PREDICTING SKIN CANCER-TRAINING AND TESTING USING VGG-16

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ABSTRACT–Skin cancer is one of the most rapidly spreading illnesses in the world and because of the limited resources available[1]. Early detection of skin cancer is crucial accurate diagnosis of skin cancer identification for preventive approach in general. Detecting skin cancer at an early stage is challenging for dermatologists, as well in recent years, both supervised and unsupervised learning tasks have made extensive use of deep learning. One of these models, convolutional neural networks (CNN), has surpassed all others in object detection and classification tests. The data pre-processing techniques like sampling, dull razor and segmentation using autoencoder and decoder is employed.

INDEX :Skin cancer, CNN, Digital Image preprocessing, VGG-16 Architecture, Skin cancer Dataset

INTRODUCTION

Digital Image Processing deals with manipulation of digital images through a digital computer[2]. It is the process of transforming an image into a digital form and performing certain operations to get some useful information from it. The Digital image processing system usually treats all images as 2D signals when applying certain predetermined signal processing methods. In the last decade, medical imaging has been affected by the emergence of non-invasive medical tools with greater accuracy and speed. Therefore, image processing mechanisms can be widely used in many medical fields in order to improve disease identification and treatment in the early stages, without the need for invasive action. Skin canceris the out-of-control growth of abnormal cells in the epidermis, the outermost skin layer, caused by unrepaired DNAdamage that triggers mutations[1]. Thesemutations lead the skin cells to multiply rapidly and form malignant tumors.Skin cancers can look quite different from one person to another due to skin tone, size and type of skin cancer and location on the body. Skin cancer is the most common form of cancer, globally accounting for at least 40% of cancer cases. The most common type is nonmelanoma skin cancer, which occurs in at least 2–3 million people per year. This is a rough estimate, however, as good statistics are not kept.There are three major types of skin cancer — basal cell carcinoma, squamous cell carcinoma and melanoma.You can reduce your risk of skin cancer by limiting or avoiding exposure to ultraviolet (UV) radiation. Checking your skin for suspicious changes can help detect skin cancer at its earliest stages. Early detection of skin cancer gives you the greatest chance for successful skin cancer treatment.Basal cell carcinoma usually occurs in sun-exposed areas of your body, such as your neckorface.Basal cell carcinoma may appear as:A pearly or waxy bump,A flat, flesh-colored or brown scar-like lesion,A bleeding or scabbing sore that heals and returns. Most often, Squamous cell carcinoma occurs on sun-exposed areas of your body, such as your face, ears and hands. People with darker skin are more likely to develop squamous cell carcinoma on areas that aren't often exposed to the sun.Squamous cell carcinoma may appear as:A firm, red nodule,A flat lesion with a scaly, crusted surface.Melanoma can develop anywhere on your body, in otherwise normal skin or in an existing mole that becomes cancerous. Melanoma most often appears on the face or the trunk of affected men. In women, this type of cancer most often develops on the lower legs. In both men and women, melanoma can occur on skin that hasn't been exposed to the sun. Melanoma can affect people of any skin tone.

In people with darker skin tones, melanoma tends to occur on the palms or soles, or under the fingernails or toenails.Melanoma signs include:A large brownish spot with darker speckles,A mole that changes in color, size or feel or that bleeds,A small lesion with an irregular border and portions that appear red, pink, white, blue or blue-black,A painful lesion that itches or burns,Dark lesions on your palms, soles, fingertips or toes, or on mucous membranes lining your mouth, nose, vagina or anus.A Neural Network is a method in artificial intelligence that teaches computers to process data in a way that is inspired by the human brain[3]. It is a type of machine learning process, called deep learning, that uses interconnected nodes or neurons in a layered structure that resembles the human brain. It creates an adaptive system that computers use to learn from their mistakes and improve continuously.They are comprised of node layers, containing an input layer, one or more hidden layers, and an output layer. Each node connects to another and has an associated weight and threshold. If the output of any individual node is above the specified threshold value, that node is activated, sending data to the next layer of the network. Otherwise, no data is passed along to the next layer of the network. Convolutional Neural Networks provide a more scalable approach to image classification and object recognition tasks, leveraging principles from linear algebra, specifically matrix multiplication, to identify patterns within an image[4]. That said, they can be computationally demanding, requiring graphical processing units (GPUs) to train models. Convolutional neural networks are distinguished from other neural networks by their superior performance with image, speech, or audio signal inputs. They have three main types of layers, which are : Convolutional layer, Pooling layer, Fully-connected (FC) layer. The convolutional layer is the first layer of a convolutional network. While convolutional layers can be followed by additional convolutional layers or pooling layers, the fully-connected layer is the final layer. With each layer, the CNN increases in its complexity, identifying greater portions of the image. Earlier layers focus on simple features, such as colors and edges. As the image data progresses through the layers of the CNN, it starts to recognize larger elements or shapes of the object until it finally identifies the intended object.A convolutional neural network is also known as a CNN, which is a kind of artificial neural network. A convolutional neural network has an input layer, an output layer, and various hidden layers. VGG16 is a type of CNN (Convolutional Neural Network) that is considered to be one of the best computer vision models to date. The creators of this model evaluated the networks and increased the depth using an architecture with very small (3 × 3) convolution filters, which showed a significant improvement on the prior-art configurations.VGG16 is object detection and classification algorithm which is able to classify 1000 images of 1000 different categories with 92.7% accuracy. It is one of the popular algorithms for image classification and is easy to use with transfer learning.

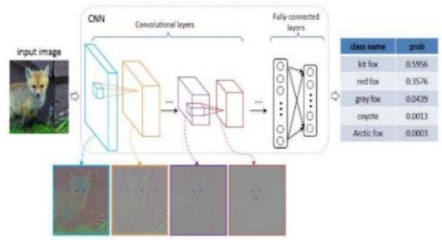
LITERATURE REVIEW :

The purpose of performing this systematic literature review was to select and categorize the best available approaches to skin cancer detection using neural networks (NNs). Systematic literature reviews collect and analyze existing studies according to predefined evaluation criteria. Such reviews help to determine what is already known in the concerned domain of study[5].Skin cancer is one of the most active types of cancer in the present decade [1]. As the skin is the body's largest organ, the point of considering skin cancer as the most common type of cancer among humans is understandable. It is generally classified into two major categories: melanoma and nonmelanoma skin cancer.Melanoma is a hazardous, rare, and deadly type of skin cancer. According to statistics from the American Cancer Society, melanoma skin cancer cases are only 1% of total cases, but they result in a higher death rate. Melanoma develops in cells called melanocytes. It can affect any area of the human body. It usuallyappears on the areas exposed to sun rays, such as on the hands, face, neck, lips, etc. Most skin cancers are caused by too much exposure to ultraviolet (UV) rays.Digital image processing helps to improve images for human interpretation. Information can be processed and extracted from images for machine interpretation[2]. The pixels in the image can be manipulated to any desired density and contrast. Images can be stored and retrieved easily.As a subcategory or field of digital signal processing, digital image processing has many advantages over analog image processing. It allows a much wider range of algorithms to be applied to the input data and can avoid problems such as thebuild-up of noise and distortion during processing. Since images are defined over two dimensions (perhaps more) digital image processing may be modeled in the form of multidimensional systems.

The generation and development of digital image processing are mainly affected by three factors: first, the development of computers; second, the development of mathematics (especially the creation and improvement of discrete mathematics theory); third, the demand for a wide range of applications inenvironment, agriculture, military, industry and medicalscience has increased.The Convolutional Neural network (CNN) is an extension to the existing neural network[4]. Convolutional neural networks are preferred over fully connected feedforward neural layers in digital imaging applications due to the spark connectivity and weight sharing properties of image pixels. CNNs can also be tuned for different mathematical learning methods such as back propagation, learning algorithms and regularisation techniques. CNN's hidden layer consists of convolution layers, nonlinear pooling layers and fully connected layers. CNN contains multiple convolution layers that are followed by several fully connected layers. Three important layers involved in making CNN are convolution layers, pooling layers and full connected layers. In CNN, the convolution layer manages a set of weights which are reduced by pooling layers to give output from the convolution and reduces the input size ratio. After the convolutional layer, the output from the pooling layer is used and fed to the fully connected layer. An essential section of CNN is the Convolutional layer which consists of a variety of weights for different applications like image segmentation and multiple 2D matrices .The VGG16 architecture, proposed by the Visual Geometry Group at the University of Oxford, is a deep convolutional neural network designed for image classification tasks[6]. Introduced in 2014, VGG16 is characterized by its simplicity and effectiveness in feature learning. The network comprises 16 layers, consisting of 13 convolutional layers and 3 fully connected layers. Notably, VGG16 employs small 3x3 convolutional filters throughout, with max-pooling layers applied after each set of convolutional operations. Rectified Linear Unit (ReLU) activation functions introduce non-linearity, and the final layers include fully connected units culminating in an output layer with the number of units corresponding to the classification task's classes. Despite its straightforward architecture, VGG16 has demonstrated strong performance on various computer vision benchmarks, such as the ImageNet dataset, making it a widely adopted model in the field.

METHODOLOGY :

Detecting skin cancer using Convolutional Neural Networks (CNNs) such as VGG16 can be a powerful approach due to the ability of CNNs to learn hierarchical features from images. VGG16 is a pre-trained deep learning model known for its simplicity and effectiveness. The VGG16 model achieves almost 92.7% top-5 test accuracy in ImageNet. ImageNet is a dataset consisting of more than 14 million images belonging to nearly 1000 classes. Moreover, it was one of the most popular models submitted to ILSVRC-2014. It replaces the large kernel-sized filters with several 3×3 kernel-sized filters one after the other. As mentioned above, the VGGNet-



16supports16 layers and can classify images into 1000 categories.

Fig 1: The architecture of CNN

To classify whether the skin cancer image given is harmful or non-harmful , the below methodology was used Fig.2. For this we use two types of field Benign and Malignant.

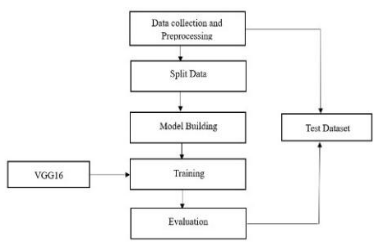


Fig 2. Flow of methodology

SYSTEM IMPLEMENTATION:

Implementation is the process of assuring that the information system is operational and then allowing users take over itsoperationfor use and evaluation.The convolutional layer is the core building block of a CNN, and it is where the majority of computation occurs. It requires a few components, which are input data, a filter, and a feature map. Let's assume that the input will be a color image, which is made up of a matrix of pixels in 3D. This means that the input will have three dimensions—a height, width, and depth—which correspond to RGB in an image. We also have a feature detector, also known as a kernel or a filter, which will move across the receptive fields of the image, checking if the feature is present. This process is known as a convolution. The feature detector is a two-dimensional (2-D) array of weights, which represents part of the image. While they can vary in size, the filter size is typically a 3x3 matrix; this also determines the size of the receptive field. The filter is then applied to an area of the image, and a dot product is calculated between the input pixels and the filter. This dot product is then fed into an output array. Afterwards, the filter shifts by a stride, repeating the process until the kernel has swept across the entire image. The final output from the series of dot products from the input and the filter is known as a feature map, activation map, or a convolved feature.Note that the weights in the feature detector remain fixed as it moves across the image, which is also known as parameter sharing. Some parameters, like the weight values, adjust during training through the process of backpropagation and gradient descent. However, there are three hyperparameters which affect the volume size of the output that need to be set before the training of the neural network begins.Python offers a plethora of advantages for machine learning professionals and enthusiasts alike, especially when working with machine learning models using the Python language. Python's extensive library ecosystem, robust visualization capabilities, low barrier to entry, strong community support, flexibility, readability, and platform independence make it an ideal choice for machine learning purposes. As a result, Python has seen a surge in usage in AI and ML applications, including image and speech recognition, predictive analytics, and autonomous vehicles. The growing popularity of Python in AI projects today is not just a coincidence. Its comprehensive library ecosystem and active developer community have made it easier than ever for machine learning professionals to take advantage of Python's powerful capabilities. With its easy-to-read syntax, extensive libraries, and cross-platform compatibility, Python has become an essential tool for AI and ML developers worldwide. One of the key factors that sets Python apart from other programming languages is its comprehensive library ecosystem. Python offers a wide range of libraries and frameworks specifically designed for machine learning, making it easier for developers to implement ML algorithms. Some popular Python libraries for machine learning include:

- NumPy: NumPy is a fundamental Python library for efficient numerical computations and array operations.
- Scikit-learn: Scikit-learn is a comprehensive machine learning library that offers a wide range of tools for various tasks, including classification, regression, clustering, and more.
- Pandas: Pandas is a powerful library for data analysis and manipulation, providing intuitive data structures like DataFrames and Series.
- TensorFlow: TensorFlow is a cutting-edge deep learning library known for its distributed computing capabilities and robust ecosystem.
- Theano: Theano is a Python library designed for fast numerical computation, particularly useful for training deep learning models.
- Keras: Keras is an easy-to-use deep learning API that acts as an interface for TensorFlow, Theano, or Microsoft Cognitive Toolkit (CNTK), simplifying the creation and training of neural networks.
- PyTorch: PyTorch is a dynamic deep learning library with a flexible computation graph, making it ideal for developing and training complex neural networks.

These libraries and Python frameworks provide powerful capabilities for data analysis, machine learning, and deep learning, allowing developers to focus on solving complex tasks without having to reinvent the wheel. With this great library ecosystem, Python has become an indispensable tool for machine learning engineers, data scientists, and researchers alike.

In this article VGG-16 architecture was used for training and testing datasets that was collected from ISIC 2018. The following Fig.3 shows the image classification of VGG-16:

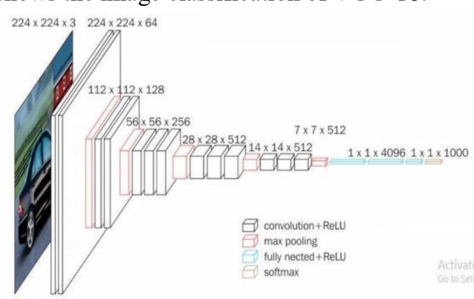


Fig.3. Image classification of VGG-16

- The 16 in VGG16 refers to 16 layers that have weights. In VGG16 there are thirteen convolutional layers, five Max Pooling layers, and three Dense layers which sum up to 21 layers but it has only sixteen weight layers i.e., learnable parameters layer.
- VGG16 takes input tensor size as 224, 244 with 3 RGB channel.
- Most unique thing about VGG16 is that instead of having a large number of hyper-parameters they focused on having convolution layers of 3x3 filter with stride 1 and always used the same padding and maxpool layer of 2x2 filter of stride 2.
- The convolution and max pool layers are consistently arranged throughout the whole architecture
- Conv-1 Layer has 64 number of filters, Conv-2 has 128 filters, Conv-3 has 256 filters, Conv 4 and Conv 5 has 512 filters.
- Three Fully-Connected (FC) layers follow a stack of convolutional layers: the first two have 4096 channels each, the third performs 1000-way ILSVRC classification and thus contains 1000 channels (one for each class). The final layer is the soft-max layer.

The following figure shows the architecture map of VGG-16:

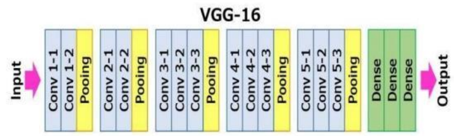


Fig.4 . VGG-16 Architecture map

Detecting skin cancer using Convolutional Neural Networks (CNNs) such as VGG16 can be a powerful approach due to the ability of CNNs to learn hierarchical features from images. VGG16 is a pre-trained deep learning model known for its simplicity and effectiveness. Here's a general outline of how you could implement skin cancer detection using VGG16:

The VGG16 model was tested on the ISIC2018 dataset and achieved an accuracy of 88%. This result is very impressive, considering that the dataset contains 2 classes with 1500 images per class. The model was able to accurately classify images with high accuracy, demonstrating its effectiveness in image re cognition tasks.Furthermore, the model was able to achieve good result with a relatively small number of parameters. This indicates that the VGG16 model is an efficient and powerful tool for image recognition tasks. The follow-ingfigure shows the images used in dataset for training.

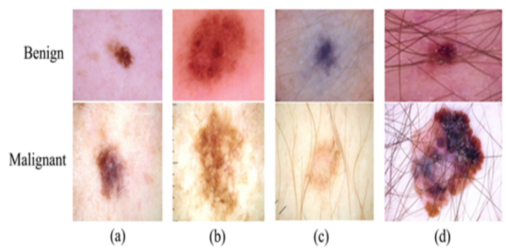


Fig.5 . Images used in dataset

The input to the model is an image of a skin lesion, which is passed through the convolutional layers to extract features. These features are then flattened and passed through the fully connected layers to make a prediction about whether or not the lesion is malignant or benign. During training, only the weights of the new output layer are updated using backpropagation. This allows us to train a new model for skin cancer classification using much less data than would be required if we were training from scratch.

Overall, transfer learning by VGG16 for skin cancer classification involves using a pre-trained model to extract features from images of skin lesions and then training a new output layer to make predictions about whether or not those lesions are malignant or benign.

Fig.6 shows the accuracy and loss function graph of the VGG16 model. There are two curves in each graph. One is the train curve and the other is the test curve. The training curve is always higher in model accuracy (a) than the test curve due to overfitting or training the model on a particular dataset. In test loss (b), it gives the value of 0.2603 and in test loss it gives the value of 0.1716 at the highest accuracy of 88%.

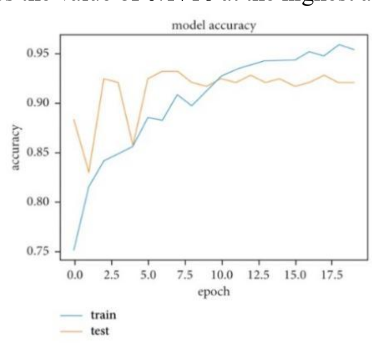


Fig .6 (a) Model accuracy

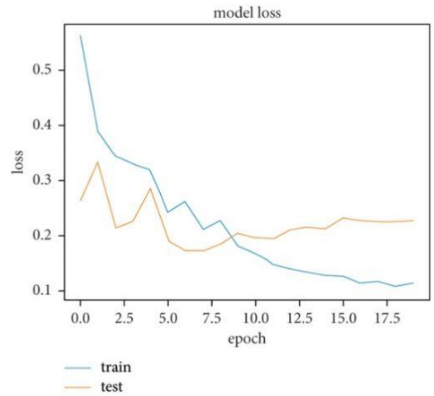


Fig.6 (b) Model loss

RESULT AND DISCUSSION:

There are many deadly diseases in the current world. Skin cancer is one of them. The best way is to diagnose it as early as possible. Medical science has developed in today's world. Previously, skin cancer was detected manually, which was difficult and expensive. But due to the advancement of deep learning in the medical science field, it has become much easier. DeepLearning, specifically CNN, can be used to rapidly detect skin cancer, which is easy and less expensive. For this reason, the CNN is proposed in this study to detect skin cancer. In this research, we used another type of convolutional neural network called VGG-16.After applying convolutional models to the dataset, an accuracy of 88% got from VGG-16. This system was built to detect skin cancer. This will help doctors detect skin cancer whether it is harmful or not can be easily and quickly.

In the future, more advanced convolutional neural network models for this comparison can be added. The information regarding deep learning models on skin cancer gathered in this research paper can help the next generation of researchers achieve 100% accuracy in detecting skin cancer. As this research paper is only based on two types of skin cancer, research can be done on other types of skin cancer using the same methods. These systems can apply to large datasets. It will help to find more accurate models for skin cancer detection via image classification.

EXISTINGAND PROPOSED :

EXISTING:

The first step in the diagnosis of a malignant lesion by a dermatologist is visual examination of the suspicious skin area. A correct diagnosis is important because of the similarities of some lesion types; moreover, the diagnostic accuracy correlates strongly with the professional experience of the physician Without additional technical support, dermatologists have a less accuracy rate in melanoma diagnosis . In suspicious cases, the visual inspection is supplemented with dermatoscopic images taken with a special high-resolution and magnifying camera. During the recording, the lighting is controlled and a filter is used to reduce reflections on the skin, thereby making deeper skin layers visible. With this technical support, the accuracy of skin lesion diagnosis can be increased . The combination of visual inspection and dermatoscopic images ultimately results in an absolute melanoma detection by dermatologists.

CONCLUSION

PROPOSED:

This project presents the first systematic review of the state-of-the-art research on classifying skin lesions using CNNs. The presented methods are categorized by whether a CNN is used exclusively as a feature extractor or whether it is applied for end-to-end-learning. The conclusion of this project discusses why the comparability of the presented techniques is very difficult and which challenges must be addressed in the future. This project employs a Convolutional Neural Network (CNN) for the identification and diagnosis of skin cancer, utilizing the ISIC dataset, which comprises images. The proposed model achieves an accuracy of 88% in classifying the training dataset into benign and malignant categories.Skin cancer, particularly melanoma, is a potentially fatal disease. Early diagnosis significantly enhances the chances of successful treatment. This project focuses on leveraging deep learning techniques, specifically CNNs, to automate the identification and classification of skin cancer.

This project introduces a method to detect skin cancer using the deep learning method. In our proposed system, the CNN can combine local features and learn characteristics of the image by combining convolutional and pooling layers. The proposed method includes images from International Skin Imaging Collaboration preprocessing to extract the region of interest in the image. The resulting dataset has been applied to the CNN model to train the model, which itcomprises different layers, including pooling, convolutional, classification layer, etc. Testing the model produced promising results with an accuracy of 70%. To improve the accuracy, I used another variation of the convolutional neural network, which is VGG-16. The results are promising. The results were enhanced to 88%. Unlike other methods, the proposed method based on neural networks shows the best results, and different machine learning techniques can improve the results.

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