1.1 Abstract

Melanoma can be noted the furthest hazardous kind of skin cancer. There is a necessity to make decision assistance systems to perceive it while it is still in early phases. Nevertheless, growing such kind of systems are challenging and complicated subject for researchers. Many Computer Aided-Diagnosis (CAD) systems have been recommended in the past two ten years to increment the correctness of melanoma finding. In this paper, we survey broad the Skin Cancer Detection literature. We identify more than 15 works determined by using PubMed, Google Scholar search tool, IEEE Xplore Digital Library conferences and journals.

Keywords: **Skin Cancer, Mobile Aplication, Classification, Melanoma, Feature Extracion, Segmentation**

1.2 Introduction

Considering the American Cancer Society [7], the rates of melanoma have been increasing during the last 30 years. Different projects and applications have been improved for the early detection of skin cancer for many years. Some projects developed as mobile application and some projects are just machine learning algorithms to classify the type of lesion as melanoma or non-melanoma. But no studies done in this field in Turkey. We will develop a mobile application that users can follow up themselves when they think there is a risk of skin cancer. The application will scan the lesion and tell the user if the situation is risky. At the same time, users can create their own archives in the application so, application will tell the difference between the present and the past, it will make comparisons. It won't make any diagnosis. We have made researches covering the last five years for the steps we will follow while developing our application. We have examined many data sets and tried to find the most useful one. In the rest of this article, we explained which methods work better and which algorithms we should use. Five fundamental steps were mentioned: image acquisition, image pre-processing, image segmentation, feature extraction and image classification.

1.3 Image Acquisition

It can often be described as an act of importing the image from a source that can be a camera picture, so it can be passed later on which actions should be taken. Image acquisition in image processing is the initial pace in the workflow series because no processing may be probable outside the image.

1.4 Pre-processing

The main purpose of image pre-processing is to increase readability of images and decrease undesirable distortions such as hair and artifacts. Also, pre-processing is used to improve visibility of feature of interest. Therefore, various algorithms enhanced to improve performance.

1.4.1 Grayscale Conversion

Grayscale image is 8-bit image and each pixel includes 256 shades of gray combination. Grayscale images are easier and more faster to process than colored images [1]. Due to this reason, entire pre-processing methods are applied on grayscale images.

1.4.2 Hair Removal Methods

- **Median Filter**

  In the literature [1] [4] [5] [14], Median Filter is using for removing hair and noise from an image. One of the non-linear digital filtering techniques is median filter. The essential aim is used to improve results of afterward processing techniques. Median filters work like this; entire image pixels are considered by median filter. It specifies whether it is representative of its region and it is replaced region's pixel values with median value. Median filter is the most proper technique for medical images.

- **DullRazor Software**

  In the literature [5][16], DullRazor is used by authors. The software uses to aim remove unwanted noise from an image. DullRazor Software consists of 3 steps.

  i. Noise such as hair is defined by grayscale morphological closing operations.
  ii. It confirms shape of noise pixels and replaced confirmed pixels. Bilinear interpolation is used for this step.
  iii. The DullRazor Software smooths replaced noise pixels by adaptive median filter.

1.4.3 Contrast Enhancement

Contrast enhancement is a technic that improves the scanning of images. The original image with low contrast does not give better results, so image enhancement increases with contrast enhancement. One of the contrast enhancement algorithms is Contrast Limited Adaptive Histogram Equalization (CLAHE). Contrast Bounded Adaptive Histogram Equalization is applied to the image to obtain a contrasted image in which the correct features can be derived [14]. Each image pixel is processed, and image contrast is advanced. The output image is well suited for other operations.

1.4.4 Other Image Enhancement Methods

Gaussian filter [15], is used to reduce noise from an image. Also, it used to smooth and blur images. Karhunen-loeve Transformation, Corner Space Transformation and Luminance Transformation [13] and Image Uneven Illumination Correction [16], Corner Detection[16] are used for increase quality of image.

1.5 Image Segmentation

Segmentation is the process of parting an image into significant specks, like the needed zone is segmented, from that could infer the essential knowledge for upward processing. It simplifies description of an image, so it makes easier to analyze. Image segmentation is the operation of partition or gathering an image into several pieces.

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1.5.1 Otsu's Method

OTSU algorithm is an automatic threshold selection region-based segmentation technic. It is widely used due to its simplicity and effect and is expected to find the ideal value for the global threshold. It is mainly based on the image histogram; it is quite divided by the values of pixels and regions from the edges of the image. It tries to segment it by applying variance in each of the smallest classes. The operation is compatible with images in the two-pixel classes following the two-mode histogram distribution.[2][4][3][14][9]

1.6 Feature Extraction

The feature extraction phase might be specified like data compression, which extracts extra and unrelated data while protecting appropriate information. The features chosen to calculate the

detected moles of skin are based on knowledge and experiments regarding appearance characteristics and variations among benign and malignant skin lesions. Nevertheless, it extracts many initial features to discover the most essential and efficient features.

1.6.1 Gray level co-occurrence matrix (GLCM)

GLCM is a table of how often a combination of several pixel brightness values (gray levels) will be created in each pixel mapping of the image. Using a two-dimensional gray-level formation matrix is often and widely used in the field of texture analysis to find the positional dependence of brightness (gray level) values that help find valuable information about adjacent pixels in the image The properties obtained based on GLCM are contrast, energy, homogeneity, correlation and another statistical parameters like mean, skew and kurtosis. [7][10][15][16].

1.6.2 ABCD scale

The ABCD (Asymmetry, Border irregularities, Color variation and Diameter) criteria is used by medical doctors for diagnosing. Every criteria are multiplied with a dedicated weight factor to product Total Dermoscopy Score (TDS). TDS values smaller than 4.75 shows benign melanocytic lesion, values between 4.8 and 5.45 shows a doubtful lesion, and values of 5.45 or larger are extremely possible of melanoma. Formula for TDS: [(A score x 1.3) + (B score x 0.1) + (C score x 0.5) + (D score x 0.5)].

1.7 Classification

After the feature extraction step, finally, we will use image classification to decide the lesion is cancerous or noncancerous. Last five years, most of the research showed machine learning and deep learning algorithms are the best way to detect skin cancer. After researching, classification algorithms with the highest accuracy value will be used in our mobile application. Every research has a different number of and type of classes.

1.7.1 Convolutional Neural Networks (CNNs):

Deep learning, particularly the convolutional neural network (CNN), has been widely applied to unravel several issues in computer vision [6]. There are different CNN architectures and they all have different results. AlexNet, GoogLeNet, VGG, ResNet are the most popular ones. Some of structures (for example, GoogLeNet, ResNet) are valid as pre-trained patterns, originally trained on roundly 1.28 million natural images of the data set ImageNet. Accordingly, structures can use weights and prejudices from these pre-trained patterns. So, if we fine-tune all layers of these models by continuing with back propagation using our data, they can also be applied to our special classification task. Alternative structures like AlexNet and VGGNet are launched so that their weight and aberrations are not affected with visual knowledges that could vary from the skin

images. [17].

1.7.2 Support Vector Machine (SVM):

SVM is also a binary classification algorithm. Which means, the result can only belong to one of the two classes. In our case, classes will be cancerous and noncancerous. The purpose of SVM is to create hyperplane that separates two classes with a maximum gap between them [1]. Support Vector Machine is essential for training data in the form of samples named feature vectors and data output samples named labels [2]. Such as differ algorithms, data splited into two pieces: training and testing. The SVM algorithm is helpful for noisy data and large data sets. For better CPU performance with large data sets, we can also use Linear SVM. [16].

1.8 Conclusion

We identify more than 15 works in this literature review, and we selected "top papers" as shown in table. According to the table, these algorithms and methods are highly convenient to use for detection of skin cancer.

Reference	Pre-Processing Methods	Feature Extraction	Classification	Accuracy
[1]	Median Filter	GLCM	SVM	95%
[14]	Clahe&Median Filter	GLCM	SVM	90.44%
[7]	Resizing	GLCM	ANN	88%

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