Gabor Filter and Moment Invariant via LDA Classifier for Skin Cancer Detection

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Abstract. Skin cancer may be a serious tumor. This can be clearly seen through the mature, uncommon appearance of fur pathology, which has abnormal properties in complex situations, wrinkled or uncertain perimeters, and dual colors. A small number of tulle melanomas of uncertain diameter can imitate benign moles and cannot be perceived by optical inspection. The only assumption for analyzing them is through dermoscopy as an option. Original identification and medical surgery can alternative for the patients. Within this research a detection method through image processing with various feature extraction such as Gabor filter and Hu Moment were employed and substantially improves the diagnosis performance with 97% via LDA Classifier.

1. Introduction

There is a developing enthusiasm for creating programmed frameworks which assist the medical specialty in primeval identification of skin cancer which is consider mixture of a couple of important stairs such as segmentation of image, feature selection, extraction and classification. The paper [1] new mathematical descriptors for the border of pigmented skin lesion images, like lesion slope and lesion slope regularity. The different works proposed incredible techniques to cancer segmentation and characterization. They consist of color clustering [2], wavelet analysis [3], Markov tree capabilities [4], use of color texture [5], software program of worldwide and dynamic thresholding, GVF snakes [6] and so on. Different solutions utilizing the chosen descriptors have been proposed. They include Linear Discriminant Analysis (LDA), clustering technique, fuzzy and neuro-fuzzy systems, K-Nearest Neighbour (KNN), neural networks, support vector machines (SVM), random woodland, Naive Bayes and so on. Ganster et al. [2] has completed 87% sensitivity and 92% specificity for a large statistic set with greater than 5300 dermoscopy images.
Recent results show 90.05% specificity and 83.06% sensitivity of cascade classifiers in tenfold pass-validation mode for recognition of melanoma in medical images [7]. Early texture kind methods are used for exploring the statistical evaluation of image.

These research objectives are to propose the most effective operator for the motive of describing the nearby image sample and simultaneously produce a tremendous image type accuracy effects. This search work analyse the results of preprocessing steps with different features extraction and classifiers. This will allow the most effective and efficient of features extraction and classifiers to be identified [8-13].

2. Methodology

The system software design must consider the slightest difference between each cancer image. The flow chart of the proposed system is shown in Figure 1. After the cancer images have been employed for the feature extraction steps. A set of three texture descriptors that are well accessed, namely Hu Moment and Gabor filter are employed and paired with innovative approaches in order to improve the performance of cancer images recognition. The system is developed on Windows 10 Ultimate 64-bit operating system with Intel Core i5 3210M CPU@2.50GHz processor, and 16 GB of RAM. The application used for coding purposes of the system is by using MATLAB R2010a software.

![Flow Chart of Skin Cancer System](image-url)
Database
The flow chart will start from development of preprocessing and object segmentation from (MIAS) Mammographic Image Analysis Society database. The dataset consists of 70 melanoma and 100 naevus images from the digital image archive of the Department of Dermatology of the University Medical Center Groningen (UMCG) used for the development and testing of the MED-NODE system for skin cancer detection from macroscopic images [11]. Next, will go through development of feature extraction algorithm which all image will go process features extraction that consist many types of features. For the next step is development of decision-making system using artificial intelligence technique.

Gabor Filter Feature Extraction
These filters can be considered as edge, line, and shape detectors. An important characteristic of Gabor filters is that they can be tuned with different frequencies and orientations. Daugman [1] was a representation of the Gabor's characteristic space minimization of the uncertainty principle of the 2-D junction in space and frequency. Besides that, there are translations of the hemispheric vascular cells in the visual of mammals are better. "Gabor 2-D [1].The advantage of using Gabor filters seems to be some degree of invariance to intensity, translation and guidance [12].

Hu Moment Invariant Feature Extraction
An must issue in the tract of pattern analysis is the identification of characters and objects, regardless of their orientation, size, and position. The idea of employed moments in attribute identification gained distinction when a set of invariant moments is derived using dynamic variants [10]. Hu defines seven values, calculated by normalizing the central moments through order three, which are invariant to the object's scale, position and orientation [7].

LDA Classifier
Linear Discriminant Analysis is a method based on the Fisher criterion. It is widely used in statistics, machine learning and pattern recognition, in which it risks the essays in a space to find a better classification by dispersing a fraction of a group within the group, so that the models in an identical group are gathered together and the average time judgments in various groups are loose. It finds a linear feature combination that separates or characterizes two or more objects or classes of events. This, in turn, will be used as a linear classifier or more frequently used for dimensionality reduction for the subsequent classification process. Linear Discriminant Analysis was closely linked to ANOVA and regression analysis. It is intended to express other measurements as a dependent variable or as a linear combination. ANOVA and regression analysis use numerical quantity as dependent variables, while LDA uses a categorical variable [13].
3. Result and Discussion

This section will focus on the result of performance analysis which is accuracy, sensitivity, specificity, Area under curve, F-measure, kappa and precision of melanoma cancer images classification by comparing each feature extraction method used with LDA classifier.

![LDA Result Percentage Chart]

**Figure 2.** Result percentage of Hu Moment with Linear Discriminant Analysis (LDA)

Figure 2 shows that the result percentage with HUMO features into Linear Discriminant Analysis. Each result will show different percentage and there are 7 results of HUMO features. For sensitivity, the highest percentage sensitivity for HUMO is 82.64%. The Specificity, accuracy and area under curve give 85.48%, 85.63% and 86.75%. Next, the percentage for F-Measure is 81.70%. Lastly, Kappa and Precision eventually gives 80.67% and 82.77%.
Figure 3. Result percentage of GABOR with Linear Discriminant Analysis (LDA)

Figure 3 shows that the result percentage with GABOR features into Linear Discriminant Analysis. Each result will show different percentage and there are 7 results of GABOR features. For sensitivity, the highest percentage sensitivity for GABOR is 86.00%. The Specificity, accuracy and area under curve give 86.90%, 88.74% and 86.31%. Next, the percentage for F-Measure is 88.73%. Lastly, Kappa and Precision eventually gives 88.14% and 89.15%.

4. Conclusion

This research work has successfully developed a salient feature extraction and classification technique to classify skin cancer images which is there are two types of image that is melanoma and naevus. This is crucial for extracting the feature of the skin cancer image. Once image preprocessing has been done, four feature extraction method namely Hu moment Vector and Gabor Image were test with Linear Discriminant Analysis (LDA) to determine the best result of sensitivity (SE), accuracy (ACC), precision (Pre), kappa, F-measure (Fmea), area under curve (AUC) and specificity (SP) for skin cancer images classification. Overall all those analysis performance gives higher than 90%.

5. References

[1] C Grana, G Pellacani, R Cucchiara, S Seidenari, A new algorithm for border description of polarized light surface microscopic images of pigmented skin lesions. IEEE Trans. Med. Imag. 22(8), 1235–1247 (2003)
[2] H Ganster, A Pinz, E Wildling, M Binder, H Kittler, Automated melanoma recognition. IEEE Trans. Med. Imag. 20(3), 233–239 (2001)

[3] R Garnavi, M Aldeen, J BaileyJ, Computer-aided diagnosis of melanoma using border and wavelet-based texture analysis. IEEE Trans. Inf. Technol. Biomed. 16(6), 1–13 (2012)

[4] M Duarte, T Matthews, WS Warren, Calderbank, Melanoma Classification from Hidden Markov Tree Features. Int. Conf. ICASSP, 2012, pp. 6865–688

[5] AG Manousaki, AG Manios, EI Tsompanaki, AD Tosca, Use of color texture in determining the nature of melanocytic skin lesions—a qualitative an quantitative approach. Comput. Biol. Med. 36, 419–427 (2006)

[6] M Silveira, JC Nascimento, JS Marques, AR Marcal, T Mendarca, S Yamauchi, J Maeda, J Rozeira, Comparison of segmentation methods for melanoma diagnosis in dermoscopy images. IEEE J. Sel. Top. Sign. Proces. 3(1), 35–45 (2009)

[7] P Sabouri, HH Gholam, T Larsson, J CollinsJ, A Cascade Classifier for Diagnosis

[8] of Melanoma in Clinical Images. Engineering in Medicine and Biology Society

[9] (EMBC) 36th Annual Intern. Conf. of the IEEE, Chicago, 2014

[10] I. Giotis, N. Molders, S. Land, M. Biehl, M.F. Jonkman and N. Petkov: “MED-NODE: A computer-assisted melanoma diagnosis system using non-dermoscopic images”, Expert Systems with Applications, 42 (2015), 6578-6585

[11] N. Howlader, A.M. Noone, M. Krapcho, J. Garshell, N. Neyman, S.F. Altekruse C.L. Kosary, M. Yu, J. Ruhl, Z. Tatalovich, H. Cho, A. Mariotto, D.R. Lewis, H.S. Chen, E.J. Feuer, K.A. Cronin, SEER Cancer Statistics Review, 1975-2010, National Cancer Institute. Bethesda, MD, http://seer.cancer.gov/archive/csr/1975_2010/, based on November 2012 SEER data submission, posted to the SEER web site, April 2013.

[12] A K Junoh, M N Mansor, S Yaacob, A Z Mukhtar, S F Fauzi, M S Abu, W Z A Wan Ahmad, W N Wan Jaafar, (2012) “LDA Classifier for Home Monitoring System”, Lecture Notes in Information Technology (ISSN: 2070-1918)

[13] M N Mansor, M N Rejab (2013). “Infant Pain Recognition System with GLCM features and GANN under Unstructured Lighting Condition” in 2013 IEEE International Conference on Control System, Computing and Engineering (ICCSCE2013)