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Skin Cancer Cell Detection Using Optimization Algorithms

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ABSTRACT

Skin cancer is a serious type of disease, malignant growth in particular, Basal Cell Carcinoma (BCC), Squamous Cell Carcinoma (SCC) and Melanoma, Melanoma is the riskiest in which endurance rate is extremely low. Melanoma can be detected earlier, potentially increasing survival rates. The skin malignant growth location innovation is comprehensively partitioned into four essential parts, viz., picture pre-processing which incorporates hair expulsion, de-clamor, honing, resize of the given skin picture, division which is utilized for portioning out the district of interest from the given picture. Segmentation can be done in a variety of ways. K-means, threshold in histogram, and other segmentation algorithms are some common ones. Features extraction from the segmented image and image classification using the segmented image's features set for this purpose, a variety of classification algorithms can be utilized. Classification is performed by machine learning and deep learning algorithms in the most recent skin cancer detection technology. Support vector machine (SVM), feed forward artificial neural network, and deep convolutional neural network are the classification algorithms that are utilized the most frequently. This paper gives an alternate kinds of improvement calculations for skin malignant growth cell identification.

Keywords: Optimization, Machine Learning, Support Vector Machine, Carcinoma, Melanoma

1 Introduction

Cancer, as a difficult disease to treat, has long occupied the human mind [1]. Cancer occurs when cells in a part of the body grow uncontrollably, divide rapidly, invade different tissues in the body, and spread throughout the body [2]. A set of these uncontrollable cells is called a tumor [3]. One of the deadliest sorts of cancers is skin cancer. Skin cancer has grown significantly over the past decades, and the importance of its early treatment is increasing day by day [4]. Melanoma is the third most common type of skin cancer and one of the malignant cancers. Melanoma is also referred to as malignant melanoma, which changes the color of the skin due to the abnormal function of pigment-producing cells. The disease is formed by the accumulation of melanin granules and its spread to the outermost layer of the skin. Despite significant mortality, melanoma is often treatable in the early stages of diagnosis. At the same time, distinguishing between melanoma and other benign moles in the early stages of development is a challenging task, even for derma- tologists. Melanoma is known as the 19th prevalent cancer in men and women. There were about 300,000 new cases in 2018. The data



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gathered by the World Health Organization (WHO) in 2018 showed that there were 17852 melanoma cases in the United Kingdom [5]. This organization predicted that the number of melanoma cases will grow by 9% to 19513 with deaths growing by 13% to 3119 by 2025. The growth of skin cancer begins when damage to skin cells (often caused by ultraviolet light) causes mutations that rapidly multiply in skin cells and form malignant tumors. Normally, skin cells grow in a controlled and regular way. However, some newly produced cells may grow out of control and form a mass of cancer cells. Changes in the shape, size, and color of a person's mole are often the first signs of melanoma. [6]. Melanoma has a black or bluish-black border; melanoma also appears as new black spots with an abnormal appearance.

2 Recent Works

In [1] In this paper, a method for skin lesion classification and segmentation as benign or malignant is proposed using image processing and machine learning. A novel method of contrast stretching of dermoscopic images based on the methods of mean values and standard deviation of pixels is proposed. Then the OTSU thresholding algorithm is applied for image segmentation. After the segmentation, features including Gray level Co-occurrence Matrix (GLCM) features for texture identification, the histogram of oriented gradients (HOG) object, and color identification features are extracted from the segmented images. Principal component analysis (PCA) reduction of HOG features is performed for dimensionality reduction. Synthetic minority oversampling technique (SMOTE) sampling is performed to deal with the class imbalance problem. The feature vector is then standardized and scaled. A novel approach of feature selection based on the wrapper method is proposed before classification. Classifiers including Quadratic Discriminant, SVM (Medium Gaussian), and Random Forest are used for classification. The proposed approach is verified on the publicly accessible dataset of ISIC-ISBI 2016. Maximum accuracy is achieved using the Random Forest classifier. The classification accuracy of the proposed system with the Random Forest classifier on ISIC-ISBI 2016 is 93.89%. The proposed approach of contrast stretching before the segmentation gives satisfactory results of segmentation. Further, the proposed wrapper-based approach of feature selection in combination with the Random Forest classifier gives promising results as compared to other commonly used classifiers.

In [2] Skin Cancer is one of the hazardous types of cancer. It is basically an unusual growing of skin cells which mostly develops on skin contact with the sun. Nowadays it also develops on areas of the skin which is not in contact to sunlight. It is essential to detect cancer at prior or else it tends to gradually spread over the other parts of the body. Here we present numerous machine learning techniques that are used to identify various types of cancer and classify whether it is Malignant or Benign. There are four main steps included in the process namely Preprocessing, Segmentation, Feature Extraction and Classification. The Paper concentrates on the comparison of different types of methods which can be used for the above steps.

In [3] Skin cancer is the far most common type of cancer. This can be treated effectively if it



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found early. The cancer detection in early stages is very expensive. Skin cancer is the abnormal growth of the skin cells. These are highly curable when identified and treated early. There are four types of skin cancers: Actinic Keratoses (AK), Basal cell carcinoma (BCC), Dermatofibroma and Melanoma. The late identification of cancer leads to the spread over other organs. The skin cancer can be detected from the images using convolution neural networks. ISIC image dataset and HAM10000 dataset will be used in this implementation. Transfer learning improves the performance of the model in CNN's. Pre trained models are used to extract features, which further used to classify types of skin cancer. The machine learning and deep learning methods used in this implementation are Random Forest, SVM, CNN and Dense net.

In [4] Skin Cancer is a dangerous disease which occurs in almost all age groups especially at an older age. It is due to the abnormal growth or rapid growth in the epidermal layer of the skin, which leads to the growth of tumor. Cancer need to be differentiated from other skin diseases as it occurs on in tissue levels where as other diseases affects to only upper layer of epidemics. As the treatment and detection is at high cost, technology can help predict the cancer at early stage, thereby reducing the detection of cancer's cost athletes and also can help save time. A fully accurate machine to detect cancer stages is difficult to prepare but at least a probability can be given and thus the medical test can further be performed if the accuracy of the machine is not up to mark. So we have proposed a CNN (Convolutional Neural Network) which can predict and classify skin cancer with a better accuracy as compared to normal Support Vector Machine.

In [5] The proposed algorithm applies feature extraction using ABCD rule, GLCM and HOG feature extraction for early detection of skin lesion. In the proposed work, Pre-processing is to improve the skin lesion quality and clarity to reduce artifacts, skin color, hair, etc., Segmentation was performed using Geodesic Active Contour (GAC) which segments the lesion part separately which was further useful for feature extraction. ABCD scoring method was used for extracting features of symmetry, border, color and diameter. HOG and GLCM was used for extracting textural features. The extracted features are directly passed to classifiers to classify skin lesion between benign and melanoma using different machine learning techniques such as SVM, KNN and Naïve Bayes classifier. In this project skin lesion images were downloaded from International Skin Imaging Collaboration (ISIC) in which 328 images of benign and 672 images of melanoma. The classification result obtained is 97.8 % of Accuracy and 0.94 Area under Curve using SVM classifiers. And additionally the Sensitivity obtained was 86.2 % and Specificity obtained was 85 % using KNN.

3 Proposed Work

Particle Swarm Optimization (PSO) is a metaheuristic technique which follows the social behavior of animals like fish and bird, which is first proposed by Eberhart and Kennedy in 1995 [5]. The algorithm finds the optimized solution from better to best in consecutive



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iteration. Each particle in the population is a candidate solution of the optimization problem. Each individual particle has a position in the search space of all possible solution. Let particle p has a position $POSp$ in the search space SP in Fig. 1. The position of the p th particle is shown as $POSp(t)$. Every particle requires memory to store the knowledge of the value (best solution, i.e., fitness function) of the personal best solution, $PBestp(t)$, achieved by the corresponding particle and another memory keeps the global best solution, $GBest(t)$. The particle $POSp(t)$ has the velocity

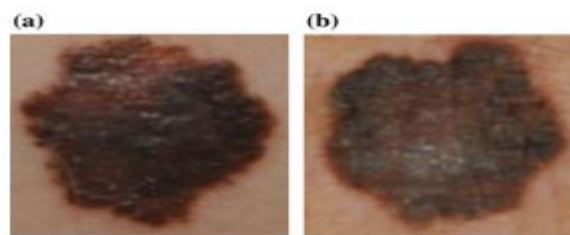


Figure 1. Malignant Melanoma Image

$V_p(t)$. Due to the presence of three vectors $V_p(t)$, $(PBestp(t) - POSp(t))$ and $(GBest(t) - POSp(t))$ the particle moves from its initial location to its updated position. Updating the position of the particle is done by the following equations (Eqs. 1 and 2):

$$POSp(t+1) = POSp(t) + V_p(t+1) \quad (1)$$

where

$$V_p(t+1) = w.V_p(t) + c1.r1.(PBestp(t) - POSp(t)) + c2.r2.(GBest(t) - POSp(t)) \quad (2)$$

where w , $c1$ and $c2$ are real valued co-efficient. In Eq. 2, w is called inertia co-efficient and $c1$, $c2$ are called acceleration co-efficient. More precisely $c1$ is the individual particle learning rate and $c2$ is the social influence. $r1$ and $r2$ are uniformly distributed random number between 0 and 1.

The step wise PSO algorithm is as follows:

Step 1: Take a group of N particle.

Step 2: Initialize position and velocity vector $POSp(t)$ and $V_p(t)$ respectively of each particle p in time t .

Step 3: Calculate the personal best solution, $PBestp(t)$ of each particle p and the global best $GBest(t)$ is the best among personal bests.

Step 4: Revise every particle's position vector $POSp(t)$ and the velocity vector $V_p(t)$ by Eqs. 1 and 2.

Step 5: Execute step 3 and step 4 until the termination condition is met.

Step 6: Output the final solution.



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4 Results and Discussion

From the extracted 1900 features, 1875 features are taken for entire experiment as 25 features are excluded as they are constant across the dataset. The full dataset has 170 samples including malignant melanoma and nevus and 1875 number of features in each sample, for classification of the dataset multilayer neural network (MLP) is used. In the present work 119 images (70% of 170) are used for training, 26 images (15% of 170) for validation and 25 images (15% of 170) for testing with 3 fold cross-validation. Fixing optimal number of hidden layer and finding optimal neuron size in each hidden layer is a tricky task for complex problem like this one. In the proposed work Particle Swam Optimization is used to solve this problem. Two hidden layer are taken in the back propagation MLP, with maximum 500 neurons in each layer

Table 1: *Performance Comparison of Existing and Proposed Work*

Related Work	Accuracy (%)	Sensitivity (%)	Specificity (%)
Goitis et.al. [6]	83	82	80
Present Work	85.6	84	83

5 Conclusion

The present work achieves better result than Giotis et al. [6] with an increment of accuracy of 2.6%. In all performance criteria the present work achieves better result than Giotis et al. The present work using PSO searches optimized neural network parameter faster than exhaustive search. All extracted 1875 features are used in the classification task. Feature selection and transformation can be used to reduce feature dimensionality in future work. It is reported that the clinical accuracy is around 85% by dermatologist in diagnosis of malignant melanoma [19]. In the present work the system achieves 2.9% better accuracy than the clinical accuracy by the dermatologist for detection of cancer cell.

References

1. Kopec D; M. H. Kabir; D. Reinharth; O. Rothschild; J. A. Castiglione, Year: 2003, "Human errors in medical practice: systematic classification and reduction with automated information systems", J. Med. Syst. UK, Vol: 27, no: 4, pp. 297–313.
2. Rigel Darrell S; Robert J Friedman, Year: 1993, "The rationale of the ABCDs of early melanoma", J. Am. Acad. Dermatol. Vol: 29, no: 6, pp. 1060–1061.
3. Kennedy James; Russell Eberhart, Year: 1995, "Particle swarm optimization", In: Proceedings of the IEEE International Conference on Neural Networks, pp. 1942–1948.
4. Giotis Ioannis; Nynke Molders; Sander Land; Michael Biehl; Marcel F. Jonkman; Nicolai Petkov, Year: 2015, "A computer-assisted melanoma diagnosis system using non-dermoscopic images", Expert Syst. Appl. Vol: 42, no: 5, pp. 6578–6585.



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5. Tan Teck Yan; Li Zhang; Ming Jiang, Year: 2016, “M.: An intelligent decision support system for skin cancer detection from dermoscopic images. In: Proceedings of the 12th International Conference on Natural Computation”, Fuzzy Systems and Knowledge Discovery (ICNC-FSKD), Vol: 10, no: 5, pp. 2194–2199.
6. McDonagh; Steven; Robert B. Fisher; Jonathan Rees, Year: 2008, “Using 3D information for classification of non-melanoma skin lesions. In: Proceedings of Medical Image Understanding and Analysis”, Vol: 12, no: 5, pp. 164–168.