that begins with the process of inflammation which is defined as a body's second line of defense [7]. A sequence of stages in bovine clinical mastitis is analyzed by studying the transition changes between stages and also defining the emission probabilities of the symptoms. The Hidden Markov model was used for the analysis of the stages of mastitis.

Zhang Tian Chi, et. al., (2016) illustrates a comparative model for the analysis of the SVM methods for normal common images and medical images [10]. In this paper, the research focuses on the application of SVM for the process of image segmentation. Two ways of applying the technique for

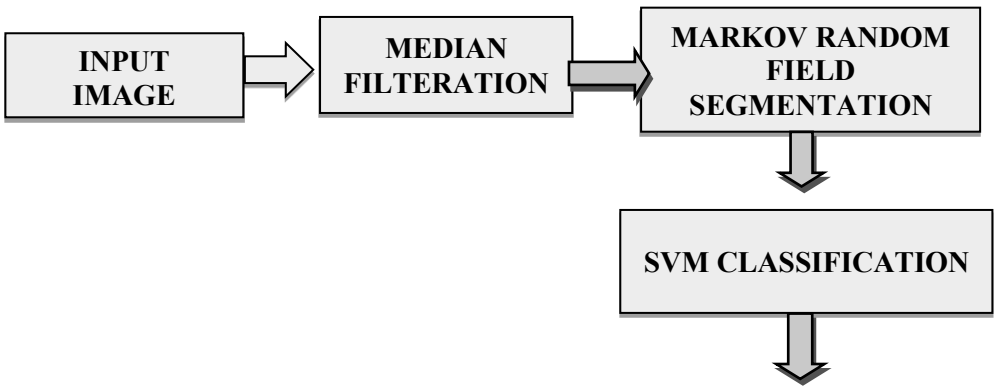
the segmentation process, one improving the methods and applying for medical image segmentation. Other is adding image features and modifying SVM for medical image segmentation. Thus the application of Support vector machine (SVM) for image segmentation is made effective and compared.

Sukkar Rafid, et. al., (2012) describes Hidden Markov Models (HMM) to define the progressive sickness that is compared with the Alzheimer's Disease stages. HMM is used for the identification of the progression of the disease which is illustrated to be unsupervised learning. The effective nature of the model is defined by statistical features determining the patterns in disease progression [13]. The study illustrates that the HMM technique is an efficient progression for the identification of AD compared to the conventional processes involving the Clinical Dementia Rating Scale Sum of Boxes scores. The classification of cognitively stable and stages of AD with both HMM and the clinical parameters are compared. Thus, HMM classifies the progression stages of AD which provides a different perspective of the disease. In this proposed methodology, the feature scaling of the psoriasis region using SVM is performed for early diagnosis and also for the determination of growth rate to define an absolute treat as a solution

3. Methodology

In computer-assisted skin disorder identification, skin pore images are useful for higher visualization of the skin surfaces enabling higher skin disorder identification. In this paper, we principally focus on image-based-psoriasis skin disorder identification and rate of growth detection. The platform used here is Microsoft visual studio, which we've created it using the .Net framework. The overall methodology is delineated within the given figure1.

In this paper, processed skin pore images of psoriasis, which is taken as the input image are acquired from 'Dermnetz.org', an online data source that contains images of all disorders related to skin. It contains all the information and related to skin, including images of different types of psoriasis – guttate, plague, pustular, and erythromycin [20]. For this work we have taken 25 guttate psoriasis images, 25 plague psoriasis images, and 20 normal skin images which are processed digitally to remove the skin pores and hairs, enabling a better visualization of the diseased region.



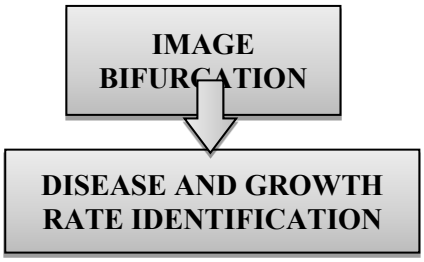


Figure 1. Block diagram of the proposed methodology.

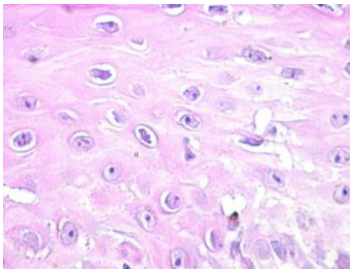


Figure 2. a)Plague Psoriasis. b) Guttate Psoriasis.

In this paper, the psoriasis images are converted into LAB space images for further processing. The processed skin pore images have been taken for median filtration for noise removal and image enhancement [16]. Reduction of noise from the image can be stated as the initial pre-processing step. In the filtration process, the code is written in order to process the image based on the width and height of the pixels. The function of the median filter is mainly the replacement of the pixels of the image with median values than the average pixel values in neighborhood ω as described in equation (1), and it also tries to get rid of the background pixel from the original image to emphasize the other regions with green color for image enhancement. The median filter is used for the filtering of skin images of different skin disorders or abnormalities which isolates the median pixels for the enhancement of the region.

$$g[x, y] = median\{f[i, j], (i, j) \in \omega\} \qquad (1)$$

Markov Random Field (MRF) is the segmentation process used in the detection process [4]. It is a probabilistic model which captures the discourse constraints like intensity, color, texture, and so on from an image [7]. MRF Segmentation produces good, flexible, and stochastic image models to seek out an adequate illustration of the intensity distribution of the taken input image for locating the hidden attributes like edges, texture, and region labels [8, 13]. This also enables to separation of the image into foreground and background creating a marker that enables to differentiation of the problematic portion from its background pixels [14]. Markov random field model specifically defines the scaling boundaries of the abnormal regions in Psoriasis images for the analysis [17].

Support Vector Machine (SVM) is an algorithm of machine learning that can be applied to the process of classification or determination. SVM uses a way known kernel trick to transfigure the data and then based on that it detects an optimal boundary between the optimal outputs. The technique does extremely complex data transformations, then figures out a way to separate data based on the outputs defined [6, 11]. In this paper, SVM is used in combination with MRF constraints for the process of segmentation of the region of interest. The next step is image bifurcation. Bifurcation means to separate. The number and size of the bifurcations known as minutiae vary from image to image. Here

each of the segmented images is bifurcated into nine parts for easier identification of the diseased region [13, 16]. Based on the bifurcation process, relativity nature of the images are obtained. Disease and rate of growth identification are very important to not solely facilitate those affected to know what it's, however it is also to expand awareness so everyone understands what psoriasis is and is not. In this paper, based on the intensity values and the image pixel data of the segmented images, the type of psoriasis and also its growth rate is defined.

4. Results and Discussion

Skin analysis has potential uses in several fields, as well as in computer-aided diagnosing for dermatology. There exists an AI-based psoriasis classification method using a multi-class machine learning algorithm, which can identify psoriasis at an early stage[1]. In this paper, our main goal is to develop a system that recognizes psoriasis skin disease and displays users the results as detected disease and its growth rate. The software platform used here is Microsoft visual studio (2010 version), with .Net framework. The processed skin pore images of psoriasis, which is taken as the input image are acquired from 'Dermnetz.org', an online free data source containing information and images of all disorders related to skin.

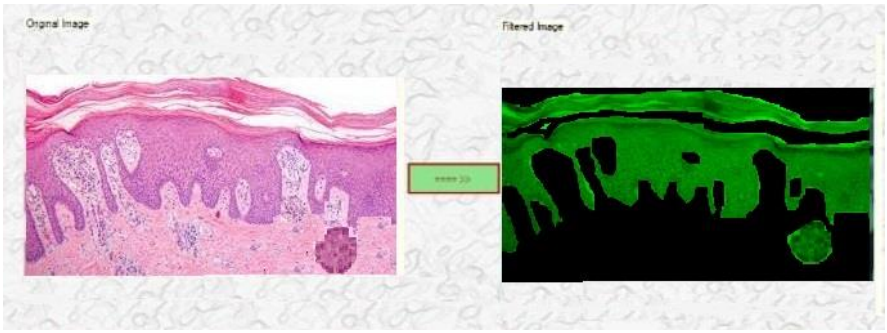


Figure 3. Input image with Filtered image.

The image processing starts with filtration as in figure 3. The filtration method used here is median filtering. During the filtration process, the program is done to process the image based on the width and height of the pixels. The median filter removes the noise pixels and enhances the green channel for analysis

The next step is Segmentation. The filtered image is taken as the input for segmentation, where the method used is Markov Random Field (MRF)Segmentation as in figure 4. Using this method, the background of the images for better visualization. Markov random field segmentation enables to split of the image into foreground and background creating a marker that enables to differentiate the problematic portion from its background pixels. Also, the threshold value – high and low, sigma value, and the mask size of the filtered image is taken as a parameter for identifying the dominated pixels during the segmentation process.

Figure 4. MRF segmented image.

After MRF model application in segmentation, the region with the largest boundary is defined with the SVM method to identify and segment the affected area. The coding is done in such a way that, the dead cell pixels are removed that is the normal skin image does not show any dominated grayscale or black pixels, so those pixels are removed. Then the skin portion where the problem is present is determined as in figure 5. Later the original image impinging leads to the RGB segmented region. The SVM techniques implemented for the process of segmentation produce a defined segmented output image which is used for the bifurcation step.

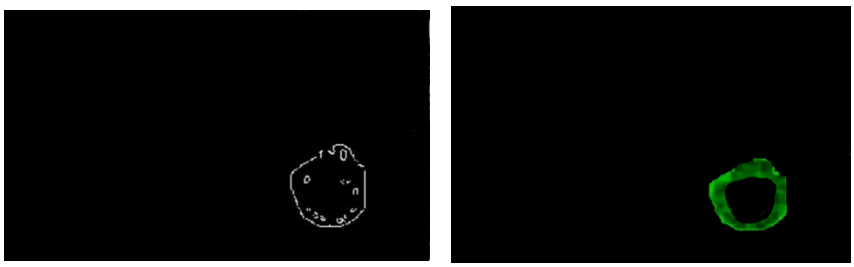


Figure 5. SVM segmented image a) Binary image b) RGB image.

Next is the image bifurcation step, where the segmented psoriasis images are split into small segments. Here the coding is done to split up the images into nine equal portions and is stored for identifying disease occurred region. Figure 6 illustrates the bifurcation step of the segmented image**.**

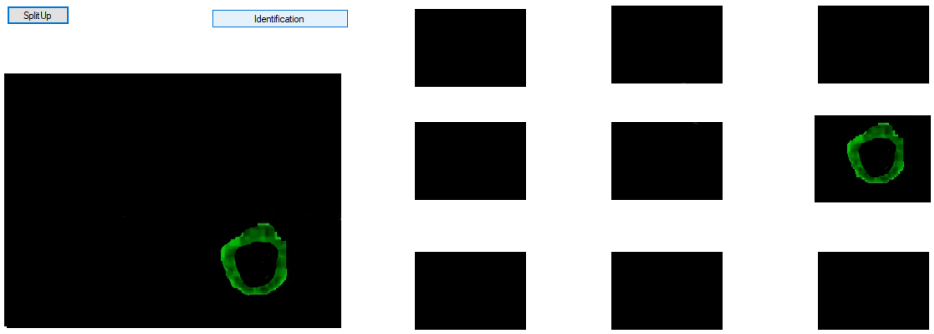


Figure 6. Output of segmented image bifurcation.

After bifurcation, these images are taken for fetching the relativity value of the segmented image segments. The coding enables the calculation of the relativity of the different types of images are

analysed using the bifurcation process. The image fragment with psoriasis always showed a higher relativity value related to bifurcation (>40) than the normal skin image. Therefore, the value 40 is fixed as a defining point of relativity which is illustrated by the largest boundary and abnormal constraint values defined by the MRF and SVM models. So, if the relativity value of the image becomes greater than 40, the section is considered as the most disease-prone region and is considered for identification of psoriasis and if the relativity value is less than 40, it is considered as that section of the image have no greater impact on the skin cells. Finally using the relativity value, the problematic portion is recognized and is loaded to the identification step. In figure 7, image relativity based on bifurcation is illustrated.

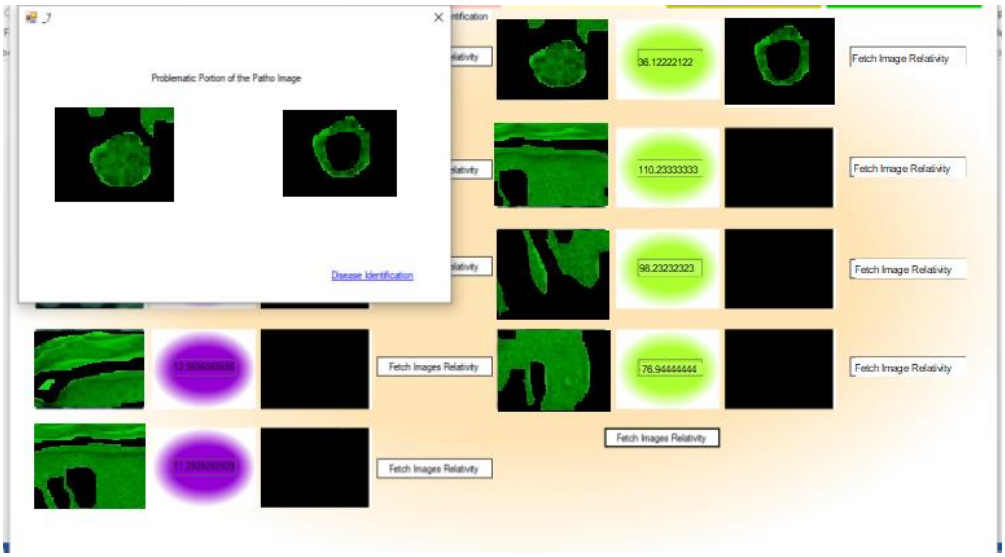


Figure 7. Image relativity output.

In the final stage of identification, where the problematic image portion is loaded to identify the pixel data like x-axis, y-axis, z-axis, red, green, and blue values. The obtained values are taken to the IBM pathological information portal, where the obtained values are compared with the already available values in IBM for the guttate and plaque psoriasis. Thus, by comparing the obtained value and already available value, the type of psoriasis is analyzed, either plague or guttate, and is shown as the detected disease. If the input given is of a normal skin image, then it won't be showing any result in the detected disease box. This is how the identification is done. And the obtained pixel data also provide the percentage of growth of the disorder. In figure 8, illustrates the final stage of the identification process in which skin disease identification-based GUI is defined with the pixel extractor values of the bifurcated images and the growth rate analyzed based on the constraints of the images.

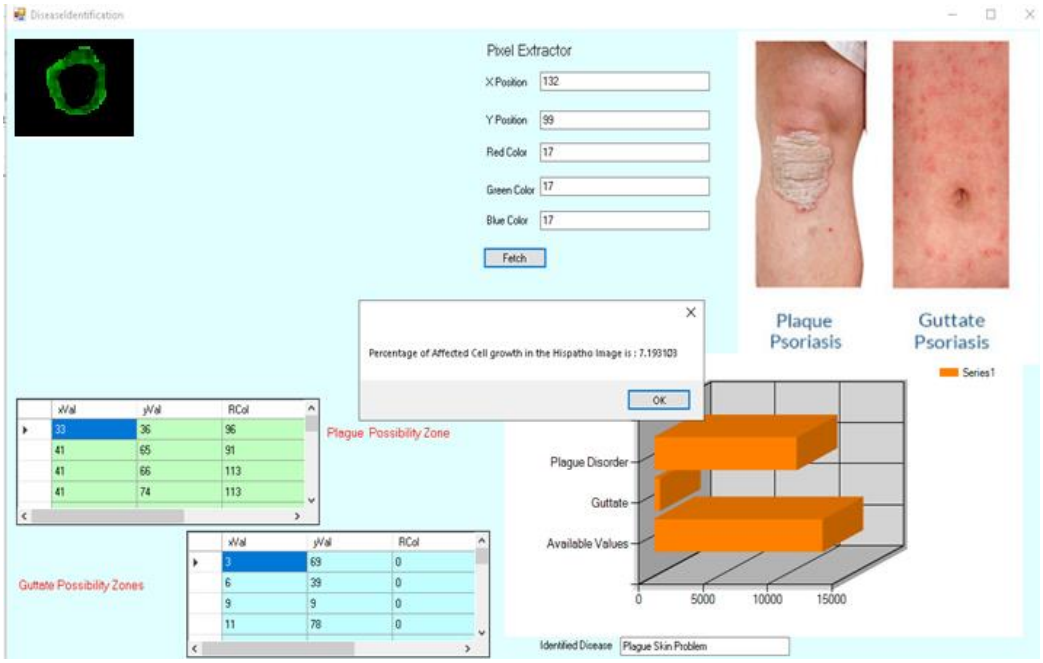


Figure 8. Skin disease identification.

Table 1. Comparison of IBM values – Plague psoriasis; Guttate psoriasis.

IBM VALUES (RANGE)	Xval	Yval	Rcol
PLAGUE PSORIASIS	40-50	3-83	88-120
GUTTATE PSORIASIS	0-40	1-116	0-48

For the description and determination of the efficiency of the technique, image samples like plague psoriasis and Guttate psoriasis are considered. In general, Table 1 illustrates the IBM standard values for the plague psoriasis and Guttate psoriasis which helps in comparison of the output values determined based on the processed technique. This table defines the range of the values to determine the complete growth rate of the disease.

In table 2, the values of Xval, Yval, and Rcol of the proposed technique for a few images are determined for the determination of the growth rate

Table 2. Comparison of output value – Plague psoriasis; Guttate psoriasis.

Image	Obtained values					
	PLAGUE PSORIASIS			GUTTATE PSORIASIS		
	Xval	Yval	Rcol	Xval	Yval	Rcol
Img1	41	65	91	1	1	0
Img2	41	66	113	3	70	2
Img3	41	74	113	6	40	1
Img4	42	6	113	9	10	2
Img5	42	12	91	11	79	3
Img6	42	75	96	14	49	0
Img7	43	8	102	17	19	0
Img8	43	9	113	19	88	5
Img9	43	10	108	22	58	5
Img10	43	11	102	25	28	5
Img11	43	67	108	27	97	0
Img12	43	75	113	38	76	2
Img13	39	13	96	41	48	45
Img14	40	64	102	41	49	34
Img15	41	5	119	41	50	17
Img16	41	12	108	41	51	0

Thus the output of the skin disease identification is finally obtained with the type of psoriasis and its growth rate.

5. Conclusion

Psoriasis is a skin disease that is spread throughout the world at a high rate and also defined as a chronic inflammatory skin disease. Early detection and determination of the growth rate is necessary to reduce the effects of the disease condition. In the proposed method, feature scaling using SVM was performed for diagnosis and determination of growth rate. In this method, the psoriasis images obtained from the database contain noise. The median filtration method is used to remove the noises present while preserving the edges for further processing. This filtered image is processed with Markov Random Field (MRF) Segmentation to remove the background pixels, obtaining the boundaries or edges of the image for better visualization of the affected area by identifying the dominated pixels making use of the threshold, sigma and mask size values. Then the region with the largest boundary is defined to the SVM model where the obtained problematic skin portion is defined separately. The image classifier then saves this image for the bifurcation process where the filtered and classified images are split up into nine equal parts. These bifurcated image segments are used to identify the relativity value of the images providing stronger evidence to psoriasis affected portion. Further, the pixel data of this psoriatic image segment is identified for determining the type of psoriasis present i.e. either guttate or plague psoriasis. The pixel data also provide the percentage of growth rate of the disease. Thus early identification of the type of psoriasis present and its growth rate provides a pragmatic approach for psoriasis diagnosis and treatment.

Ethical Statement

There are no ethical issues in using the data and images acquired from the database

Conflicts of Interest

There are no conflicts of Interest among the authors in publishing or submitting the manuscript to the Journal.

References

[1] R Kalbande, Uday Khopkar, Avinash Sharma, Neil Daftary, Yash Kokate and Royston Dmello 2020 Early Stage Detection of Psoriasis Using Artificial Intelligence and Image Processing *Soft Computing: Theories and Applications* p 1199-1208.

[2] Prem J Patil, Sagar J Buchkule, Varsha S More and Sanket G Abhale 2020 Skin Disease Detection using Image Processing Technique *International Research Journal of Engineering and Technology (IRJET)* **10** p 664-67.

[3] Venmathi AR, EN Ganesh and N Kumaratharan 2019 Image Segmentation based on Markov Random Field Probabilistic Approach *International Conference on Communication and Signal Processing* p 0490-95

[4] Sanapathi Tharangini and Gurajala Rama Krishna 2018 Skin Cancer Detection Using Particle Swarm Optimization *International Journal of Creative Research Thoughts* **6** p 737-43

[5] M H O Rashid, M A Mamun, M A Hossain, M P Uddin 2018 Brain Tumor Detection Using Anisotropic Filtering, SVM Classifier and Morphological Operation from MR Images *International Conference on Computer, Communication, Chemical, Material and Electronic Engineering* p 1-4

[6] Mariusz Kubanak, Janusz Bobulski 2017 The use of hidden Markov models to verify the identity based on facial asymmetry *Eurasip Journal on image and video processing* **45** https://doi.org/10.1186/s13640-017-0193-2

[7] Safeer M Saifudeen, S Selvam, A SermaSaravanaPandian, R Venkataramanan, A Mohamed Safiullah 2017 Detection of Progression of Clinical Mastitis in Cows Using Hidden Markov Model *International Journal on Pure and Applied Bioscience* **5** p 436-41

[8] Natalie Garzorz-Stark, Linda Krause, Felix Lauffer, Anne Atenhan, Jenny Thomas, Sebastian P Stark, Regina Franz 2016 A novel molecular disease classifier for psoriasis and eczema *Exp Dermatol PubMed* **25** p 767-74

[9] Gulbahar Sarac,Tuba Tulay Koca,Tolga Baglan 2016 A brief summary of clinical types of psoriasis *Journal Northern Clinical Isthambul* **3** p 79-82

[10] Tian Chi Zhang, Jing Yang, Jian Pei Zhang, Jing Zhang 2016 SVM Methods in Image Segmentation *The Sixth International Conference on Advanced Collaborative Networks, Systems and Applications* p 62-65.

[11] Vimal K Shrivastava , Narendra D Londhe , Rajendra S Sonawane , Jasjit S Suri 2016 Computer-aided diagnosis of psoriasis skin images with HOS, texture and color features: A first comparative study of its kind *Comput Methods Programs Biomed* **126** p 98-109

[12] Ying Wang, Susan M. Resnick, Christos Davatzikosm 2014 Analysis of Spatio-Temporal Brain Imaging Patterns by Hidden Markov Models and Serial MRI Images *Human brain mapping* **35** p 4777-94.

[13] Rafid Sukkar, Elyse Katz, Yanwei Zhang, David Raunig, and Bradley T. Wyman 2012 Disease Progression Modeling Using Hidden Markov Models *Proceedings of 34th Annual International Conference of the IEEE EMBS* p 2845-48

[14] Amir Kolaman, Amir Egozi, Hugo Guterman 2011 Relativity and contrast enhancement *International Conference on Information Visualization Theory and Applications* p 94 -99.

[15] Zoltan Kato 2008 Markov Random Fields in Image Segmentation *SSIP* p 2-155.

[16] S Bharathi *et al* 2021 Identification of Melanoma from Nevus Images *J. Phys.: Conf. Ser.* 1917-012027

[17] Guo-Shiang Lin, Kuan-Ting Lai , Jian-Ming Syu, Jen-Yung Lin and Sin-Kuo Chai 2021 Instance Segmentation Based on Deep Convolutional Neural Networks and Transfer Learning for Unconstrained Psoriasis Skin Images *Appl. Sci.* **11** 11. 3155. 10.3390/app11073155.