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Skin Cancer Detection System Based on Machine Learning for Recognition of Cancerous Images

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Abstract

Skin cancer ranks among the most prevalent types of cancer globally and poses significant risks when left untreated. Skin cancer arises when abnormal cells proliferate uncontrollably in the skin. This uncontrolled growth can be triggered by genetic mutations, exposure to ultraviolet (UV) radiation from the sun or artificial sources like tanning beds, or various other factors. In this, the early detection of cancer plays a crucial role in treatment and reducing death rates. For early Detection, an automated and robust system is required to minimize the efforts, time, money and death rate. In recent years, advancements in artificial intelligence, particularly deep learning, and machine learning have shown promising results in various medical applications, including skin cancer detection. This research paper presents an automated skin cancer detection system based on deep learning and machine learning techniques. In this, both Machine learning and Deep learning techniques are used for early detection of skin cancer. The proposed system utilizes convolutional neural networks (CNNs) to analysing dermoscopic images and accurately classify skin lesions as benign or malignant. By leveraging a large dataset of images, from which the model learns to identify complex patterns and features which indicate different types of skin cancer. Additionally, the paper discusses the potential implications of deploying such a system in clinical settings, including improving diagnostic accuracy, reducing workload for healthcare professionals, and facilitating timely interventions for patients. This study investigates the creation of an automated skin cancer detection system utilizing the latest advancements in deep learning techniques.

Keywords: Skin cancer detection, Convolutional neural networks (CNNs), Dermoscopic images, medical applications, Healthcare automation, Deep learning.

INTRODUCTION

Cancer is the result of abnormal growth of cells in the body. Skin cancer is the significant health issue characterized by the abnormal growth of skin cells which gives colour to our skin, hairs and eyes and that cell is called “Melanocytes”. It is the type of cancer commonly caused by exposure to sunlight or it may be in genetic or sometimes the cause of the cancer is unknown. The Sunlight which contains UV rays that can damage the skin cells, and may also cause sunburn and changes in skin texture. These all can be the reasons or causes of skin cancer [1].

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There are mainly two type of skin cancer i.e. Melanoma and Non-melanoma. The common Non melanoma cancers are Basal cell and squamous cell.

The Melanoma skin cancer is the 17th most common cancer in the world and it is the 13th most common skin cancer in Men’s and 15th most common skin cancer in women’s. The Melanoma

Skin cancer can affect any part of the human body, but it mostly appears on that parts which is exposed to sun rays, such as hand, face, lips, neck, etc. the Melanoma type of skin cancers can only be cured if it is detected in early stage otherwise it will cause a painful death [2].

The World Health Organization (WHO) reported over 150,000 new melanoma cases in 2020. According to ncdirindia.org, an estimated 12.8% increase in cancer incidence is expected by 2025 compared to 2020. As from the research, the Age-Adjusted-Rate per 100,000, the ratio of melanoma skin cancer is highest in North Region of India for both Males and Females [3].

Figure 1 In recent times, skin cancer rates are increasing day by day in various regions and in different countries. So, to reduce these rates we develop a robust model or system so that we can detect the cancer in early stage and give proper treatment for better recovery. This Research paper contains various methods, algorithms that how we develop that system [4].

RELATED WORK

Determining the "best" machine learning algorithm for developing a skin cancer detection system depends on various factors, including the specific characteristics of collected dataset, the complexity of the problem, computational resources available, and performance metrics of interest (e.g., accuracy, sensitivity, specificity). Convolutional Neural Networks (CNNs) are extensively employed in medical image classification for their capacity to automatically learn hierarchical features from raw pixel data. In our project, CNNs might have been used to extract features from skin lesion images and classify them as either benign or malignant. In this paper classification of melanoma cancer i.e. Benign or Malignant is performed [5].

Figure 2 Early detection of melanoma at its early stage is the best way to reduce the effect of this disease. This paper discusses the types of skin cancer i.e. basal cell, squamous cell, and Melanoma and in this we also discuss on which type of skin cancer we are implementing our project [6].

Figure 3 In this paper, we mainly discuss Melanoma skin cancer because it is the most common and deadliest form of skin cancer among all the other types. Melanoma type of skin cancer that generally begin from the cell that gives colour to our skin hair eyes... And that cell is called *Melanocytes.* It is the most lethal type of skin cancer but it can also be treated if it detected in early stage. The melanoma cancer is also sub categorize into two parts i.e. Benign and Malignant [7].

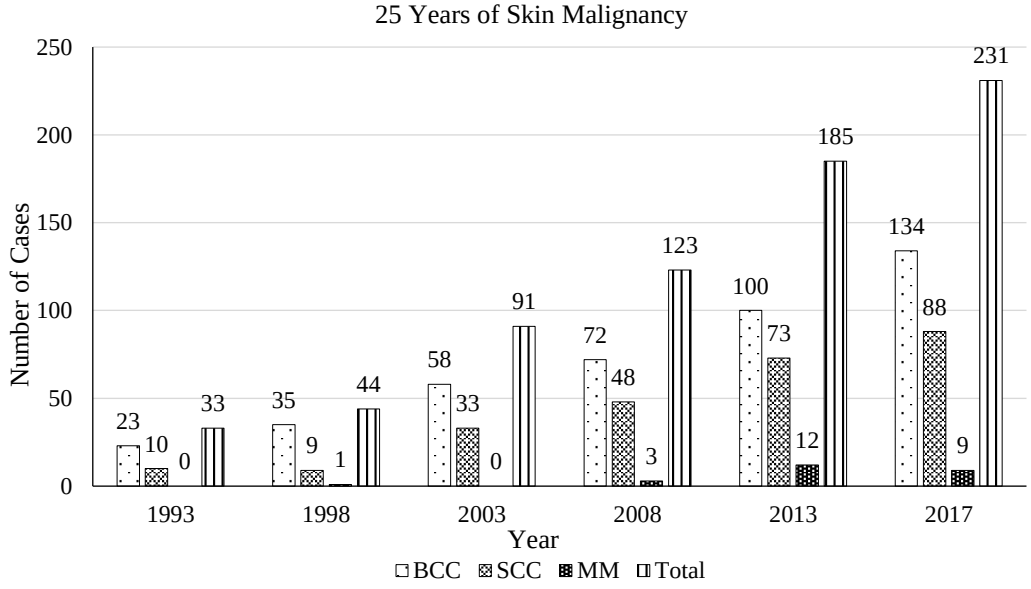
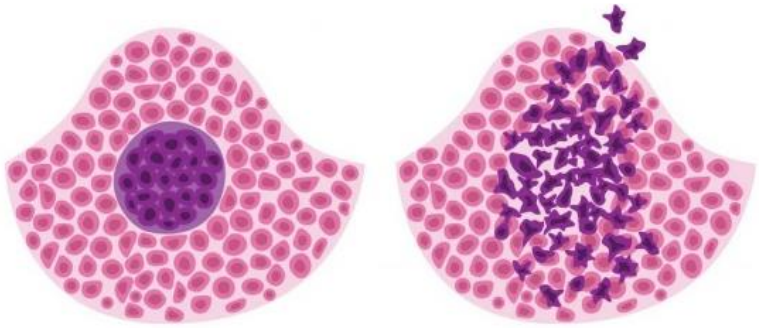
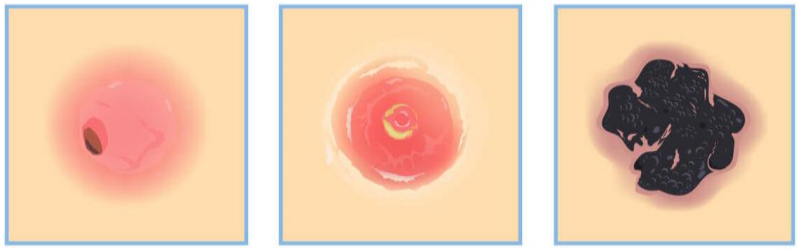


Figure 1. Skin cancer rates in different years.



Benign tumor Malignant tumor

Figure 2. Benign Vs Malignant.



Basal Cell Carcinoma | Squamous Cell Carcinoma | Melanoma

Figure 3. Different type of skin cancers.

PROPOSED METHODOLOGY

The proposed methodology is shown in Figure 4 using a block diagram and each block is explained in detail below. The block diagram consists of all the processes and methods that are required to build the proposed system that are discussed below:

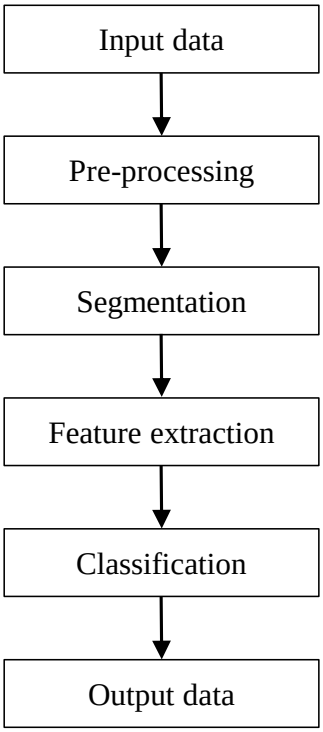


Figure 4. Flow chart of proposed system.

Data Collection

Figure 5 In machine learning Data collection involves gathering the information or samples that will be used to train or test a model and the data could be selected from various different sources and it is also important to ensure that data is accurate, complete, and properly labelled if necessary for supervised learning tasks. The dataset is collected from Kaggle.com which consists of 10,000 images of Benign and Malignant of Melanoma cancer. Every image is categorized into Benign and Malignant based on their type and characteristics [8].

Data Preprocessing

In machine learning, data processing refers to the steps taken to prepare and clean the data before using it to train a model. This includes tasks such as eliminating irrelevant information, addressing missing values, and converting the data into a format that the model can interpret [9].

Figures 6,7 The preprocessing involves various different steps to ensure that the data is in correct/ right form for machine learning model so that the model can perform effectively. Firstly, the data is cleaned by removing irrelevant or any duplicate entries and also address missing values [10].

Figure 5. 10,000 melanoma cancer images, categorized into basal, squamous, melanoma, benign, and malignant.

Figure 6. Input Image.

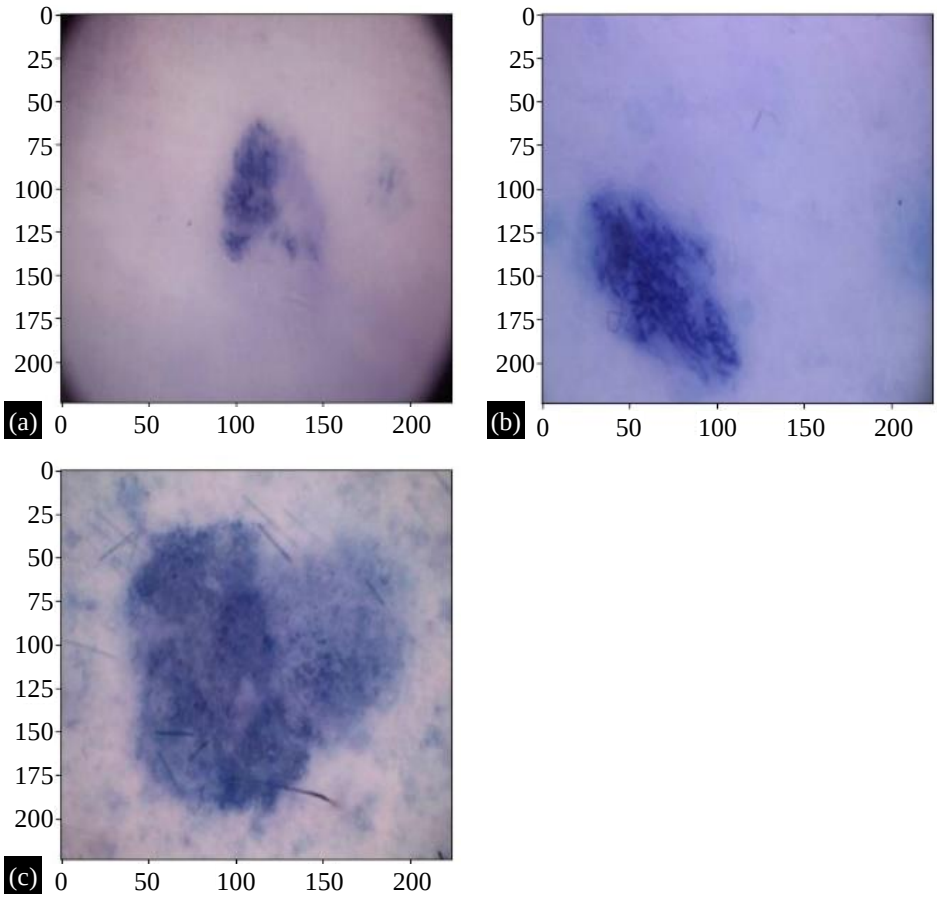


Figure 7. Images after preprocessing steps.

Segmentation

In machine learning, segmentation refers to the process of partitioning a dataset into distinct groups or segments based on specific criteria, allowing for detailed separate analysis of each segment. This helps in understanding patterns within each segment and it can be useful for target analysis.

Image segmentation in image processing helps to simplify the complex images by describing the objects or the regions within them, and provide the facility to the tasks like object recognition or image compression.

It is a powerful tool for extracting the meaningful information from the data by uncovering the hidden patterns or structures from the datasets.

Overall, segmentation process act as an important tool across diverse domains, empowering analysts and practitioners to extract valuable insights/information and drive impactful actions from complex datasets [11].

Feature Extraction

Feature Extraction is a process of machine learning and pattern recognition which aims at transforming the raw data into a set of features that are more productive and informative and also does not contain any redundancy. This process is crucial for enhancing the performance of a machine learning model by highlighting important information and reducing the data's dimensionality. Generally, the process of feature extraction involves identifying and solitude various characteristics and features from the data that are important for the problem. These features or characteristics captures the important aspects of the data with respect to task, such as classifying images or predicting the target.

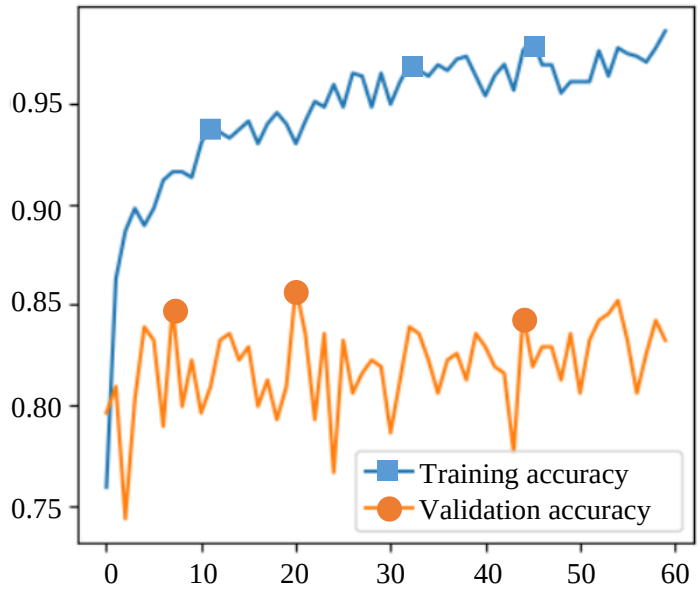


Figure 8. Training and validation accuracy.

This process of feature extraction not only reduces the computational cost by removing irrelevant or redundant data from the dataset but it also improves the efficiency and performance of the machine learning model and algorithms by providing them high quality and relevant data. This makes feature extraction an important step in the preprocessing phase of a machine learning [12, 13].

Classification

Classification is the last and fundamental process in machine learning, which involves the organisation of items, objects, or categorizing the data into groups based on certain attributes, features or characteristics. In the field of machine learning and deep learning, classification refers to type of supervised learning algorithm that predicts the category or class of an input image based on their training and learning. Supervised learning implies that the algorithm learns from the dataset that has been 'labelled' according to their features and characteristics.

The goal of the classification algorithm is to correctly predict the class label of unseen data or new data based on their features, characteristics, and their corresponding learning [14].

Output Data

Figure 8 In this, an input image is uploaded into the proposed model and based on the features and characteristics of that image the output is predicted.'

The Training and Validation accuracy graph illustrates that how the model's performance changes over the course of training. The X-axis indicates the number of training epochs or iterations, whereas the Y-axis shows the model's accuracy on both the training and validation datasets [15].

Figure 9 The Training and Validation loss graph illustrates the changes in the loss function throughout the training process. The loss function evaluates how accurately the model is performing on the training data in comparison to the actual labels [16, 17].

CONCLUSION

The Development and validation of our skin cancer detection system represent a significant advancement in early diagnosis of skin cancer so that treatment can be done. By using Machine Learning algorithms and a comprehensive dataset of images, our system shows remarkable accuracy in distinguishing between Benign and Malignant skin cancers.

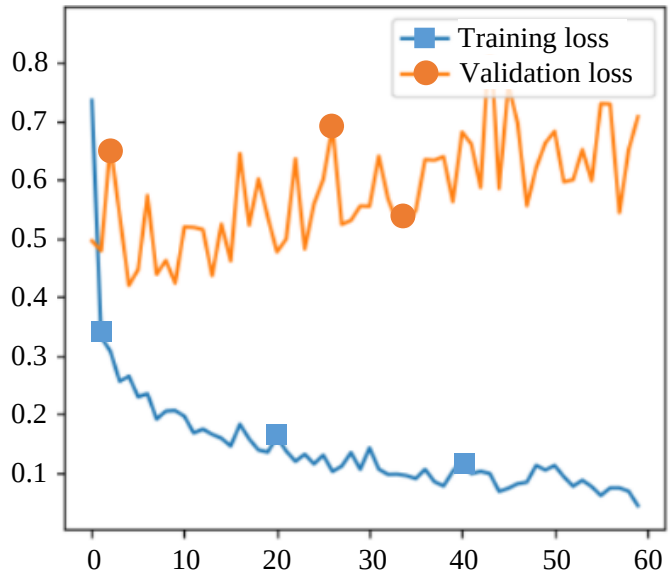


Figure 9. Training and validation loss.

The implication of our project has mainly two benefits. Firstly, it offers an auspicious tool for Dermatologists to enhance their diagnostic processes. Secondly, this system can serve as a valuable educational resource for medical practitioners, which improves their diagnostic skills and they can better understand about the skin cancer. It has one more advantage i.e. there are very less number of Dermatologists centres are available for the detection of cancers so many of the persons are not able to diagnose the lesions on their body parts and some persons because of their financial issues. So, with the help of this proposed system anyone can check their lesions and can find out whether that lesion is cancerous or not. This will definitely reduce the chances of growing the cancerous cell in the body and treatment can be done and this will also reduce the death rate which is increasing day by day.

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