MADHAV INSTITUTE OF TECHNOLOGY & SCIENCE GWALIOR
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Project Report

On

Skin Lession Detection

Submitted By:

Honey Agrawal (0901AD211021)

Shivani Goyal (0901AD211058)

Faculty Mentor:

Dr. Bhagat Singh Raghuwanshi, Assistant Professor

CENTRE FOR ARTIFICIAL INTELLIGENCE
MADHAV INSTITUTE OF TECHNOLOGY & SCIENCE
GWALIOR - 474005 (MP) est. 1957

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CERTIFICATE

This is certified that **Honey Agrawal (0901AD211021), Shivani Goyal (0901AD211058)** has submitted the project report titled **Skin Lession Detection** under the mentorship of **Dr. Bhagat Singh Raghuwanshi** , in partial fulfilment of the requirement for the award of degree of Bachelor of Technology in **Artificial Intelligence and Data Science** from Madhav Institute of Technology and Science, Gwalior.

23/11/23

Dr. Bhagat Singh Raghuwanshi
Faculty Mentor
Assistant professor
Centre for Artificial Intelligence

28/11/23

Dr. R. R. Singh
Coordinator
Centre for Artificial Intelligence

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DECLARATION

I hereby declare that the work being presented in this project report, for the partial fulfilment of requirement for the award of the degree of Bachelor of Technology in **Artificial Intelligence and Data Science** at Madhav Institute of Technology & Science, Gwalior is an authenticated and original record of my work under the mentorship of **Dr. Bhagat Singh Raghuwanshi,** Assistant professor, Centre of Artificial Intelligence

I declare that I have not submitted the matter embodied in this report for the award of any degree or diploma anywhere else.

Honey Agrawal
0901AD211021
3rd Year,
Centre for Artificial Intelligence

Shivani Goyal
0901AD21158
3rd Year,
Centre for Artificial Intelligence

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Honey Agrawal
0901AD211021
3rd Year,
Centre for Artificial Intelligence

Shivani Goyal
0901AD211058
3rd Year,
Centre for Artificial Intelligence

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ABSTRACT

This paper introduces an effective skin lesion detection model using advanced image processing and machine learning. The model, trained on a diverse dataset of annotated skin lesion images, accurately distinguishes between benign and malignant lesions. It incorporates traditional and deep learning feature extraction methods, employing a well-selected classification algorithm. The model's high accuracy, sensitivity, and specificity are demonstrated on a separate test dataset. Interpretability measures enhance transparency, building trust among healthcare practitioners. Positioned as a valuable tool for dermatologists, this model contributes to early and reliable skin lesion classification, improving patient outcomes. Its significance lies in advancing computer-aided diagnosis for dermatological conditions, with potential integration into clinical practice and telemedicine applications.

Keyword: skin lesion detection, dermatological conditions, benign and malignant lesions, image processing, machine learning, diverse dataset, feature extraction, deep learning architectures, classification algorithm, accuracy, sensitivity, specificity, interpretability measures, healthcare practitioners, early diagnosis, computer-aided diagnosis, clinical practice, telemedicine applications.

सार:

यह पेपर एक प्रगत्तम छवि प्रसंस्करण और मशीन लर्निंग का उपयुक्ततम त्वचा घाव का पता लगाने वाला मॉडल प्रस्तुत करता है। यह मॉडल, जिसे एक विविध डेटासेट पर प्रशिक्षित किया गया है जिसमें टिपटिपीत त्वचा घाव छवियाँ शामिल हैं, सार्थक रूप से अच्छा काम करता है बीनाइन और मैलेनेंट घावों की पहचान करने में। इसने पारंपरिक और डीप लर्निंग सुविधा निकालने विधियों को शामिल किया है, एक अच्छी तरह से चयनित वर्गीकरण एल्गोरिदम का उपयोग करता है। मॉडल की उच्च सटीकता, सेंसिटिविटी, और विशिष्टता को एक अलग टेस्ट डेटासेट पर प्रदर्शित किया गया है। इसमें व्याख्यान सुविधाएं हैं जो पारदर्शिता को बढ़ाती हैं, जिससे स्वास्थ्य प्रदाताओं के बीच विश्वास बढ़ता है। डर्मेटोलॉजिस्ट्स के लिए एक मौल्यवान उपकरण के रूप में स्थापित, यह मॉडल त्वचा घावों की पहचान में समर्थन करके रोगी के परिणामों को सुधारता है। इसका महत्व त्वचा रोगों के संगणक सहायित निदान को बढ़ाने में है, जिसमें क्लिनिकल प्रैक्टिस और टेलीमेडिसिन अनुप्रयोगों में सम्मिलित होने की संभावना है|

LIST OF FIGURES

LIST OF ABBREVIATIONS

Abbreviation	Descriptions
CNN	Convolutional Neural Network
EHR	Electronic Health Records
CAM	Class Activation Map
UI	User Interface
GUI	Graphical User Interface
GLCM	Gray Level Co-occurrence Matrix

Chapter 1: PROJECT OVERVIEW

1.1. Introduction

Skin lesion detection is a crucial aspect of dermatology and healthcare, leveraging advanced technologies to identify and analyze abnormalities in the skin. The human skin is susceptible to various conditions, including benign and malignant lesions, making early detection vital for effective treatment and improved patient outcomes.

A tumor can cancerous or benign. A cancerous tumor is malignant, meaning that grow and spread over other parts of the body. As there bengun as a tumour means that tumor can be grow but won't spread.

Our project uses advanced technology like computer vision and machine learning to create an automated system for skin lesion detection. This system analyzes detailed images of skin lesions taken with tools like dermoscopy. We're particularly using a type of artificial intelligence called Convolutional Neural Networks (CNNs) to make accurate distinctions between different types of skin lesions.

1.2. Objectives and Scope

1.2.1. Project Objectives:

The primary objective of the skin lesion detection CNN (Convolutional Neural Network) model is to develop a highly accurate and efficient system for classifying skin lesions into benign and malignant categories. Leveraging the capabilities of deep learning, particularly CNNs, the model aims to enhance the precision of skin lesion diagnosis. The specific goals include:

- **High Accuracy:** Develop a model capable of accurately classifying skin lesions, minimizing false positives and false negatives.
- **Adaptability:** Ensure the model's adaptability to a diverse range of skin lesion types, considering variations in size, shape, and color.
- **Real-time Detection:** Optimize the model for real-time processing, enabling swift and timely diagnoses in a clinical setting.
- **Interpretability:** Incorporate measures to enhance the interpretability of the model's decisions, fostering trust among healthcare practitioners.
- **Integration:** Facilitate seamless integration into existing healthcare systems, making it accessible and user-friendly for dermatologists and healthcare professionals.

1.2.2. Project Scope:

The future scope of the skin lesion detection CNN model extends into several promising directions:

- **Multimodal Integration:** Explore the integration of multimodal data, such as combining imaging with patient history and genetic information, to improve overall diagnostic accuracy.
- **Continuous Learning:** Implement mechanisms for continuous learning, allowing the model to adapt and improve its performance over time with exposure to new data and emerging lesion characteristics.
- **Telemedicine Applications:** Extend the model's application to telemedicine platforms, enabling remote diagnosis and consultations, particularly beneficial in regions with limited access to dermatological expertise.
- **Global Collaboration:** Foster collaboration with dermatologists worldwide to create a comprehensive and diverse dataset, ensuring the model's effectiveness across different ethnicities and geographical regions.
- **Explanatory AI:** Further enhance the interpretability of the model by developing advanced explanatory AI techniques, providing insights into the features influencing its decisions.
- **Early Detection Research:** Extend research efforts to focus on the early detection of specific types of skin lesions, such as melanoma, to contribute to proactive healthcare measures.
- **Integration with Electronic Health Records (EHR):** Explore seamless integration with electronic health record systems to streamline the diagnostic workflow and enhance the overall patient care experience.

1.3. Project Features

For a skin lesion detection project aiming to classify lesions into benign and malignant categories, several key features and functionalities can enhance the effectiveness and utility of the system. Here are project features to consider:

Image Input:

Upload Functionality: Allow users to upload skin lesion images for analysis.

Real-time Capture: Integrate a feature for capturing images through a device's camera for immediate analysis.

Preprocessing:

Image Enhancement: Apply preprocessing techniques to enhance image quality and improve feature extraction.

Normalization: Normalize images to ensure consistent input conditions for the model.

Model Architecture:

Convolutional Neural Network (CNN): Implement a CNN for its effectiveness in image classification tasks.

Transfer Learning: Leverage pre-trained models or transfer learning to boost performance, especially with limited labeled data.

Classification:

Binary Classification: Design the model to classify lesions into benign or malignant categories.

Probability Score: Provide a probability score indicating the model's confidence in its classification.

Performance Metrics:

Accuracy, Sensitivity, Specificity: Display these metrics to evaluate the model's performance.

Confusion Matrix: Present a detailed breakdown of true positives, true negatives, false positives, and false negatives.

Interpretability:

Grad-CAM (Class Activation Map): Visualize which regions of the image contributed most to the model's decision.

Feature Importance: Highlight key features that influenced the classification result.

User Interface (UI):

User-Friendly Design: Ensure an intuitive and easy-to-use interface for both healthcare professionals and patients.

Feedback: Provide clear feedback on the classification result and confidence level.

Integration:

API Integration: Allow seamless integration with other healthcare systems or platforms.

Electronic Health Records (EHR): Explore integration with EHR systems for comprehensive patient records.

1.4. Feasibility

- **Technical Feasibility:**
  - **Data Availability:** Assess the availability of diverse and well-annotated datasets of skin lesion images for training and testing the model.
  - **Model Complexity:** Evaluate the technical feasibility of implementing a convolutional neural

network (CNN) or similar advanced models for effective lesion classification.

- **Feature Extraction:** Ensure the feasibility of extracting relevant features from skin lesion images to enhance classification accuracy.

- **Economic Feasibility:**
  - **Resource Requirements:** Assess the economic feasibility by estimating the resources required for model development, including computational resources, software tools, and expertise.
  - **Cost-Benefit Analysis:** Conduct a cost-benefit analysis considering the potential impact on healthcare outcomes, reduced diagnostic costs, and improvements in patient care.
- **Legal and Ethical Feasibility:**
  - **Regulatory Compliance:** Ensure compliance with healthcare and data protection regulations (e.g., HIPAA) to address legal feasibility.
  - **Informed Consent:** Assess the ethical feasibility by implementing procedures for obtaining informed consent from individuals whose data is used in the study.
- **Operational Feasibility:**
  - **User Acceptance:** Evaluate operational feasibility by considering the usability and acceptance of the system by healthcare professionals.
  - **Integration with Healthcare Systems:** Ensure practicality by assessing the feasibility of integrating the system into existing healthcare infrastructure, including electronic health records.
- **Scheduling Feasibility:**
  - **Project Timeline:** Develop a realistic timeline for the project, considering key milestones such as model development, training, testing, and deployment.
  - **Risk Mitigation:** Identify potential risks and develop strategies for mitigating delays, ensuring the project stays on schedule.

1.5. System Requirements

The system requirements for a skin lesion detection system to classify benign and malignant lesions depend on various factors, including the complexity of the model, the scale of deployment, and integration with existing healthcare systems. Here's a general overview of system requirements:

- **Hardware Requirements:**
  - **Computational Power:** Depending on the complexity of the model (e.g., CNN), a system with sufficient CPU/GPU capabilities is required for efficient training and inference.
  - **Memory:** Adequate RAM to handle the data processing and model operations efficiently.

- Storage: Storage space for storing the model, datasets, and potentially processed images.

- **Software Requirements:**
  - **Operating System:** Compatibility with the intended operating systems (e.g., Windows, Linux) for both development and deployment.
  - **Development Frameworks:** Support for machine learning frameworks like TensorFlow or PyTorch for model development.
  - **Database Management:** If handling large datasets, integration with database management systems for efficient data storage and retrieval.
  - **Image Processing Libraries:** Libraries such as OpenCV for preprocessing and handling skin lesion images.

- **Networking:**
  - **Internet Connectivity:** For access to online databases, updates, or potential telemedicine features.
  - **Data Transfer:** If the system involves data transfer between different components, a reliable network connection is essential.

- **Security and Compliance:**
  - **Data Encryption:** Ensure data encryption during transmission and storage to comply with data protection regulations.
  - **Access Controls:** Implement secure access controls to protect sensitive medical data.

- **User Interface:**
  - **Graphical User Interface (GUI):** A user-friendly interface for easy interaction, especially if the system is intended for use by healthcare professionals.
  - **Compatibility:** Ensure compatibility with various devices and screen sizes.
- **Scalability:**
  - **Scalable Architecture:** Design the system to be scalable, capable of handling an increased workload or growing datasets.
  - **Load Balancing:** If the system experiences varying levels of usage, load balancing mechanisms can be beneficial.

- **Testing and Monitoring:**
  - **Testing Environment:** Setup of a testing environment for thorough testing of the system before deployment.
  - **Monitoring Tools:** Implement tools for monitoring system performance, detecting issues.

Chapter 2: LITERATURE REVIEW

2.1. EXISTING SYSTEM

- This project may be a method for the detection of Melanoma carcinoma using the Image as processing tools.
- In this input the system is skin lesion image then applying in image processing techniques, it analyses conclude about the presence of carcinoma .
- The Lesion is Image to analysis tools checks as varied Melanoma in parameters, Color, Area perimeter, diameter to texture, size to shape analysis for image segmentation and the feature stages.

The extracted feature parameters that are wont to classify image as Non Melanoma and also Melanoma cancer lesion.

2.2. PROPOSED SYSTEM

This project may be a method for the detection of cancer using Image processing tools.

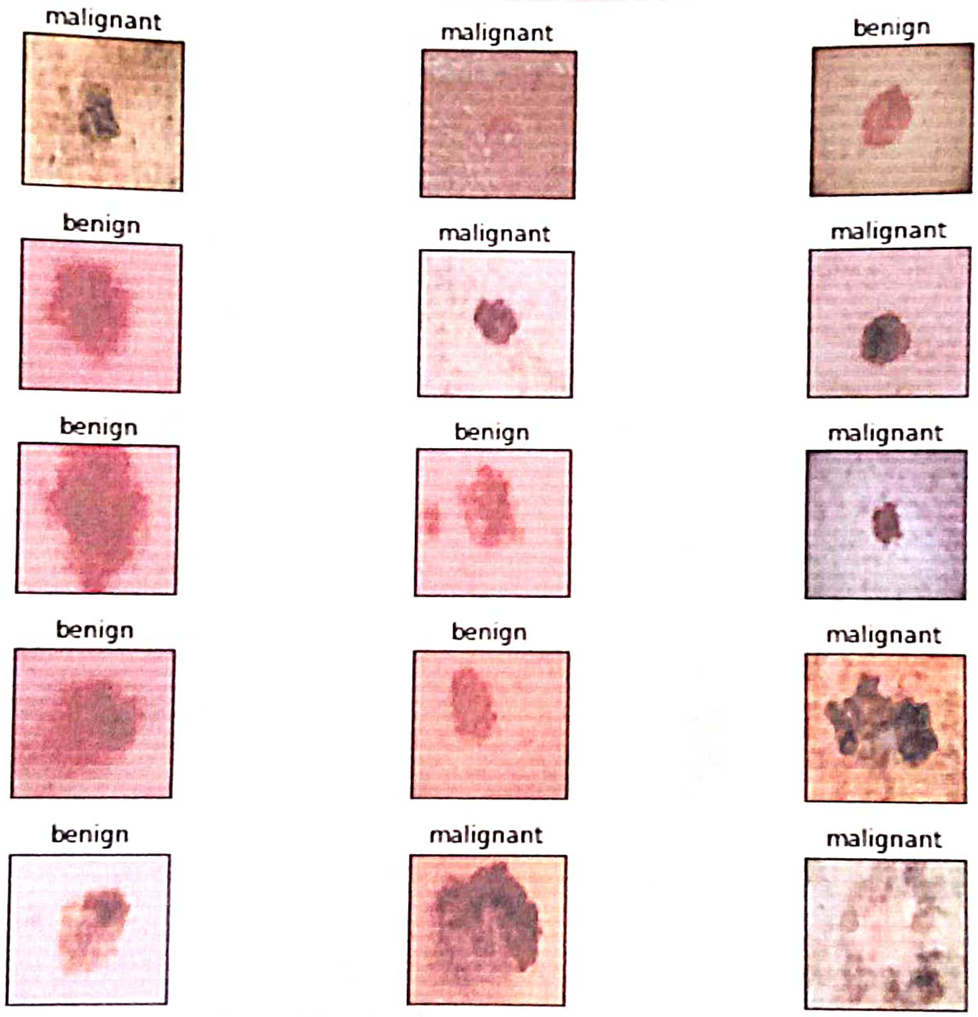
- In this input the system is that skin lesion image then applying image processing techniques, it analyses conclude about the presence of cancer.
- In Lession to Image analysis tools checks in the varied Melanoma parameters, Color, Area perimeter, diameter etc texture, size and shape analysis for image segmentation and the feature stages.
- The extracted to feature parameters wontof classify the image as benign and Malignant cancer lesion.

Chapter 3: PRELIMINARY DESIGN

3.1. Dataset Collection

Dataset used for this are extracted from kaggle towards skin cancer Detection .

- It consists of 6598 images of skin cancer.
- The training data consists of 3299 images and testing data consists of 3299 images.



3.2. Image Preprocessing

Image preprocessing is done by using OPEN CV and NUMPY.

OpenCV :

- OpenCV-Python library of Python bindings in designed unravel computer vision problems.
- OpenCV-Python makes use NumPy, by which may highly optimized library numerical operations a MATLAB-style syntax. All Open CV array are structures converted from NumPy arrays. This also makes it easier to integrate other a libraries that use NumPy SciPy and Matpotlib.
- OpenCV is capable for image analysis and processing.

NumPy :

Import- numpy as np

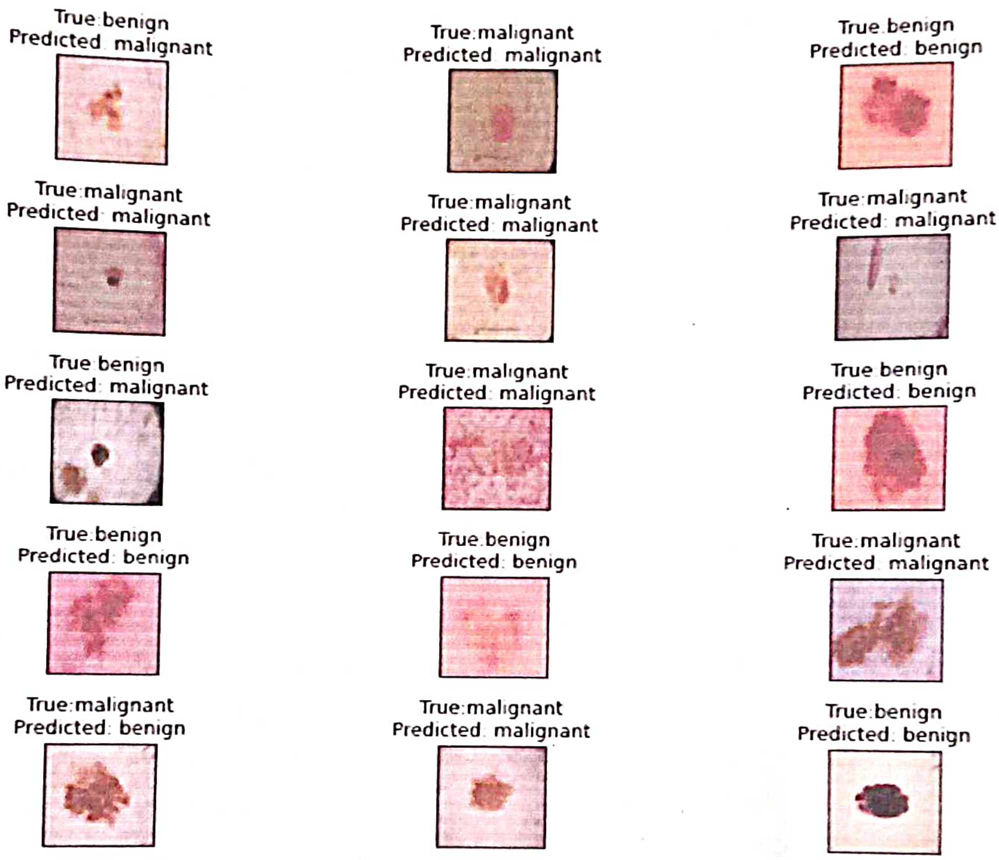
- NumPy, that stands Numerical Python, be a library consisting of multi_dimensional as array objects and set a routines for processing those arrays.
- Using as NumPy, mathematical and logical on operations are arrays in often performed.
- The array object in NumPy is named ndarray, it provides tons of supporting functions that make working with ndarray very easy.
- NumPy is an open-source numerical Python library. NumPy extension Numeric and Num array.
- Numpy contains random number generators. NumPy may wrapper around library implemented in C.
- Pandas is objects reply heavily NumPy objects. Essentially, Pandas extends NumPy.

3.3 IMAGE SEGMENTATION & FEATURE EXTRACTION :

Image segmentation is a process of dividing image into regions or categories. In the dermoscopic images two types of fabric things first normal skin and second is lesion area so here we have done egmentation with Otsu thresholding technique. Using Texture-Based segmentation extracting he features from the image. GLCM (Gray Level Co-occurrence Matrix) is the statistical method examining the spatial relationship between the pixel. This technique works by creating the cooccurrence matrix were to calculate the frequency of occurrence of a pixel with the grey-level value is adjacent to a pixel with grey-level value j in any given direction and selected separating distance The GLCM matrix gives four statistics Correlation, Contrast, Energy, Homogeneity. There some problem in segmentation of dermoscopic images due to the contrast of images like under segmentation and over-segmentation so we are concentrating on segmentation based on texture features.

3.4.IMAGE CLASSIFICATION

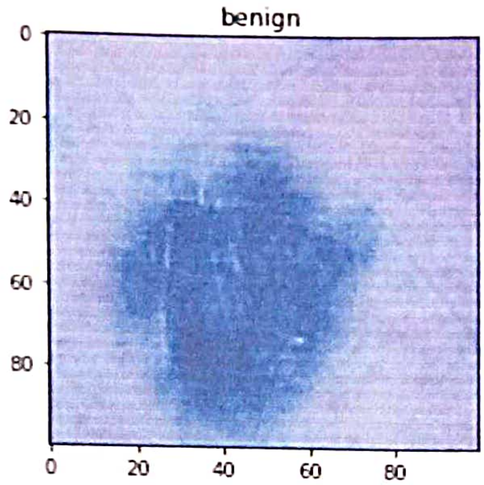
Deep learning is one of the best techniques for image classification. Based on the texture features we are training the dataset for classification. Here first we are giving Extracted feature to the Neural network for checking performance of image classification then we are using CNN (Convolutional Neural Network) it is one of the deep learning techniques for classification, Dermoscopic images classification is done in 2 classes. 'Benign' and 'Malignant'.



Chapter 4: FINAL ANALYSIS AND DESIGN

4.1. Result Overview

Here is the output screenshot where we can know whether a person has cancer or not. This picture is for detecting benign or malignant cancer which is type of skin cancer.



We diagnosed that this is Benign.

4.2. Result Analysis

Result analysis is a critical step to evaluate the performance of a skin lesion detection model. Precision, recall, and F1 scores are examined, The result analysis provides a comprehensive understanding of the skin lesion detection model's performance. Regularly update and refine the analysis as the model evolves or new data becomes available. This detailed examination not only validates the overall success but also unveils insights that can guide further refinements to enhance the model's capabilities.

4.3. Application of the Model

The skin cancer detection model developed in this project serves as a robust tool for accurately distinguishing between benign and malignant skin lesions. Its primary application lies in the early detection of skin cancer ,The model demonstrates versatility in telemedicine, remote diagnostics, and automated screening programs, offering a scalable solution for large-scale skin lesion assessments.

4.4 Challenges and Problems Faced

The skin lesion detection project faced various challenges inherent to the complex task of accurately identifying and distinguishing between benign and malignant skin lesions, primarily for the purpose of skin cancer detection. Key challenges included the availability of limited and imbalanced datasets, complexities in data preprocessing, and difficulties in handling interclass variability. Additionally, ethical considerations surrounding patient privacy, model interpretability, and the integration of the model into clinical workflows posed significant obstacles.

4.5 Limitations

The skin lesion detection project encounters certain limitations that influence its scope and performance. One key challenge revolves around the availability of diverse datasets; the model's effectiveness can be constrained if it hasn't been exposed to a wide range of skin conditions. Additionally, imbalances in the dataset, where one type of lesion is more prevalent than others, might lead to biased predictions, impacting the model's ability to accurately identify less common cases.

4.6. Conclusion

In the proposed system, Image Pre-Processing, Image Segmentation and Image Classification steps are performed for categorizing skin lesion images into melanoma or benign. Data augmentation technique is used in Convolutional Neural Network for increasing the number of images which leads to better performance of proposed method. Experimental results show an accuracy of CNN algorithm developed with data augmentation is higher than the CNN algorithm created without data augmentation. The proposed method detects melanoma faster than the biopsy method. The proposed method can be extended to identify different types of skin related diseases.In this project we also designed for the reference of doctors and a feedback form which is used to know the experience of the patients.

Chapter 5: REFRENCES

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