**Decoding Diabetics: Unconventional Indicators for Diabetic Diagnosis**

R24-120

Project Final Thesis

Methiny. S - IT21083228

B.Sc. (Hons) in Information Technology Specializing in Information Technology

Department of Information Technology

Sri Lanka Institute of Information Technology

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# DECLARATION

I declare that this is my own work, and this Thesis does not incorporate without acknowledgement any material previously submitted for a degree or diploma in any other University or institute of higher learning and to the best of my knowledge and belief it does not contain any material previously published or written by another person except where the acknowledgement is made in the text.

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The above candidate has carried out this research thesis for the Degree of Bachelor of Science (honors) Information Technology (Specializing in Information Technology) under my supervision.

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(Ms. Karthiga Rajendran)

# ABSTRACT

One of the most important aspects of healthcare is the early diagnosis of nail infections, especially those associated with diabetes. Using deep learning techniques, this research aims to construct a Python-based detection system that can effectively categorise nail photos as either non-diabetic or diabetic. Convolutional Neural Networks (CNNs) are the foundation of the model because of their superior performance in image categorisation applications. The main framework is TensorFlow, which has a large number of tools and modules, while Keras offers an easy-to-use interface for modelling and training.

The method employs augmentation and resizing techniques to preprocess photos, guaranteeing that the model is trained on a wide range of datasets. For probabilistic output, the architecture consists of numerous MaxPooling layers, Dense layers with SoftMax activation, and Convolution2D layers with ReLU activation functions. The model's complexity is controlled using the Adam optimiser, which improves the model's ability to detect nail infections. In order to train the model, data must be systematically divided into training, validation, and testing sets. Batch size, learning rate, and epochs are all adjusted for best results.

The outcomes show how well the model can identify diabetic nail infections, offering important information for prompt diagnosis and therapy. The use of Matplotlib's data visualisation functionality facilitates a deeper comprehension of the model's performance. By providing a strong tool for the early diagnosis of nail infections, this discovery advances medicine and may improve patient outcomes by enabling prompt care.

**Keywords:** Diabetes Detection, Nail Infection Detection, Convolutional Neural Networks

(CNN), Deep Learning, TensorFlow

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# LIST OF ABBREVIATIONS

|  |  |
| --- | --- |
| **Abbreviations** | **Description** |
| SLIIT | Sri Lanka Institute of Information Technology |
| CNN | Convolutional Neural Network |
| ML | Machine Learning |
| DL | Deep Learning |
| MS | Microsoft |
| DM | diabetes mellitus |
| DFU | Diabities Foot Alsusr |
| MB | Mega Byte |
| XML | Extensible Markup Language |
| CSV | Comma-Separated Values |
| API | Application Programming Interface |
| WHO | World Health Organization |
| ECG | Electrocardiogram |
| HOG | Histogram of Oriented Gradients |
| SVM | Support Vector Machines |
| OS | Operating System |
| SDLC | Software Development Life Cycle |
| WBS | Work Breakdown Structure |
| IDE | Integrated Development Environment |
| HTML | Hyper Text Markup Language |
| JS | Java Script |
| CSS | Cascading Style Sheet |

# INTRODUCTION

## Background Study and Literature Review

### Background Study

The development of machine learning technologies has completely changed the precision and effectiveness of disease identification and categorisation in the field of medical diagnostics. Nail infections provide serious health hazards and frequently necessitate prompt treatment to avoid consequences, especially in individuals with diabetes. Conventional diagnostic techniques, which depend on medical personnel visually inspecting patient data, can be arbitrary and inconsistent. An increasing number of people are interested in using automated systems to improve diagnosis accuracy in order to overcome these difficulties.

The objective of this study is to create an automated system for detecting nail infections by utilising Convolutional Neural Networks (CNNs), a well-researched deep learning architecture that has demonstrated effectiveness in picture classification tasks. The CNN model is the best option for differentiating between various nail states because of its capacity to learn from and extract information from complex picture data.

The TensorFlow and Keras libraries provide an extensive toolkit for creating and refining deep learning models, which is leveraged by the suggested system. The model imports photographs from a disc folder and resizes each one to 256 by 256 pixels in order to maintain uniformity. Techniques for augmenting data, such flipping and rotating photographs, are used to make the training dataset more variable and strengthen the model's resilience.

Several Convolution2D layers with ReLU activation functions are part of the CNN's architecture, which is intended to identify and extract hierarchical characteristics from nail image data. By reducing the spatial dimensions of the feature maps, MaxPooling2D layers highlight the most significant characteristics and increase computational efficiency. In order to transform the final feature representations into probabilities for classification, the network additionally includes Flatten and Dense layers using a Softmax activation function.

Numerous hyperparameters, such as batch size, learning rate, and epochs, are adjusted to maximise the model's performance. Because of its adaptable learning rate characteristics, which aid in ensuring stable and efficient training, the Adam optimiser is chosen. To carefully assess the accuracy and generalisation capacity of the model, the dataset is split into subsets for training, validation, and testing.

The goal of this research is to develop a useful and effective tool that will significantly outperform current diagnostic techniques in the early detection of nail infections. The process is automated by the system, which enhances diagnostic precision and facilitates prompt intervention for better patient outcomes. With potential applications extending to several additional diagnostic domains, the integration of powerful machine learning algorithms in medical diagnostics represents a promising frontier in healthcare technology.

### Literature Review

Automated medical diagnosis has greatly advanced with the use of machine learning (ML) and deep learning technologies, especially in dermatology. Research explicitly addressing nail infections is still lacking, despite the fact that numerous studies have employed image-based analysis to focus on skin cancer and other skinrelated disorders. Conventional techniques to identify nail infections, like visual examination by medical practitioners, are frequently laborious and subjective, producing unreliable results. Recent developments in deep learning, particularly with regard to Convolutional Neural Networks (CNNs), have demonstrated potential for automating the diagnosis of nail infections through the analysis of photographs for minute abnormalities and patterns that would not be immediately noticeable to the human eye.

Model performance has been improved by the use of techniques including data augmentation and transfer learning, which strengthen the models' resistance to the variations in nail pictures caused by illumination, angle, and patient skin tone. Notwithstanding, several obstacles persist, such as the requirement for more extensive and varied datasets that are particular to nail infections and the creation of models that can proficiently manage the subtleties associated with distinct patient demographics. In order to fill these gaps, this study uses Keras and TensorFlow to create a comprehensive model that is optimised for accuracy and dependability when identifying nail infections, especially in patients with diabetes.

## Research Gap

Although machine learning (ML) and deep learning techniques have made great strides in their application to medical imaging, there is still a considerable gap in their specialised application for nail infection detection, especially in patients with diabetes. The majority of dermatological research to date has been on skin disorders like melanoma and dermatitis, frequently ignoring nail issues that can be early markers of systemic diseases like diabetes. Furthermore, although Convolutional Neural Networks (CNNs) have demonstrated efficacy in the classification of skin images in general, there has been scant research on how to optimise and adapt CNNs for the particular features of nail images, which frequently include minute variations in texture and colour that are critical for precise diagnosis.

Moreover, a major obstacle is the dearth of thorough, annotated datasets for nail infections; these datasets are frequently small, unbalanced, or lack diversity in terms of infection types and demography. Because of this restriction, models created with these datasets are less effective in actual clinical settings and have a lower degree of generalisability. Furthermore, the integration of multimodal data, which could improve diagnostic accuracy, has not yet been thoroughly investigated in study. Examples of this include merging nail scans with patient histories or other clinical data. To close these gaps, concentrated work must be put into building specialised models for the identification of nail infections, expanding and diversifying datasets, and utilising multimodal techniques to increase the application and robustness of these diagnostic instruments.

## Research Problem

Due to the shortcomings of existing diagnostic techniques, the identification and diagnosis of nail infections, especially in patients with diabetes, pose serious problems for the medical community. Conventional methods frequently result in inconsistent results and delays in diagnosis because they mainly depend on the subjective assessment of nail problems by medical professionals. The inherent complexity of nail infections, which can vary in shape and severity, exacerbates this problem. The main research challenge is to create an automated machine learning system that can effectively and reliably identify nail infections from pictures.

Obtaining comprehensive and diverse datasets that cover a wide range of nail conditions and infection types is a challenge that this system must overcome. Other major issues include the variability in nail appearance caused by differences in colour, texture, and condition due to factors like lighting and camera quality, and the optimisation of deep learning models, such as Convolutional Neural Networks (CNNs), to handle these particular characteristics. Furthermore, the system needs to be easily incorporated into clinical practice, delivering healthcare practitioners userfriendly interfaces and insights that can be put to use.

This research attempts to improve patient outcomes and the management of nail infections, particularly among high-risk diabetic populations, by building a strong machine learning model capable of high-precision classification and increasing diagnostic accuracy.