

Analyzing Skin Disease Using XCNN (eXtended Convolutional Neural Network)

Ashish Tripathi, G. L. Bajaj Institute of Technology and Management, India*

Arun Kumar Singh, G. L. Bajaj Institute of Technology and Management, India

Adarsh Singh, G. L. Bajaj Institute of Technology and Management, India

Arjun Choudhary, Sardar Patel University of Police, Security, and Criminal Justice, India

Kapil Pareek, Sardar Patel University of Police, Security, and Criminal Justice, India

K. K. Mishra, MNNIT Allahabad, India

ABSTRACT

Skin disease is one of the major concerns for clinicians and researchers. Fungus, germs, allergies, and viruses are the main causes of skin diseases. There has always been unsaid competition between conventional and advanced computing-based techniques, and with these new techniques, cost of treatment is also being reduced drastically. In this paper, a deep learning-based model named eXtended Convolutional Neural Network (XCNN) has been proposed to classify three types of skin diseases (i.e., acne, rosacea, and melanoma). XCNN is easy-to-use, economic, and accurate. It will help clinicians to identify and categorize such diseases at the initial stage through automated screening. The proposed work is designed for multi-classification that takes digital images and applies XCNN to identify the type of disease. The model has been built on the dataset of the various skin disease images. It gives 95.67% accuracy in recognizing the diseases with improved recall, f1-score, and precision values compared to other state-of-the-art models.

KEYWORDS

Acne, Convolutional Neural Network (CNN), eXtended Convolutional Neural Network (XCNN), Melanoma, Rosacea, Skin Disease

INTRODUCTION

The skin is the body's most unique and biggest organ. It consists of blood vessels, lymphatic vessels, nerves, and muscles that enable it to perspire, detect external temperature, and protect the body. In addition to functioning as a sensory organ for the external environment, the skin protects the internal organs and tissues within the body against toxic substances, bacteria, pollutants, the sun's ultraviolet rays, and genetic skin diseases (Abunadi et al., 2021). In contrast, the skin may restrict the loss of

lipids and water from the epidermis and dermis to sustain the skin's protective barrier. However, the clinician has difficulty distinguishing the kind of skin disease and its stage during the evaluation phase. The complexity of skin diseases is difficult to analyze at an early stage. Consequently, it is more difficult for medical practitioners to recommend potential medication and treatment to the patient.

Skin diseases include a wide variety of conditions that affect the skin, including genetic diseases (Acne, Rosacea), bacterial infections (Cellulitis, boils), viruses, fungal infections (Yeast, Ringworm), allergic reactions (Eczema, Hives, itching), skin cancers (Melanoma, Nevus, Basal, Squamous) and parasites (Scabies, Mites), etc., the symptoms may include a bump, rash, or a dry patch. Although, most skin disorders develop in the layers of the skin (Kshirsagar et al., 2022).

Skin is the first organ of the body to reveal detectable signs of underlying disease because of its appearance and accessibility. Skin abnormalities are typically indicative of severe diseases. In this respect, classifying skin disorders and symptoms can help clinicians predict skin disease stages. It can also assist in determining the level of severity. However, a few skin diseases are known to show symptoms after several weeks or months, leading to the spread of the disease at a severe level in the infected area. This may have several reasons like inadequate medical data for the said disease, confusion in classifying the type of disease at the initial stage, expensive medical diagnosis equipment, time consumed in a clinical tests, etc. However, the advancement in medical technologies has made the possibility of diagnosing diseases quickly and more accurately, but such diagnoses are still limited to some parts of the globe (Wu et al., 2019). It is also very costly and unaffordable for every person. In this context, "deep learning" based techniques may be useful in quick analyzing clinical information and concluding. It is one of the domains that may contribute significantly to the functional and accurate identification of several skin problems.

Among all skin diseases, Acne is the eighth most common disease in the world, affecting more than 681 million population (Flohr et al., 2021). Acne occurs when clogged skin follicles clump together and enlarge due to a blockage created by oil from glands, germs, and dead cells. Rosacea is also a common skin disease affecting more than 415 million people worldwide (Van Zuuren et al., 2019). Rosacea is a chronic skin condition that causes redness and pimples on the face. It can also thicken the skin and create eyesight problems. Melanoma is the nineteenth most commonly occurring type of skin cancer in the world, having 300,000 new cases in 2018 worldwide and 132,000 globally each year (Zhang et al., 2020, Nahata et al., 2020). In recent years, cancer has surpassed heart disease as the leading cause of mortality in humans. Approximately nine million people die each year, with 70% of these fatalities occurring in nations with low living standards (Curtin et al., 2020). This was owed to a delay in consulting medical experts at the start of the disease, an increase in the level of infection, and a lack of the necessary treatment, which turned into skin cancer and resulted in death. Often patients are unaware of the type of skin disease they are suffering from and how lethal it can be for them. Melanoma is a type of skin cancer that develops from melanocytes, the pigment-producing cells in the skin. This type of skin cancer is also known as Malignant Melanoma. It is the most severe type of skin cancer, with a mortality rate of approximately 20% if cancer doesn't get detected at the early stage. In most cases, it is possible that skin diseases may be converted into skin cancer, so it is vital to diagnose and proper medication for the disease at an early stage to stop susceptibility to infection (Linares et al., 2015).

Usually, diagnosing a skin disease takes more time and causes a financial burden on the patients. People in developing countries generally ignore primary symptoms and avoid the necessary treatment at the start of the disease. As a consequence of the above challenges, treatment becomes more complex. Using a deep-learning technique, namely eXtended Convolutional Neural Network (XCNN), these challenges mentioned above may be resolved by analysis of microscopic images of infected skin. Deep-Learning techniques enhance the image quality at the initial stage through segregating regions, pre-processing methods, and detecting lesion areas from healthy skin to emphasize the infected region. Subsequently, essential features are retrieved from each image and differentiated from other images with the same features. Eventually, the features are sent into the classification stage in order

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