Review paper

Artificial intelligence in cancer diagnosis and treatment methods.

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Article Info	Abstract
	Skin cancer is the most common type of cancer in the whole world and it accounts for 75% of all cancers in the world. Different types of cancers can occur in the skin. The most common cancers are basal cell cancer or squamous cell cancer, but some of them are especially pigment cell cancer, which is one of the rarest types of skin cancer. Image processing is one of the fascinating technologies and sciences that has many applications and is used in many fields. In this context, we can mention identity recognition, face recognition, computer vision, classification and understanding of video and images, which are practical aspects of image processing. One of the applications of image processing that has developed a lot in recent years is its use in medicine and medical imaging. One of the important parameters in using computers to improve medical images is the detailed analysis of images. In many cases, the separation of similar lesions in different medical sciences is difficult and error-prone with the human eye, and the processing of medical images is supposed to turn these limitations into opportunities and provide qualified services to doctors in better diagnosis. Therefore, in order to increase confidence, you can use a computer and process medical images. In image processing, operations must be performed to prepare images, recognize and extract information. The set of processes that take place in image processing systems are: pre-processing, improving the quality of images, converting images and finally classifying images and analyzing images from each of these processes in medicine to increase and improve the quality of images and extract Their concept is applicable.

Introduction

The proliferation and sometimes abnormal proliferation of body cells is called cancer. The human body is made up of millions of cells, which together form tissues such as muscles, bones and the body. Most of the body's normal cells grow and reproduce in response to threats from inside and outside the body. If these processes happen in their correct way, the body remains healthy and maintains its normal function. But the problems will start when a normal cell has mutated or changed into a cancer cell. The appearance and function of cancerous cells are different from normal cells. In this case, the mutation or change in the DNA or the genetic material of the cell happens [9]. Skin cancer is a disease that arises from malignant cancer cells in the outer layers of the skin. The skin's job is to protect your body from light, heat, infection, and injury. The skin also stores water, vitamin D and fat in the body. Skin cancer involves abnormal changes in the outer layer of the skin. Skin cancer is the most common and common type of cancer in the whole world and it accounts for 75% of all cancers in the world. Worldwide, doctors diagnose about 160,000 new cases of melanoma every year [2]. In any case, most people with skin cancer recover, but due to its high prevalence, it is one of the major concerns of people. The skin has different main layers and different types of cells. The upper layer of the skin is called the epidermis, which contains 3 types of cells, which we will introduce below:

1-Squamous cells: wide, scale-like cells on the surface of the skin

2- Basal cells: round skin cells

3- Melanocytes: cells that determine the color of your skin.

Different types of cancers can occur in the skin. The most common cancers are basal cell carcinoma or squamous cell carcinoma. Most skin cancers only grow locally and involve nearby tissues, but some of them, especially melanoma, which is the rarest type of skin cancer, may spread through the lymphatic system or blood circulation and reach the farthest. points relative to the location of the lesion. . Because melanoma has different characteristics compared to other types of skin cancer, it is not as common as other skin cancers, but this type of cancer is very dangerous and malignant and can be fatal if not treated on time. Skin cancer is more common in fair-skinned people who spend a lot of time in the sun. Skin cancer can occur anywhere on the body, but it is more common in places that are exposed to sunlight, such as the face, neck, hands, and arms. The symptoms of skin cancer are different. The most common symptom of skin cancer is a change in the skin, abnormal growth or a wound that does not heal, sometimes a small bump appears.

This protrusion can appear with different characteristics and forms. These features include:

1. Appears as a shell-white, skin-colored or pink bump.

2. This bump is transparent, in the sense that you can see a little inside it from its surface. For example, small blood vessels are often visible in them. In people with darker skin, these lesions may be darker but partially transparent. In the most common type of this cancer, this lesion appears on the face and ears. These skin lesions of this disease may tear, bleed and peel excessively.

3. It is in the form of a brown, black or blue lesion or a lesion with dark spots, along with raised and clear edges.

4. A flat, red, scaly spot with a raised lip that is more common on the back or chest.

Over time, these spots can become larger.

5. A white, waxy, scar-like lesion without a clear border; This type of leg cell cancer is called morpheaform, which has the lowest prevalence [26].

It should also be considered that any pain or dullness in the skin is not a sign of this disease, but as soon as you see a change in your skin, you should take this seriously and see a doctor.

One of the most important known causes of skin cancer is continuous exposure to ultraviolet rays over many years. It can be said that no one is immune to this cancer, but those who are at greater risk are: men and women with fair skin who get sunburned more often, people who spend a long time in the sun like farmers, traveling salesmen and sailors are also exposed to the same danger. In any case, contact with sunlight cannot be absolutely avoided, but people with fair skin should prevent this cancer or reduce its risk by reducing exposure to ultraviolet rays or by not being exposed to these rays [27].

In some other rare cases, other factors can cause basal cell skin cancer, including:

1. Exposure to radiation

2. Arsenic exposure

3. Complications caused by scars, infections, tattoos and burns

4. Chronic inflammatory skin diseases

It should be noted that if a person gets this disease according to the mentioned conditions, after contracting this disease, the probability of its return is high. In general, factors that increase the risk of leg cell cancer can be divided into two categories: genetic and non-genetic.

Genetic factors can increase the risk of basal cell cancer:

1. Family history of this disease

2.White skin

3. Skin that quickly gets freckles or sunburn

4. Having skin that does not tan or darken in the sun, but only becomes red and inflamed

5. The presence of hereditary syndromes that cause skin cancer; including skin abnormalities, nervous system problems or endocrine disorders

6. Having fair skin, red or blonde hair, or colored and bright eyes

In general, gender is also effective in the incidence of this cancer. Basal cell cancer is more common in men than women.

The non-genetic factors of this disease also include:

7. Increasing age is directly related to the increased risk of infection

8. Constant exposure to sunlight

9. Severe sunburn, especially in childhood

10. Living in high altitudes or sunny places

11. Exposure to radiation therapy

12. Arsenic exposure

13. Taking immunosuppressive drugs, especially after organ transplant surgery [26]

A . image processing

Image processing is one of the fascinating technologies and sciences that has many applications and is used in many fields. In this context, we can mention identity recognition, face recognition, computer vision, video and image classification and understanding, which are all applications of image processing. One of the applications of image processing that has developed a lot in recent years is its use in medicine and medical imaging. One of the important parameters in using computers to improve medical images is the detailed analysis of images. In many cases, the separation of similar lesions in different medical sciences is difficult and error-prone with the human eye, and the processing of medical images is aimed at turning these limitations into opportunities and providing competent services to doctors in better diagnosis. Therefore, in order to increase confidence, you can use a computer and process medical images. It is hoped that with the development of this science and the help of medicine, more of our fellows will be saved from dying from severe diseases [2].

Image processing is a processing technique with the help of mathematical operations that uses any form of signal processing. This method is also used in medical applications to diagnose and treat various diseases [5].

Digital processing is actually digital image processing that can be implemented with the help of programming, computer knowledge and artificial intelligence. Image processing is one of the applications and subsets of artificial intelligence, which, as its name suggests, is processed on digital images and displays a certain output along with specific information based on predetermined training. Today, the applications of image processing technology in various ways in industrial, technical, medical, scientific and security fields have caused it to be highly regarded and used by various people and businesses [31].

B. Medical image processing

In general, in image processing systems, we usually have several major processes, which are: Pre-processing, image quality improvement, image conversion and finally image classification and analysis. Each of these processes are used in medicine to improve the quality of images and extract their insights and concepts. In the following, we explain each of these processes and their applications in detail.

C. Preprocessing

Pre-processing is used to correct problems in the captured images that may occur during medical imaging, such as light or noise, and corrects them intelligently. In medical imaging, there may be disturbances caused by different lighting in the background, high-frequency reception, and problems caused by light orientation, which image processing and artificial intelligence help to correct, and usually by default on all images. received is applied [14-23].

D. upgrade images

This process is used to facilitate the interpretation of images and their understanding. Even after the pre-processing stage, the images may not have sufficient resolution or may not have the appropriate quality to display the information in the images. For this reason, each image may require special settings in terms of brightness and dispersion. Artificial intelligence and image processing are also used for this purpose in medical imaging.

E. Convert images

Some images may require various manipulations. For example, when we need to make changes or use color in images or corrections, etc., we can use image processing and image conversion process. Image processing can intelligently perform all these operations on medical images with the help of artificial intelligence.

F. image analysis

After the previous processes are done on the images and the images are improved in terms of quality, the image analysis process is used to extract the information and features in the images. For this purpose, various techniques such as edge detection, image segmentation, etc. are used. Image analysis is also one of the applications of intelligent image processing in medical imaging.

G. image processing software

In the field of image processing, there are many software with many features, each of which can be used in different fields.

H. results

In this research, the mobile phone waste classification system has four main features:

1- Record / select image

2- Image processing

3- Extraction feature

4- Classification

The Open CV library, which is a computer vision function, has been used to implement the image processing features required by the system. The following block diagram shows the connection between different parts:
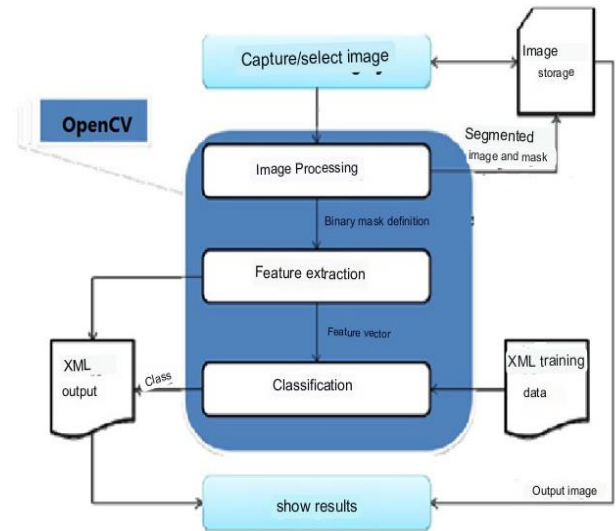

Fig. 1: The architecture of the system in the automatic classification mobile system [9].

I. extraction of feature vectors:

First, feature vectors are extracted from cancerous and non-cancerous images. Dataset database images are located in two folders: positive (non-cancerous images) and negative folder (cancerous images). In the database, there are num_pos=130 non-cancerous images and num_neg=120 cancerous images.

The matrix of feature vectors corresponds to the images and the rows of the matrix are the variables of the feature vector. n is equal to the total number of images in the database, n=num_pos+num_neg and m is the number of feature vector elements. We extract two different feature matrices from images and compare the performance of each in classifying skin wound images. Feature 1 function is the violet transformation feature, Feature 2 function extracts the geometric and color features related to skin wound areas.

1- In extracting the violet transform feature (1Feature) for each input image, 40 image channels

2- In the extraction of geometric and color features (feature 2), a vector with 28 elements is extracted for each input image.

J. methods of running programs:

1- To extract feature vectors of images, run Extract Features.m program.

By running this program, a data file containing matrix of feature vectors and vector of labels is generated for each feature.

Data0.mat file →   Violet attribute

Data2.mat file   →   Geometric and color features

It takes about one minute to run the program to read all the images in the database and extract all the feature vectors.

2- The program performs the dimension reduction operation of the feature matrix using the principal component analysis (PCA) method and implements the classification operation of positive and negative images using the support vector machine (SVM) algorithm and measures accuracy, sensitivity, and detection. and calculates and displays the confusion matrix for each feature. The feature vector extraction program needs about a minute to read all the images and extract the feature vectors. Therefore, the feature extraction program and the classification program are written separately from each other so that there is no need to re-extract the feature vectors every time the data is classified.

K .Calculating the accuracy of the image classification algorithm:

L .Description of the k-fold cross validation method

To check the accuracy of the image classification algorithm, we use the k-fold cross validation method (k=01). In this method, we divide the total sum of positive and negative images in the database into k groups. In each step, we train the SVM support vector machine classification algorithm using training images, and then calculate the accuracy parameters of the classification algorithm using test images.

M .criteria for calculating the accuracy of the image classification algorithm:

In a binary classifier, based on the output of the classifier, we will have the following four modes:

True Positive (TP)= Images that were positive and correctly predicted positive

Negative (TN)= Images that were negative and were correctly predicted to be negative

Positive (FP)= Images that were positive and were predicted to be falsely negative

Negative (FN)= Images that were negative and were predicted to be falsely positive

The higher the TP and TN, the better the performance of the algorithm. The lower the FP and FN, the better the performance of the algorithm. The above four values are displayed in the confusion matrix as shown below. This matrix shows how many of the classified samples are correct and how many are incorrect. The numbers on the main diagonal of the matrix indicate the number of correct classifications. And the numbers on the subdiameter indicate the number of wrong classifications. If all the numbers on the subdiameter are zero, the classification algorithm has maximum accuracy.

Fig. 2: P and N matrix

We separate the training and testing feature vectors and their labels from the feature vector matrix (pca_Features) and labels vector (Labels). trainData is the training data and trainLabels are the training labels. testData is the test data and testLabels are the training labels.

trainData=pca_Features(trainIdx,   :); trainLabels=Labels(trainIdx);

testData=pca_Features(testIdx,:);

 testLabels=Labels(testIdx);

N. Implementation of SVM classification algorithm:

To train the support vector machine (SVM) classifier, we use the command SVMmodel=fitcsvm(X,Y,...). X is the matrix of training feature vectors and Y is the training labels. The output of the SVM model is the

trained model of the SVM classification algorithm. To extract geometric and color features, the input image is first read and smoothed by an anisotropic diffusion filter. By segmenting the image, the skin wound area is separated from the rest of the image, and then erosion and reduction morphological operations are performed on it. To extract geometric features, we use the regionprops command. The regionprops command calculates the properties of connected and separated regions in a binary image. These features are: the area of the areas, the perimeter of the areas, the coordinates of the enclosing rectangular area and the image of the areas with the holes inside them filled. It also calculates an enclosed ellipse for each area, which calculates the characteristics of the major axis length (MajorAxisLength) and minor axis length (MinorAxisLength) and the eccentricity of this ellipse. To extract the color feature after segmenting and separating the wound area in the binary image bw_image, we multiply each of the blue, green, red and gray color channels in the binary image bw_image to separate the image of the wound area corresponding to that channel. From the images of the wound area of each image channel, we extract the four features of average, standard deviation, variance, third moment and prominence or elongation of the brightness intensities in the wound area and add them to the 2F matrix, which represents the vector of color features, with the cat command. We have 4 image channels and 5 features are extracted for each channel. So we will have a total of 21 color features for each image.

O. Introduction of support vector machine (SVM) algorithm:

In problems where the data are not linearly separable from each other, the data points are mapped to a feature space so that we can separate them linearly in the new space. The dimensions of this feature space are greater than the dimensions of the original space in which the data points are located.
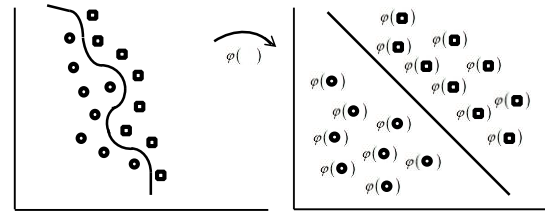

Fig. 3: Converting data points to feature space for data that are not linearly separable

Performing calculations in feature space can be expensive. To solve this problem, we use the Kernel function. . In the linear mode, the kernel function was considered as a point product $K(\vec{X_i}, \vec{X_j}) = \vec{X_i} \cdot \vec{X_j}$ .Because the linear SVM algorithm is only dependent on $\vec{X_i} \cdot \vec{X_j}$ 'The SVM algorithm will depend only on $\varphi(\vec{X_i}) \cdot \varphi(\vec{X_j})$ in the mapping to the feature space ($X \to \varphi(X)$). The kernel function for the feature space is defined as $k(\vec{X_i}, \vec{X_j}) = \varphi(\vec{X_i}) \cdot (\vec{X_j})$. All point multiplications in linear mode are replaced by non-linear kernel function $k(\vec{X_i}, \vec{X_j})$. Therefore, the problem of nonlinear classification, like the linear case, becomes finding a cloud page in the feature space that has the largest margin of the mapped points.

Conclusion

Skin cancer is a disease that arises from malignant cancer cells in the outer layers of the skin. Image processing can be used to identify it. In the field of image processing, there are many software with many features, each of which can be used in different fields: Halcon, Mapcloud and Matlab software can be mentioned among these software. In general, for image processing, during the pre-processing stages in order to enhance and remove unnecessary and unwanted information from the skin image, such as hair and bubbles or noises formed in the image, methods such as histogram conversion, various filters(KL1), Median filter and interpolation and gamma correction methods were used. After the pre-processing steps on the information, it is time to segment the image, which is to separate the image of the lesion from the skin around the lesion, which can be done with different methods such as Otsu's algorithm, LHS, threshold integration and statistical region (SRM). , gradient flow deviation (GVF), image segmentation based on color

using K-average clustering, combined color space statistical clustering method and growth zone hierarchy algorithm, SO-FCM, border detection technique based on color penetration were used. . After the image segmentation steps, the image feature extraction step is; This stage is based on ABCD rules and the geometric features of the lesion and can be calculated using different techniques such as calculating the area, perimeter, largest diameter, circular index, irregularity index, asymmetry, compact index, fractal dimensions, sudden edge, color change. , mean and standard deviation of RBG are used. And finally, by comparing these characteristics, it is possible to find out whether the lesion is benign, suspicious, or malignant. And at the end, a series of steps are used to extract the features and colors of the images, each of which was briefly explained.

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Author Contributions

A.Yazdanfard collected the data. A.Yazdanfard analyzed the data. A.Yazdanfard interpreted the results and wrote the manuscript.

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Conflict of Interest

The author declares that there is no conflict of interests regarding the publication of this manuscript. In addition, the ethical issues, including plagiarism, informed consent, misconduct, data fabrication and/or falsification, double publication and/or submission, and redundancy have been completely observed by the authors.

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