International Journal of Scientific Research in Engineering and Management (IJSREM)
Volume: 08 Issue: 07 | July - 2024 SJIF Rating: 8.448 ISSN: 2582-3930

Melanoma Detection and Classification using Deep Learning

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ABSTRACT: Melanoma is a type of carcinoma with a notably high mortality rate. Accurate diagnosis of this aggressive cancer is crucial due to its severe implications. Key diagnostic indicators include asymmetrical shape, heterogeneous color, diameter greater than 6 mm, and irregular borders, which dermatologists typically identify through visual examination. The conventional method for carcinoma detection is biopsy, involving the removal or scraping of skin samples for extensive laboratory testing. This process is both painful and time-consuming. To improve patient experience and enhance diagnostic efficiency, computer-based detection using image processing techniques and deep learning algorithms, specifically Convolutional Neural Networks (CNNs), has been developed to accurately identify melanoma.

Keywords: Deep learning, CNN, Computer-based detection

1. INTRODUCTION

The most common and prevalent kind of cancer on the planet is skin cancer. More than 3. 5 million cases of melanoma, basal cell carcinoma and carcinoma are diagnosed annually. It often has the amount of carcinoma, carcinoma and colon cancers in addition in fact, an individual falls victim to Melanoma every 57 seconds. Because it is with every sort of cancer, early screening and detection of carcinoma is that the most hopeful sign of creating a full recovery. Early detection of carcinoma yields a ten year survival rate of 94%. However, this survival rate drops drastically because the cancer progresses and reaches subsequent stages .Ten year survival rates come to a 15% within the case of Melanoma, when it's detected within the end . [4] However, early detection of skin cancer is an expensive affair. As skin lesions look quite similar to each other, it is difficult to determine whether a lesion is benign or malignant. Extensive analysis needs to be performed to identify the category of the lesion. Traditionally, an image using a special device, known as a dermatoscope, is taken to study the lesion closely.

Unfortunately, from new algorithms, it has become possible to differentiate between clinically similar skin conditions. These algorithms do not require the images to be taken from special purpose devices, instruments are expensive and not widely available with dermatologists. One of the challenges of visual screening is the visual similarity between skin diseases. In the last few years, significant advancements have taken place in the domain of computer vision. With the advent between clinically similar skin conditions. These algorithms do not require the images to be taken from special purpose devices, such as dreamscapes, and can be applied on images obtained from general purpose cameras. To detect unusual mole characteristics that could indicate skin cancer or melanoma, a search for moles with irregular borders, shapes, colors, and moles with more than 6mm diameter is done. To assess the soreness of the skin and classify it either as melanoma or benign, numerous techniques, including genetic algorithms, artificial neural networks (ANNs),CNNs, ABCDE rule, and support vector machines (SVMs), have been proposed. . All these techniques have been verified as cost-effective, highly efficient, and less painful than conventional medical techniques. [10]
However, in many computer vision problems, it becomes undeniable that both CNNs and deep learning are the technique of choice. The CNN is designed in such a manner to differentiate melanoma from solar lentigo and seborrheic keratosis, which is often difficult. Deep learning is a class of machine learning that uses multiple layers to progressively extract higher level features from the raw input. Convolutional Neural Network

(CNN) is a deep learning algorithm used in classification and identification of the disease.

Fig 1: Melanoma [1]

Fig 2: Malignant Melanoma [1]

1. LITERATURE SURVEY

Several studies have demonstrated the efficacy of deep learning models in melanoma detection. For instance, Esteva et al. (2017) employed a CNN to classify skin lesions, achieving performance on par with dermatologists. Their model was trained on a large dataset of over 129,000 clinical images, encompassing more than 2,000 diseases. The study highlighted the potential of deep learning in achieving dermatologist-level accuracy in melanoma detection .

Due to the scarcity of large, annotated medical image datasets, transfer learning and data augmentation are commonly used to enhance the performance of deep learning models. Transfer learning involves pre-training a CNN on a large dataset, such as ImageNet, and fine-tuning it on a smaller medical image dataset. Studies by Codella et al. (2018) and Tschandl et al. (2020) have demonstrated the effectiveness of transfer learning in improving melanoma detection accuracy . Data augmentation techniques, such as rotation, flipping, and scaling, are also employed to artificially increase the size of the training dataset and improve the model's robustness.

CNN is One of the main categories to do image recognition andimage classifications.

Esemble methods, which combine the predictions of multiple models, have been explored to improve the. In their study, Kawahara et al. (2016) combined the outputs of several CNNs trained on different image modalities to achieve superior performance. Hybrid models that integrate deep learning with traditional image processing techniques have also been investigated. For example, Xie et al. (2020) proposed a hybrid model that combined a CNN with a wavelet transform, achieving high accuracy in melanoma classification.

While deep learning models have shown impressive performance in melanoma detection, their black-box nature poses challenges in clinical adoption. Researchers have focused on enhancing the interpretability of these models. Techniques such as Grad-CAM (Gradient-weighted Class Activation Mapping) allow for the visualization of regions in the image that the model considers important for its decision, thereby providing insights into the model's reasoning process. Studies by Wadhawan et al. (2021) and Goyal et al. (2021) have explored the use of such techniques to increase the transparency and trustworthiness of deep learning-based melanoma detection systems

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2. METHODOLOGY

2.1 Preprocessing:

Image processing may also be the product of doing such operations on an image, thus encouraging an improved image or removing any valuable knowledge from it. This pre-processing also important to hurry up the training and scaling techniques. The output of the image pre-processing technique may be a high resolution image which can beutilized in the further process. The figure 3 shows theprocedure of preprocessing carcinoma detection.

2.2 Deep Leaning

Deep learning (also mentioned as deep structured learning or hierarchical learning) could even be a component of a broader family of machine learning methods supported artificial neural networks. Deep learning (also mentioned as deep structured learning or hierarchical learning) could even be a component of a broader family of machine learning methods supported artificial neural networks. Deep learning

could even be a category of machine learning algorithms that uses multiple layers to progressively extract higher level features from the raw input. As an example, in image processing, lower layers may identify edges, while higher layers may identify the concepts relevant to an individual's like digits or letters or faces. learning or hierarchical learning) could even be a component of a broader family of machine learning methods supported artificial neural networks. Deep learning could even be a category of machine learning algorithms that uses multiple layers to progressively extract higher level features from the raw input. As an example, in image processing, lower layers may identify edges, while higher layers may identify the concepts relevant to an individual's like digits or letters or faces.

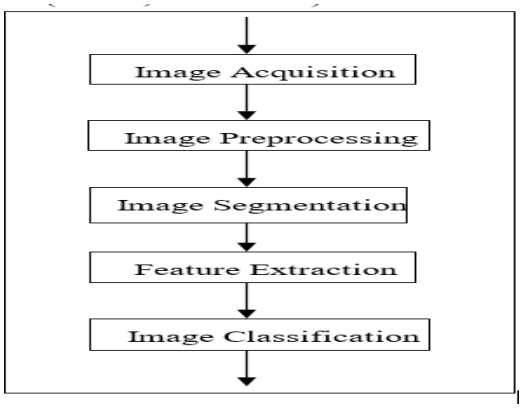


Fig 3: Melanoma Detection Technology[5]

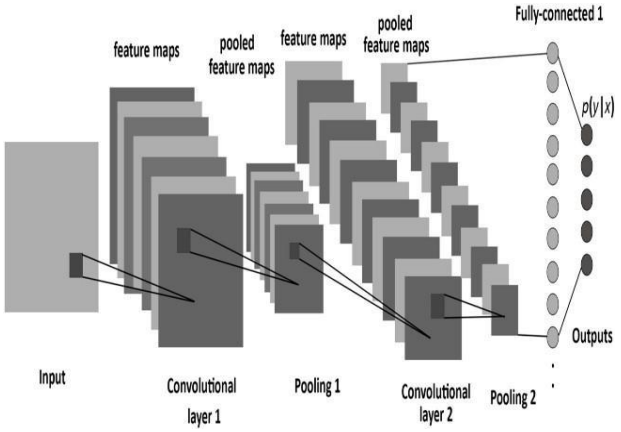
2.2 Dataset Used:

The availability of large, annotated datasets is crucial for training and validating deep learning models, particularly in medical image analysis. Kaggle, a popular platform for data science competitions, has played a significant role in advancing research in melanoma detection by providing high-quality datasets. One of the most notable datasets is the "SIIM-ISIC Melanoma Classification" dataset, which was part of a Kaggle competition aimed at encouraging the development of accurate and robust melanoma detection algorithms. The SIIM-ISIC Melanoma Classification dataset comprises over 33,000 dermoscopic images, along with corresponding metadata such as patient age, sex, and anatomical site of the lesion. This dataset is meticulously annotated, including labels indicating whether a lesion is benign or malignant. The large size and diverse nature of this dataset enable the training of deep learning models that can generalize well to various clinical scenarios.

2.3 Convolutional Neural Network

A Convolutional Neural Network (CNN) is an algorithm in deep learning which contains a mixture of convolutional and pooling layers in sequence then followed by fully connected layers at absolutely the best as like multilayer neural network. CNN could even be a category of algorithm which is motivated to wish advantage of any 2d structure in data. Hence CNN is one of the favored algorithm for image classification. CNN also proves promising for task related to tongue processing. CNN leverages the local feature of an image to understand higher accuracy for classification. CNN is one of the neural network which is simple to point out and has less number of hyper parameter as compare to ordinary fully connected neural network. The network will contains several convolutional networks mixed with nonlinear and pooling layers. When the image passes through one convolution layer, the output of the primary layer becomes the input for the second layer. And this happens with every further convolutional layer. The nonlinear layer is added after each convolution operation. It's an activation function, which brings nonlinear

Fig 4: CNN Model



property. Without this property a network wouldn't be sufficiently intense and will not be able to model the response variable (as a category label). The pooling layer follows the nonlinear layer. It works with width and height of the image and performs a down sampling operation on them. As a result the image volume is reduced. this means that if some features (as an example boundaries) have already

been identified within the previous convolution operation, than an thorough image is not any more needed for further processing, and it's compressed to less detailedpictures. VGG16

Detection of skin cancer melanoma through Computer vision-Wilson F.Cueva,F.Munoz , G.Vasquez,G.Delgado	97.51 %	Compared to doctor this system achieves highest efficiency.	Time taken to detect melanom a is very high.
Skin Cancer Detection and Classification-Pratik Dubal,Sankirtan Bhatt,Chaitanya Joglekar,Dr.Sonal i Patil.	76.9%	Neural network provide a sophisticated way to classify complex data with a high degree of accuracy.	The number of output classes can be increased as more data is available.
Computer Aided Detection of Skin Cancer-J.Abdul Jaleel,Sibi Saleem,Aswin R.B.	88%	It proves to be better diagnosis method than the conventional biopsy method.	By varying image processin g techniques and ANN,the accuracy can be improved
Review on Automatic Early Skin Cancer Detection-Azadeh Noori Hoshyar,Adel Al-Jumaily.	92%	The automated skin Cancer system can be well designed as a substitute of clinician in melanoma diagnosis.	It is a time consum i ng process.
Research on Skin Cancer Cell Detection using Image Processing= Enakshi Jana, Dr.Ravi Subban, S,Saraswathi	94%	The different architectures of ANN and SVN forskin cancer image classificatio n provides best accuracy	By using other techniques other types of ckin cancer can be classified

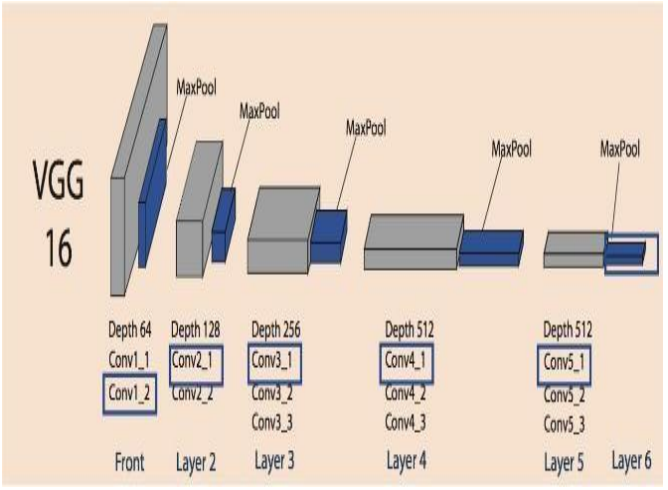


Fig 5: VVG16 CNN MODEL [3]

Activation layer is used for show how the neurons layers inside the model is connected. There are 1024 neuron layers are connected .ADAM optimizer is an adaptive learning rate optimization algorithm used for training deep neural networks which leverages the power of adaptive learning rates method to hunt out the individual learning rates of each parameter.

SCREENSHOTS:

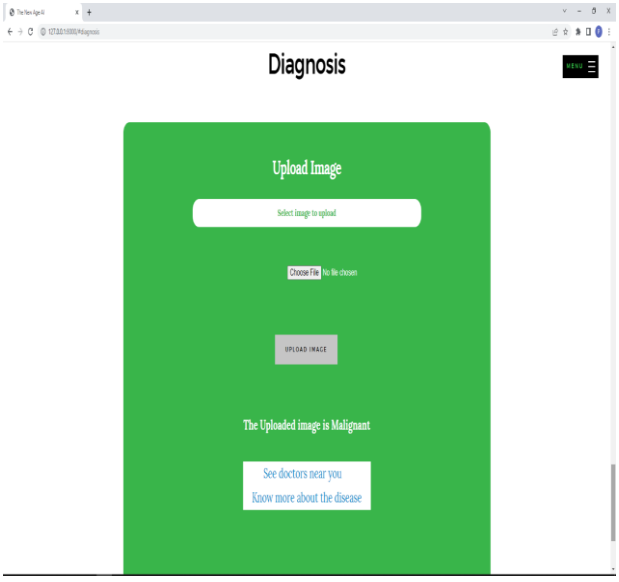


Fig6: Disease Predicted

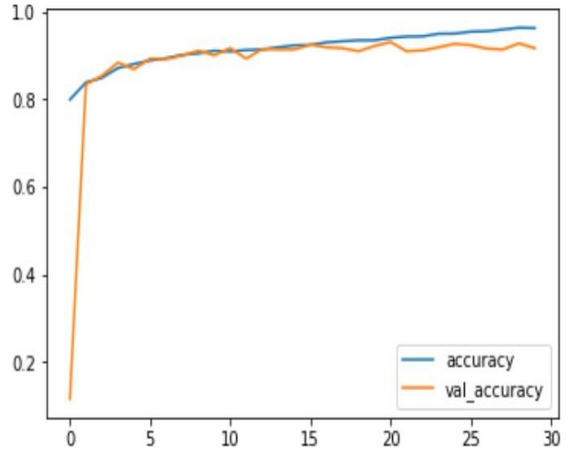


Fig 7: Accuracy Graph

V. CONCLUSION

The diagnosis of skin cancer has been considered difficult because of the effects of insufficient diagnosis and excellent detection accuracy. The implications of artificial intelligent methods and the efficient use of soft computing skills will negate the problems of detection inaccuracy that the proposed CNN model was tested on various use cases and achieved better results in accuracy than other methods. Hence, our proposed model produced the best results.

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