SK Abubakar Siddikh and D. Nagaraju, International Journal of Research in Engineering, IT and Social Sciences, ISSN 2250-0588, Impact Factor: 6.565, Volume 14 Issue 06, June 2024, Page 1564-1575

SKIN DISEASE DETECTION USING DEEP LEARNING

Sk.Abubakar siddikh, Department of CSE, Narayana Engineering College, Gudur, India

Dr. D. Nagaraju

Professor, Department of CSENarayana EngineeringCollege,Gudur, India

Abstract:

Air pollution has a significant impact on human health, particularly on the skin. Exposure to pollutants can lead to various skin diseases, especially in densely populated urban areas where pollution levels are typically higher. These skin diseases not only cause physical discomfort but also have a profound psychological and social impact, thereby highlighting the urgent need for effective diagnosis and treatment.

This study introduces a skin disease determination system designed to improve diagnostic accuracy through advanced image processing techniques and machine learning. The system aims to identify skin diseases by analyzing input images of affected skin areas. The process begins with the acquisition of high-resolution skin images, which are then subjected to a series of preprocessing steps. First, noise reduction techniques are applied to enhance image quality. Next, the images are converted to grayscale to simplify the processing while retaining essential features. The grayscale images undergo segmentation to isolate the region of interest, ensuring that the focus remains on the affected skin area.

Feature extraction is a critical step in this system, aimed at reducing the dimensionality of the data while preserving significant information that characterizes the skin disease. This step involves identifying key patterns and attributes within the segmented images that can distinguish different types of skin conditions. By minimizing the amount of data to be processed, feature extraction facilitates faster and more efficient classification.

For the classification task, a Convolutional Neural Network (CNN) is employed due to its proven effectiveness in image recognition and medical diagnosis. The CNN is trained on a comprehensive dataset comprising various skin disease images, enabling it to learn intricate patterns and features associated with each condition. The trained CNN can then accurately classify new images, providing a reliable diagnosis of the skin disease.

This system's potential benefits include faster diagnosis, reduced need for specialist consultations, and the ability to reach underserved populations where access to dermatological care is limited. By leveraging advanced image processing and machine learning techniques, this skin disease determination system represents a significant advancement in the field of dermatology, with the promise of improving patient outcomes and quality of life.

Keywords: Air pollution, skin diseases, image processing, noise reduction, grayscale conversion, segmentation, feature extraction, Convolutional Neural Network (CNN), medical diagnosis, dermatology.

I. INTRODUCTION

II. Skin diseases are one of the most commonly seen infections among people. Due to the disfigurement and associated hardships, skin disorders cause lots of trouble to the sufferers. Speaking of skin cancer, the facts and figures become more serious. In United States, skin cancer is the most common form of cancer. According to a 2012 statistics study, over 5.4 million cases of no melanoma skin cancer, including basal cell carcinoma and squamous cell carcinoma, are treated among more than 3.3 million people in America. In each year, the number of new cases of skin cancer is more than the number of the new incidence of cancers of the breast, prostate, lung and colon in combined. Research also shows that in the course of a lifetime, one-fifth of Americans will develop a skin cancer.

III. However, the diagnosis of skin disease is challenging. To diagnose a skin disease, a variety of visual clues may be used such as the individual lesional morphology, the body site distribution, color, scaling and arrangement of lesions. When the individual components are analyzed separately, the recognition process can be quite complex. For example, the well- studied skin cancer, melanoma, has four major clinical diagnosis methods: ABCD rules, pattern analysis, Menzies method and 7-Point Checklist. To use these methods and achieve a good diagnostic accuracy, a high level of expertise is required as the differentiation of skin lesions need a great deal of experience. Unlike the diagnosis by human experts which depends a lot on subjective judgment and is hardly reproducible, a computer aided diagnostic system is more objective and reliable.

IV. By using well-crafted feature extraction algorithms and combining with some popular classifiers (e.g; SVM and ANN), current state of art computer aided diagnostic systems can achieve very good performance on certain skin cancers such as melanoma. But they are unable to perform diagnosis over broader classes of skin diseases. Human engineered feature extraction is not suitable for an universal skin disease classification system. On one hand, hand- crafted features are usually dedicated for one or limited number of skin diseases. They can hardly be applied to other classes and datasets. One the other hand, due to the diversity nature of skin diseases, human engineering for every skin disease is unrealistic.

V. One way to solve this problem is to use feature learning which eliminates the need for feature engineering and lets the machine to decide which feature to use. Many feature learning based classification systems have been proposed in past few years. However, they have been mostly 2 restricted to dermoscopy or histopathology images. And they mainly focus on the detection of mitosis, an indicator of cancer. In recent years, deep convolutional neural networks (CNN) become very popular in feature learning and object classification. The use of high performance GPU makes it possible to train a network on a large-scale dataset so as to yield a better performance.

1.2 List of Skin Conditions:

Many conditions affect the human integumentary system the organ system covering the entire surface of the body and composed of skin, hair, nails, and related muscle and glands. The major function of this system is as a barrier against the external environment. The skin weighs an average of four kilograms, covers an area of two square meters, and is made of three distinct layers: the epidermis, dermis, and subcutaneous tissue. The two main types of human skin are: glabrous skin, the hairless skin

on the palms and soles (also referred to as the "palmoplantar" surfaces), and hairbearing skin. Within the latter type, the hairs occur in structures called pilosebaceous units, each with hair follicle, sebaceous gland, and associated arrectorpili muscle.

In the embryo, the epidermis, hair, and glands form from the ectoderm, which is chemically influenced by the underlying mesoderm that forms the dermis and subcutaneous tissues? The epidermis is the most superficial layer of skin, a squamous epithelium with several strata: the stratum corneum, stratum lucidum, stratum granulosum, stratum spinosum, and stratum basale. Nourishment is provided to these layers by diffusion from the dermis, since the epidermis is without direct blood supply. The epidermis contains four cell types: keratinocytes, melanocytes, Langerhans cells, and Merkel cells. Of these, keratinocytes are the major component, constituting roughly 95 percent of the epidermis. This stratified squamous epithelium is maintained by cell division within the stratum basale, in which differentiating cells slowly displace outwards through the stratum spinosum to the stratum corneum, where cells are continually shed from the surface. In normal skin, the rate of production equals the rate of loss; about two weeks are needed for a cell to migrate from the basal cell layer to the top of the granular cell layer, and an additional two weeks to cross the stratum corneum.

The dermis is the layer of skin between the epidermis and subcutaneous tissue, and comprises two sections, the papillary dermis and the reticular dermis. The superficial papillary dermis interdigitates with the overlying rete ridges of the epidermis, between which the two layers interact through the basement membrane zone. Structural components of the dermis are collagen, elastic fibers, and ground substance. Within these components are the pilosebaceous units, arrectorpili muscles, and the eccrine and apocrine glands. The dermis contains two vascular networks that run parallel to the skin surface one superficial and one deep plexus which are connected by vertical communicating vessels. The function of blood vessels within the dermis is 3 fourfold: to supply nutrition, to regulate temperature, to modulate inflammation, and to participate in wound healing. The subcutaneous tissue is a layer of fat between the dermis and underlying fascia. This tissue may be further divided into two components, the actual fatty layer, or panniculusadiposus, and a deeper vestigial layer of muscle, the panniculuscarnosus.

Clinically, the diagnosis of any particular skin condition is made by gathering pertinent information regarding the presenting skin lesion(s), including the location (such as arms, head, legs), symptoms (pruritus, pain), duration (acute or chronic), arrangement (solitary, generalized, annular, linear), morphology (macules, papules, vesicles), and color (red, blue, brown, black, white, yellow). Diagnosis of many conditions often also requires a skin biopsy which yields histologic information that can be correlated with the clinical presentation and any laboratory data.

1.3 OVERVIEW: OCCUPATIONAL SKIN DISEASES:

The growth of industry, agriculture, mining and manufacturing has been paralleled by the development of occupational diseases of the skin. The earliest reported harmful effects were

ulcerations of the skin from metal salts in mining. As populations and cultures have expanded the uses of new materials, new skills and new processes have emerged. Such technological advances brought changes to the work environment and during each period some aspect of the technical change has impaired workers' health. Occupational diseases, in general and skin diseases, in particular, have long been an unplanned by-product of industrial achievement. Fifty years ago in the United States, for example, occupational diseases of the skin accounted for no less than 65- 70% of all reported occupational diseases. Recently, statistics collected by the United States Department of Labor indicate a drop in frequency to approximately 34%. This decreased number of cases is said to have resulted from increased automation, from enclosure of industrial processes and from better education of management, supervisors and workers in the prevention of occupational diseases in general. Without doubt such preventive measures have benefited the workforce in many larger plants where good preventive services may be available, but many people are still employed in conditions which are conducive to occupational diseases.

Unfortunately, there is no accurate assessment of the number of cases, causal factors, time lost or actual cost of occupational skin disease in most countries. General terms, such as industrial or occupational dermatitis or professional eczema, are used for occupational skin diseases but names related both to cause and effect are also commonly used. Cement dermatitis, chrome holes, chloracne, fibreglass itch, oil bumps and rubber rash are some examples. Because of the variety of skin changes induced by agents or conditions at work, these diseases are appropriately called occupational dermatoses-a term which includes any abnormality resulting directly from, or aggravated by, the work environment. The skin can also serve as an avenue of entry for certain toxicants which cause chemical poisoning via percutaneous absorption.

1.4 The Skin:

Human skin, except for palms and soles, is quite thin and of variable thickness. It has two layers: the epidermis (outer) and dermis (inner). Collagen and elastic components in the dermis allow it to function as a flexible barrier. The skin provides a unique shield which protects within limits against mechanical forces, or penetration by various chemical agents. The skin limits water loss from the body and guards against the effects of natural and artificial light, heat and cold. Intact skin and its secretions provide a fairly effective defence zone against micro- organisms, providing mechanical or chemical injury does not impair this defence. Provides an illustration of the skin and description of its physiological functions.

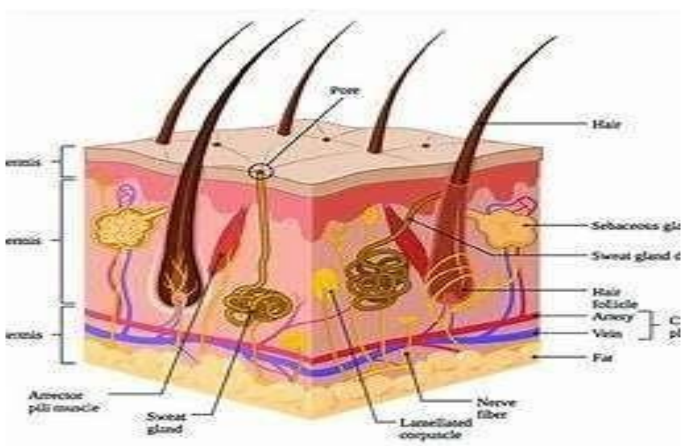

Figure 1. Schematic representation of the skin.

1.5 Types of Occupational Skin Diseases:

Occupational dermatoses vary both in their appearance (morphology) and severity. The effect of an occupational exposure may range from the slightest erythema (reddening) or discoloration of the skin to a far more complex change, as a malignancy. Despite the wide range of substances that are known to cause skin effects, in practice it is difficult to associate a specific lesion with exposure to a specific material. However, certain chemical groups are associated with characteristic reaction patterns. The nature of the lesions and their location may provide a strong clue as to causality. A number of chemicals with or without direct toxic effect on the skin can also cause systemic intoxication following absorption through the skin. In order to act as a systemic toxin, the agent must pass through the keratin and the epidermal cell layers, then through the epidermal-dermal junction. At this point it has ready access to the bloodstream and the lymphatic system and can now be carried to vulnerable target organs.

- **ACTINIC KERATOSIS:** Actinic keratosis, also known as solar keratosis, is a common precancerous skin lesion that typically appears as a scaly or crusty growth on areas of the skin that have been exposed to the sun, such as the face, scalp, ears, neck, and hands. It is caused by prolonged exposure to ultraviolet 6 (UV) radiation from the sun or tanning beds, and is most commonly seen in fair-skinned individuals over the age of 40. Actinic keratosis is not usually painful, but it can be itchy or tender to the touch. If left untreated, it can develop into squamous cell carcinoma, a type of skin cancer, although most actinic keratoses do not progress to cancer. Treatment options for actinic keratosis include cryotherapy (freezing), topical medications, photodynamic therapy (PDT), and surgical removal. It is important to protect the skin from further sun damage by wearing protective clothing and using sunscreen with a high SPF.

- **BASAL CELL CARCINOMA:** Basal cell carcinoma (BCC) is the most common type of skin cancer, accounting for about 80% of all cases. It typically appears as a raised, pearly bump or a pink, scaly patch on areas of the skin that have been exposed to the sun, such as the face, scalp, ears, neck, and shoulders. BCC is caused by damage to the DNA in the skin cells, usually as a result of long-term exposure to ultraviolet (UV) radiation from the sun. It is most commonly seen in fair-skinned individuals over the age of 50, although it can occur in younger people and those with darker skin. BCC is usually slow-growing and rarely spreads to other parts of the body, but it can cause damage to nearby tissues if left untreated. Treatment options for BCC include surgical removal, cryotherapy (freezing), topical medications, and photodynamic therapy (PDT).

DERMATOFIBROMA: Dermatofibroma, also known as benign fibrous histiocytoma, is a common benign skin growth that usually appears as a firm, round or oval bump on the skin. It can be red, brown, or purple in color, and is most commonly found on the legs, but can also appear on other parts of the body. The exact cause of dermatofibroma is unknown, but it is thought to occur as a result of an inflammatory or immune response to an injury or insect bite. It is more common in women than in men and is usually seen in adults. History-wise, dermatofibroma was first described in the medical literature in 1961 by Dr. Darier and Dr. Ferrand. It was initially called a "histiocytoma" because it was thought to be a tumor of histiocytes, a type of immune cell. However, it is now known that dermatofibromas are not true tumors but rather a benign growth of the skin's connective tissue

MELANOMA: Melanoma is a type of skin cancer that arises from the pigment- producing cells of the skin called melanocytes. It can occur anywhere on the body, but is most commonly found on the legs in women and the chest and back in men. Melanoma can also develop in areas that are not exposed to the sun, such as the palms of the hands, soles of the feet, and under the nails. The exact cause of melanoma is not known, but it is believed to be related to a combination of genetic and environmental factors, such as prolonged exposure to ultraviolet (UV) radiation from the sun or tanning beds, having fair skin, and a history of sunburns. Melanoma has been known for centuries, with descriptions of its characteristic features dating back to ancient Greece. However, it was not until the 19th century that physicians began to recognize it as a distinct form of skin cancer. In the 20th century, advances in diagnostic techniques and treatment options led to improved outcomes for patients with melanoma, although it remains a significant public health concern today.

• **NEVUS:** Nevus, also known as a mole or birthmark, is a common benign growth of the skin that typically appears as a dark, raised spot. Moles can be flat or slightly raised, and can range in color from tan to dark brown or

black. They can occur anywhere on the body and are usually harmless, but in some cases they can develop into skin cancer. The exact cause of nevi is not fully understood, but they are thought to be related to a combination of genetic and environmental factors. Some nevi are present at birth, while others develop later in life due to sun exposure or hormonal changes. Nevi have been known and described for thousands of years, with references to them found in ancient Egyptian and Greek medical texts. In the 19th century, advances in dermatology led to improved understanding of nevi and their relationship to skin cancer. Today, nevi are routinely evaluated by dermatologists as part of skin cancer screening and surveillance.

• **PIGMENTED BENIGN KERATOSIS:** Pigmented benign keratosis, also known as seborrheic keratosis, is a common benign skin growth that typically appears as a waxy, raised, and pigmented lesion on the skin. It can vary in color from tan to black and can occur anywhere on the body, but is most commonly found on the face, neck, chest, and back.The exact cause of pigmented benign keratosis is not fully understood, but it is believed to be related to a combination of genetic and environmental factors. It is more common in people over the age of 50 and is often associated with sun damage. Pigmented benign keratosis was first described in the medical literature in the early 20th century, and was initially thought to be a type of seborrheic dermatitis. It was later recognized as a distinct entity and is now one of the most common benign skin growths seen in clinical practice.

• **SEBORRHEICKERATOSIS:** Seborrheic keratosis is a common benign skin growth that typically appears as a waxy, raised, and often pigmented lesion on the skin. It can vary in color from light tan to black, and is most commonly found on the face, chest, and back. Seborrheic keratosis is more common in older adults and can be mistaken for melanoma or other forms of skin cancer. The exact cause of seborrheic keratosis is not known, but it is believed to be related to genetic and environmental factors, including sun exposure. It is not contagious or harmful, and typically does not require treatment unless it is causing discomfort or is cosmetically bothersome. Seborrheic keratosis was first described in the medical literature in the mid-19th century, and was initially thought to be a type of basal cell carcinoma. However, it was later recognized as a distinct entity and is now one of the most common benign skin growths seen in clinical practice. Advances in diagnostic techniques, including dermoscopy and biopsy, have improved the ability to differentiate seborrheic keratosis from skin cancer.

• **SQUAMOUS CELL CARCINOMA:** Squamous cell carcinoma is a type of skin cancer that arises from the squamous cells that make up the outer layer of the skin. It is the second most common form of skin cancer, after basal cell carcinoma, and is typically found on areas of the body that are frequently exposed to the sun, such as the face, ears, neck, hands, and arms. However, it can also develop on other areas of the body, including the genitals and inside the mouth. Squamous cell carcinoma often appears as a thick, scaly, or crusty patch of skin with an elevated border. It may also appear as a sore that does not heal or as a growth with a central depression. Squamous cell carcinoma can metastasize, or spread to other parts of the body, if left untreated. Squamous cell carcinoma has been recognized as a distinct form of skin cancer since the early 19th century. Treatment options for squamous cell carcinoma include surgery, radiation therapy, and topical or systemic chemotherapy. The prognosis for squamous cell carcinoma is generally 9 good if it is detected and treated early, but it can be more difficult to treat if it has metastasized to other parts of the body. In recent years, research has led to the development of new therapies for advanced squamous cell carcinoma, including immune checkpoint inhibitors and targeted therapies that target specific genetic mutations. These treatments have shown promise in improving outcomes for patients with advanced squamous cell carcinoma.

• **VASCULAR LESIONS:** Vascular lesions are abnormalities in the blood vessels that can occur anywhere in the body, including the skin, soft tissue, and internal organs. They can be present at birth (congenital) or can develop later in life (acquired). There are many types of vascular lesions, including hemangiomas, port-wine stains, venous malformations, and lymphatic malformations, among others. These lesions can vary in size, shape, and location, and can cause a range of symptoms, including pain, swelling, and cosmetic concerns. Vascular lesions have been recognized for centuries, with descriptions dating back to ancient times. In the 19th century, the French dermatologist Jean Baptiste Cazenave provided one of the first systematic descriptions of vascular lesions, including hemangiomas and port-wine stains.

2. RELATED WORK:

Skin disease detection using Support Vector Machines (SVM) is a popular method in computeraided diagnosis. SVM is a machine learning algorithm that is commonly used for classification tasks, including skin disease detection. The results and accuracy of skin disease detection using SVM depend on various factors such as the quality and quantity of the input data, the feature extraction method, and the selection of SVM parameters. Generally, SVM has shown promising results in detecting various skin diseases with high accuracy. For example, a study published in the Journal of Medical Systems reported an accuracy of 97.2% in classifying skin diseases using SVM.

3. METHODOLOGY:

The modules in Skin disease detection are

Image acquisition: Image acquisition is the step where the affected skin image is taken as input. **Image pre-processing**: The aim of pre-processing is an improvement of the image data that suppresses unwanted distortions or enhance some image feature important for further processing. **Image segmentation:** Image segmentation is the process of partitioning a digital image into multiple segments.

Feature extraction: The aim of feature extraction is to find out and extract features that can be used to determine the meaning of given sample.

Classification: In this phase to detect and classify the different skin diseases, we are using the CNN classifier. The flow diagram of the air pollution detection and monitoring is given below

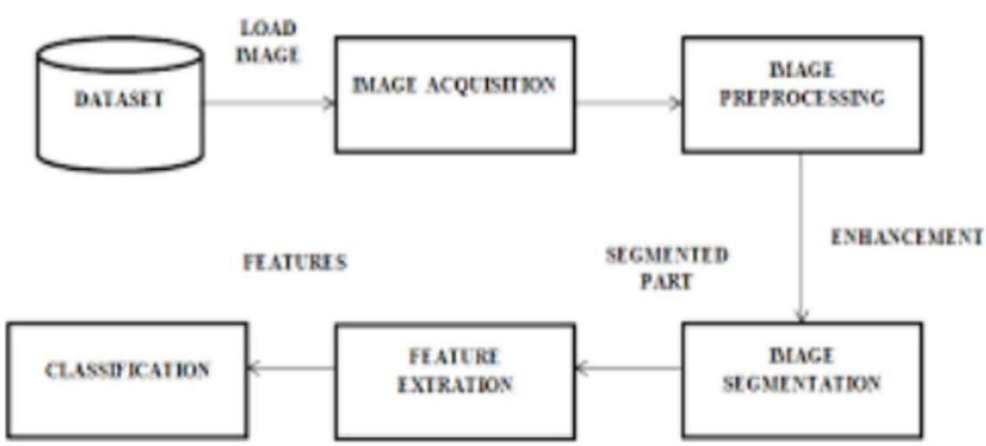

FIGURE 2: BLOCK DIAGRAM OF A CNN DATA FLOW

PROPOSED METHOD:

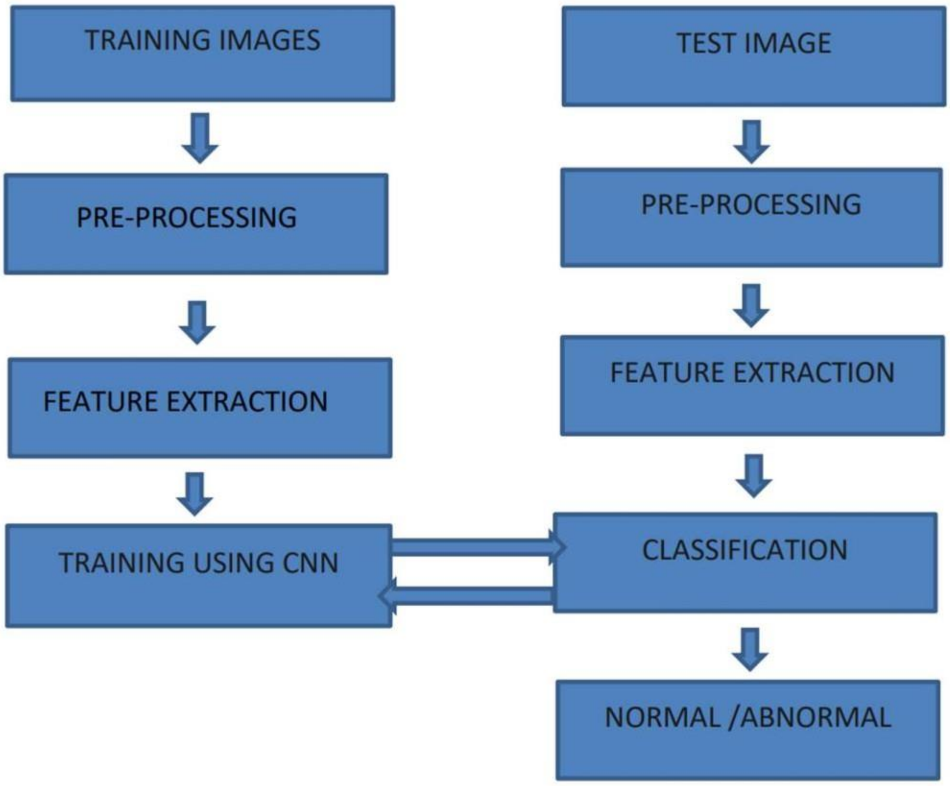

Figure 3: Block diagram of proposed work

a.) Data Collection:

i. Downloaded the dataset for different skin diseases from the given online source.
ii. https://www.kaggle.com/datasets/nodoubttome/skin-cancer9-classesisic
iii. Collected images of different skin diseases organized into subdirectories based on their respective names as shown in the project structure.
iv. Divided our collected dataset into two parts that include:Training data and testing data.

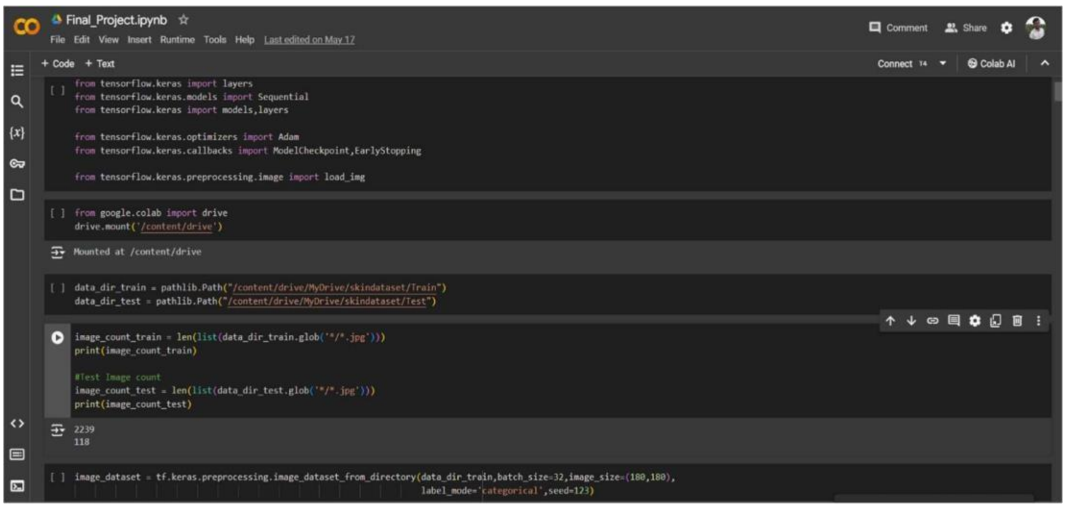

Figure 4: Loading the images from the drive

b.) Data Preprocessing:

To improve the recognition rate of the image, a procedure of image pre-processing is performed such as 5*5 median filtering & Histogram equalization. Feature-Extraction: The information about the image is extracted using features. Features are the attributes which are related to particular class.

Data Cleaning: Initially, the raw data undergoes preprocessing to handle missing values and ensure data consistency. Rows containing NaN values are dropped to maintain data integrity.

Data Transformation: The raw data is transformed using methods from feature engineering into a format that is appropriate for model training. Numeric conversion functions are used to convert string representations of numerical values into float format, ensuring uniformity across the dataset.

Figure 5: IMAGE OF PRE-PROCESSING OF AN IMAGE

c.) Feature extraction:

The aim of the feature extraction method is to extract biologically meaningful features of the melanoma, eczema, impetigo, region that can aid in identification and evaluation. 1. Color: The color of the skin differs over the various shades of brown, black, red, white or green. The value is assigned on the presence of each color in the image. 2. Major Axis Length or Greatest Diameter (GD): The length of the line passing through lesion centroid and connecting the two farthest boundary points. 3. Minor Axis Length or Shortest Diameter (SD): The length of the line passing through lesion blob centroid and connecting the two nearest boundary points.
4. Area (A): Number of pixels of the lesion. 5. Perimeter (P): Number of edge pixels. 6. Texture: Image texture gives us information about the spatial arrangement of color or intensities in an image where it may get vary for each pixel or particularly the selected region of an image. To quantify tperceived texture of an image the Texture is used where it is a set of metrics calculated in image processing.

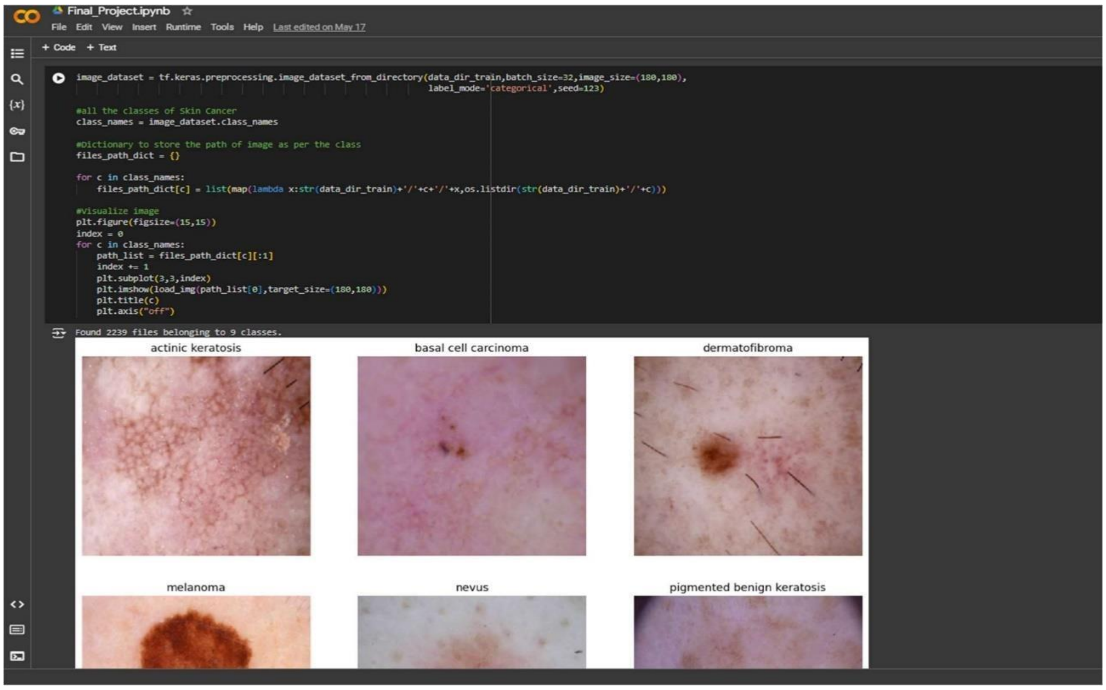

Figure 6: Displaying the images after classification

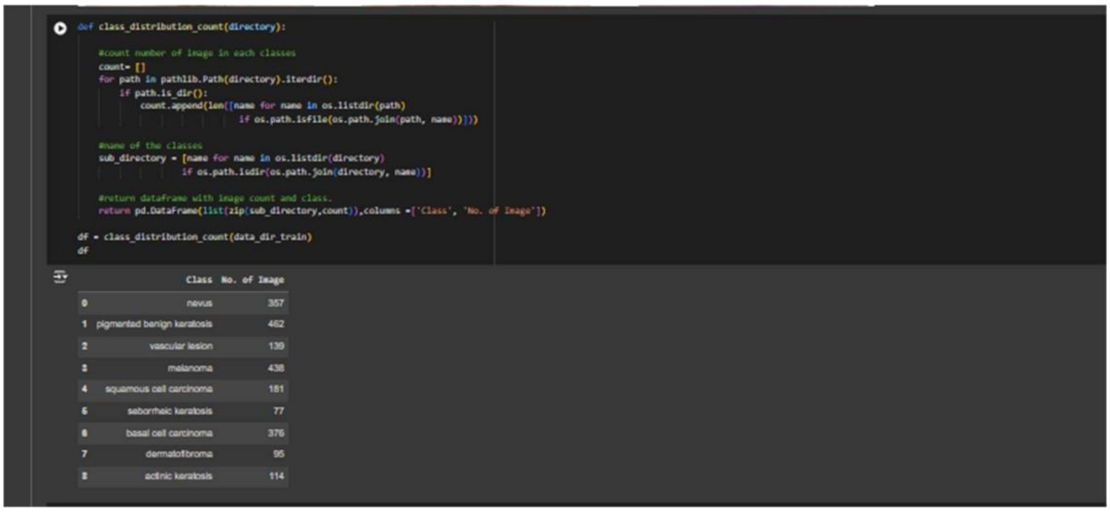

Figure 7: Classifying the total images based on the disease from the training dataset

d.) Model selection and training:

After processing the collected data, it should undergo the development depending on the algorithm. The tensorflow library in Python was utilized for model development and training.

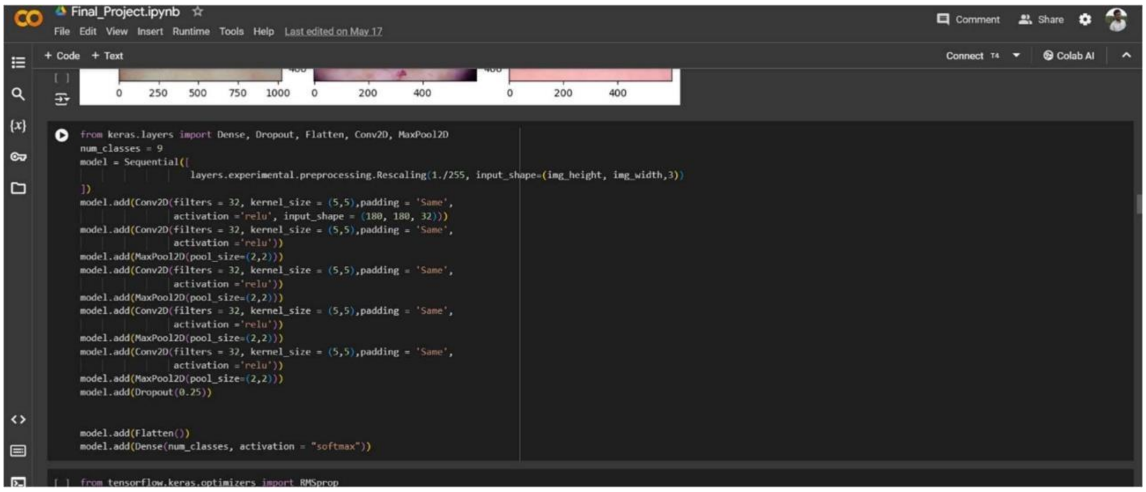

Figure 9: Training the model with the training dataset

e.) Evaluation and Validations:

Standard evaluation measures like mean absolute error (MAE), R-squared were majorly used to assess the trained model. The model's extrapolation efficiency was gauged using cross- validation strategies. The implemented system underwent rigorous evaluation and validation to assess its performance and reliability. Real-time monitoring capabilities were tested under various scenarios to ensure responsiveness and accuracy.

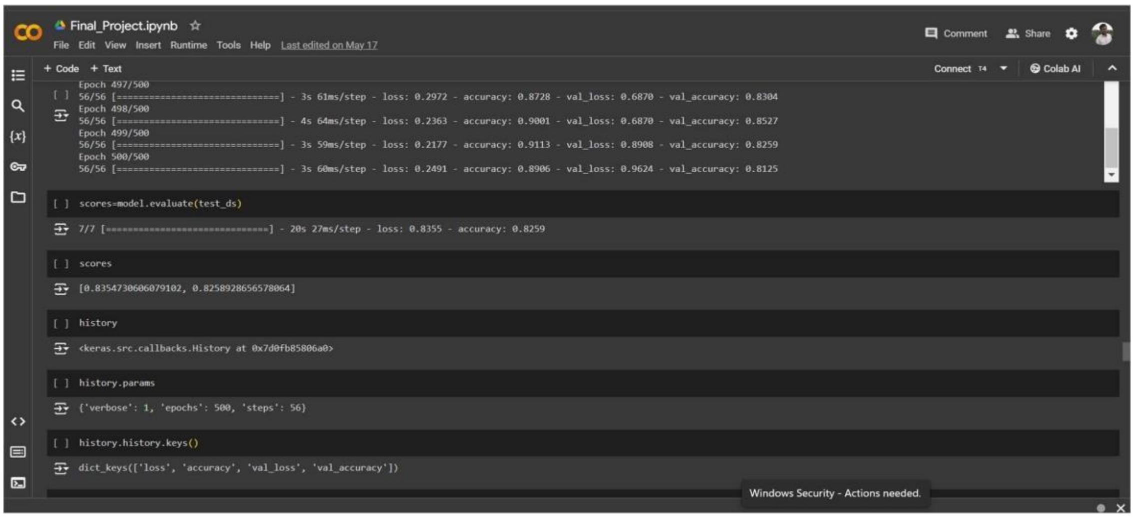

Figure 10: Displaying the evaluation results

4. RESULTS AND ANALYSIS:

These predictions are demonstrated, showcasing the practical applicability of the proposed approach. Predictions are made based on input data collected at different temperatures, allowing for timely interventions and decision-making in air efficiency management.

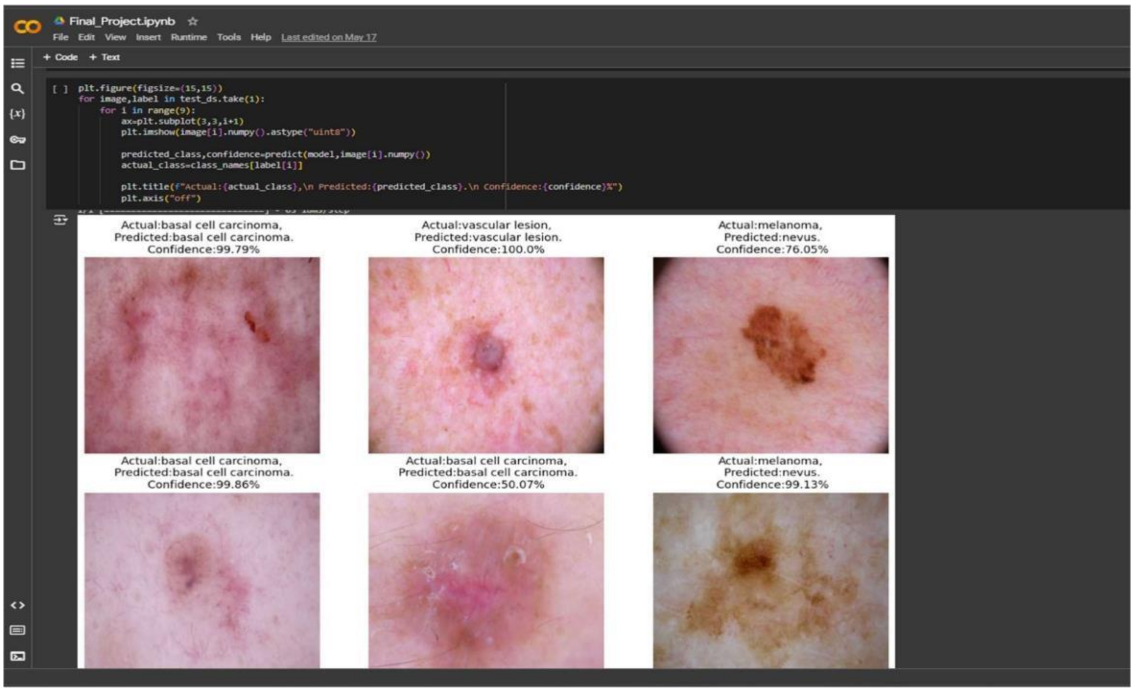

Figure 11: Prediction some random images from the test dataset

5. CONCLUSION:

The proposed work shows the improvement in identifying the skin diseases at different stages using image processing techniques based on active pre-processing, thresholding and CNN classifier.

The proposed work is to extract the features of the skin disease image given as input and detect the disease, features extracted are area, perimeter, mean and texture features.

6. REFERENCES:

Haralick R.M, Shanmugam K and Dinstein I, Textural features for image classification, IEEE Trans. Syst, Man, Cybern, 3 (6), 1973, 610–621.

Jeffrey Glaister, Student Member, IEEE, Alexander Wong, Member, IEEE, and David Clausi A, Segmentation of Skin Lesions From Digital Images Using Joint Statistical Texture Distinctiveness, IEEE Transactions On Biomedical Engineering, 61 (4), 2014.

Kavitha V, Palanisamy V, A Survey of Deflection Routing Techniques in Optical Burst Switching Networks, Archives Des Sciences, 66 (3), 2013, 704-712.

Kavitha V, Palanisamy V, Load Balanced Deflection Routing and Priority Scheduling in OBS Networks, International Review on Computers and Software, 8 (7), 2013, 1603-1612.

Kavitha V, Palanisamy V, New Burst Assembly and Scheduling T technique for Optical Burst Switching Networks, Journal of Computer Science, 9 (8), 2013, 1030-1040.

Kavitha V, Palanisamy V, Simultaneous Multi-path Transmission for Burst Loss Recovery in Optical Burst Switching Networks, European Journal of Scientific Research, 87 (3), 2012, 412-416.

Kavitha V, Veeralakshmi C, Surveillance on Many casting Over Optical Burst Switching Networks under Secure Sparse Regeneration, Journal of Electronics and Communication Engineering, 4 (6), 2013, 1-8.

Mohanapriya S, Vadivel M, Automatic retrival of MRI brain image using multiqueries system, 2013 International Conference on Information Communication and Embedded Systems (ICICES), 2013, 1099-1103.

PalanivelRajan S, Cellular Phone based Biomedical System for Health Care, IEEE Digital Library Xplore, IEEE Catalog Number, CFP1044K-ART, 2010, 550-553.

PalanivelRajan S, Experimental Explorations on EOG Signal Processing for Real Time Applications in LabVIEW, IEEE Digital Library Xplore, IEEE Catalog Number, CFP1221TCDR, 2012.

PalanivelRajan S, Intelligent Wireless Mobile Patient Monitoring System, IEEE Digital Library Xplore, IEEE Catalog Number, 2010, 540-543