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INTEGRATING DEEP LEARNING APPROACH FOR NAIL DISEASES IDENTIFICATION BY ASHIKUL ISLAM NAYEEM ID: 201-15-13985 This Report Presented in Partial Fulfillment of the Requirements for the Degree of Bachelor of Science in Computer Science and Engineering Supervised By Name: Mr. Raja Tariqul Hasan Tusher Assistant Professor Department of CSE Daffodil International University Co-Supervised By Name: Ms. Nazmun Nessa Moon Associate Professor Department of CSE Daffodil International University DAFFODIL INTERNATIONAL UNIVERSITY DHAKA, BANGLADESH JANUARY 2024 APPROVAL This Project titled "Nail Diseases Identification Using Machine Learning", submitted by Ashikul Islam Nayeem, ID No: 201-15 -13985 to the Department of Computer Science and Engineering, Daffodil International University, has been accepted as satisfactory for the partial fulfillment of the requirements for the degree of B.Sc. in Computer Science and Engineering and approved as to its style and contents. The presentation has been held on *date*. BOARD OF EXAMINERS (Name) Designation Department of CSE [Font-12] Faculty of Science & Information Technology Daffodil International University Chairman (Name) Designation Department of CSE Faculty of Science & Information Technology Daffodil International University Internal Examiner (Name) Designation Department of ------- Jahangirnagar University External Examiner i DECLARATION We hereby declare that, this project has been done by us under the supervision of , Raja Tariqul Hasan Tusher, Assistant Professor, Department of CSE Daffodil International University. We also declare that neither this project nor any part of this project has been submitted elsewhere for award of any degree or diploma. Supervised by: Raja Tariqul Hasan Tusher Assistant Professor Department of CSE Daffodil International University Co-Supervised by: Nazmun Nessa Moon Associate Professor Department of CSE Daffodil International University Submitted by: Ashikul Islam Nayeem ID: 201-15-13985 Department of CSE Daffodil International University ii ACKNOWLEDGEMENT First we express our heartiest thanks and gratefulness to almighty God for His divine blessing makes us possible to complete the final year project/internship successfully. I am really grateful and wish my profound my indebtedness to Raja Tariqul Hasan Tusher, Assistant Professor, Department of CSE Daffodil International University, Dhaka. Deep Knowledge & keen interest of my supervisor in the field of "Nail Diseases Identification Using Machine Learning" to carry out this project. His endless patience ,scholarly guidance ,continual encouragement , constant and energetic supervision, constructive criticism , valuable advice ,reading many inferior draft and correcting them at all stage have made it possible to complete this project. I would like to express my heartiest gratitude to Dr. Sheak Rashed Haider Noori, Professor and Head, Department of CSE, for his kind help to finish our project and also to other faculty member and the staff of CSE department of Daffodil International University. I would like to thank my entire course mate in Daffodil International University, who took part in this discuss while completing the course work. Finally, I must acknowledge with due respect the constant support and patients of my parents. iii ABSTRACT The prevalence of nail diseases, which are responsible for millions of fatalities each year, has increased by a factor of ten in recent years for a variety of reasons. In order to combat the epidemic, it is now required beyond a shadow of a doubt to have a technique of identifying nail infection that is not only quick and accurate but also affordable. Using a CNN model that had been properly calibrated, the objective of this study was to implement a multiclass classification system for nail diseases that was based on digital imagery. In order to classify the diseases that could potentially impact the nails, thirty distinct illness categories were used. These disease classifications encompass a wide variety of nail infections that are commonly suffered by people. Roboflow, an open- source website, was used to acquire dataset, they provide data for research purpose. As soon as the preprocessing step was finished, all 7437 images were loaded into the model so that it could carry out the categorizing process automatically. In the beginning, the dataset was put through CNN models, and the fine tuning that was employed for training purposes was taken into

consideration. In comparison to the other papers that were examined, the accuracy that CNN was able to achieve resulted in a score of 95%. In an effort to improve the accuracy of categorization, CNN model core structure served as the foundation for the design of the (CNN) model. For the purpose of determining the various hyper-parameters, an ablation study was carried out as part of the research. We can get good accuracy from this model by using Adam optimizer. A certain number of performance matrices are developed to ensure that the process will perform well. iv TABLE OF CONTENTS CONTENTS Board of examiners Declaration Acknowledgements Abstract CHAPTER 1: Introduction 1.1 Introduction 1.2 Motivation 1.3 Research Objectives 1.4 Research Questions CHAPTER 2: Background 2.1 Related Works 2.2 Scope of the Problem 2.3 Challenges CHAPTER 3: Research Methodology 3.1 Working Process 3.2 Dataset Preparation 3.3 Image Pre-processing 3.4 Proposed Model CNN PAGE i ii iii Iv 1-4 1 3 3 4 5-8 5 7 7 9-14 9 9 12 13 v CHAPTER 4: Experimental Results and Discussion 4.1 Results and Discussion 4.2 Result of ablation study 4.3 Performance Analysis 4.4 Statistical Evaluation 4.5 Model Description CHAPTER 5: Impact on Society, Environment and Ethical Aspects 5.1 Impact on Society 5.2 Impact on Environment 5.3 Ethical Aspects CHAPTER 6: Conclusion and Implication for Future Research 6.1 Summary of the Study 6.2 Conclusion 6.3 Implication for Further Study REFERENCES 15-21 15 15 18 19 20 22-23 22 22 23 24-25 24 24 25 26 vi LIST OF FIGURES FIGURES PAGE NO Figure 3.1.1: An overview of the classification process 9 Figure 3.2.1: Example image of dataset 11 Figure 3.5.1: Basic structure of CNN architecture with parameters 14 Figure 4.4.1: Confusion Matrix of CNN 19 Figure 4.5.1: Training and Validation Accuracy with Loss 20 Figure 4.5.2: Disease's detection 21 vii LIST OF TABLES TABLES PAGE NO Table 3.2.1: Description of the dataset utilized in this paper 10 Table 4.2.1: Finding best Regularizer 15 Table 4.2.2: Finding best Pooling Layer 16 Table 4.2.3: Finding best Batch Size 16 Table 4.2.4: Finding best Loss Function 17 Table 4.2.5: Finding best Optimizer 17 Table 4.2.6: Finding best Learning Rate 18 Table 4.3.1: Configure Best Model 18 Table 4.4.1: Statistical Analysis 19 viii CHAPTER 1 INTRODUCTION 1.1 Introduction Nail is a complex structure made by hard protein and keratin. It is a protective barrier for tissues of the human body that surround the border of fingers. Recent studies indicate fingernails contain a high amount of important information that is related to the human body. Also, subtle but significant symptoms are seen as early signs of diseases, increasing the possible chance of early detection of various diseases. Various fingernails can be recognized by focusing on color and texture of nail. This indicates the early stages of diseases and highlight the importance of detecting and observing nail conditions. As an example, we can say the dark nail plate, which may be the active stage of melanoma in the early stages. The yellow color of the nail indicates a yellow nail, which indicates the activity of the unusual breath condition called yellow nail syndrome. If we see the statistics, it highlights the wide occurrence of nail-related problems in the whole world. More than 15% of the world population is facing onychomycosis, an infection that causes significant health issues [7]. Adding to the character of these diseases, the condition is like a life-threatening one, such as subungual melanoma, which is an extra disadvantage for its nature. It is characterized by a time of two years before symptoms are seen, and the survival rate is only 43% in ten years [7]. With the increasing priority of dermatology in medical science, all researchers are more interested in this kind of topic, like image recognition algorithms, automated melanoma experiments, skin cancer detection, and classifying every dermatological image. The addition of deep learning and artificial intelligence, mostly through convolutional neural networks (CNN), is used as a central point of research in this section. The interest in this research promises the wide issues of nail disease that watch every individual of all ages. The main potential of artificial intelligence is in medical diagnosis. On the deep side, artificial intelligence in machine learning is used in various industries like medicine and science. This technology offers a high accuracy of detection and deep knowledge of nail diseases and promising opportunity. This potential is transferred to detect disease and ambitious to create a model that fill-up the necessary requirements that can identify the diseases by capturing fingernail images. This model is made for detect diseases by utilizing deep learning convolutional neural network (CNN) model with necessary fine tuning for getting an efficient and reliable accuracy. This work not only consider common nail diseases but also add identifying unknown and unusual conditions of nail. So, it provides a comprehensive approach to classify diseases. By using other CNN models that are pre-trained, such as Visual Geometry Group (VGG) and RESNET, based on their ability to process complex datasets efficiently and give good accuracy in the medical stage, which presents a tough obstacle to the ability of deep learning algorithms. This work aims to identify the problem by implementing various methods for getting the best output and organizing the dataset to recognize the diversity of importance in achieving maximum accuracy. Deep learning techniques in medical imaging cannot overstate their importance. The model has the capability to identify patterns with huge complexity in a vast dataset, gain knowledge about the image, and extract features by classifying objects. This feature makes it a powerful tool in medical imaging. The proposed model has the motive to take advantage of this achievement by demonstrating the ability of convolutional neural networks to present the best accuracy and early detection of diagnosis by analyzing fingernail images. There hasn't been much research work done on the use of convolutional neural networks for nail disease diagnosis, despite their increasing popularity in

feature learning and object classification. In order to close this knowledge gap, our work demonstrates the untapped potential of strong convolutional neural network (CNN) models for comprehending the intricacies of nail disease. In order to improve medical treatment results around the world by allowing early disease detection, the primary objective is to help scientists learn more about these diseases. Modern Convolutional Neural Network (CNN) models support the suggested application, which not only helps us learn more about different nail diseases but could also change how diseases are found around the world. Ultimately, this research hopes to improve health outcomes and bring in a new age of early diagnosis by making a significant contribution to the growth of medical science and technology. 1.2 Motivation When it comes to health-related information, fingernails provide a wealth of information; However, the absence of a diagnostic method that is both comprehensive and effective makes it difficult to detect numerous diseases indicated by nail anomalies in a timely manner. The lack of diverse datasets, coupled with existing gaps in exploring deep learning applications for nail disease detection, is a barrier to developing both accurate and easily accessible diagnostic tools. The methods currently used for diagnosis often result in delayed detection, which affects the timely initiation of treatment. These gaps are most needed to be filled, which will allow the incorporation of state-of-the-art into Convolutional Neural Networks (CNN) with a user-friendly application. This will allow early and accurate detection of a wide range of nail disorders, ultimately leading to improved healthcare outcomes from a global perspective. 1.3 Research Objectives Through the examination of fingernail photographs, the primary purpose of this research is to develop a model that is not only easy to use but also has the potential to be accessible on a worldwide scale. This tool will assist in the process of early disease detection. In order to accomplish this goal, a CNN model that utilizes deep learning and fine-tuning will be constructed and put through extensive testing. The focus is not just on common nail disorders, but also on conditions that are less investigated and more uncommon. This makes a substantial contribution to the study of a wide variety of ailments and the early detection of those ailments. 1.4 Research Questions • In what ways can the flaws of current deep learning-based systems that accurately categorize distinct types of nail disease be examined? • In what ways can a deep learning based methodology be devised to increase the precision of accurately distinguishing various types of nail diseases within their domain of study? CHAPTER 2 BACKGROUND 2.1 Related works The majority of the authors use an approach based on image processing to categorize nail diseases. We obtain a comprehensive understanding of our issue by reading up on it in the literature. One of the key points of the paper is this excellent literature review. An important issue in our lives is nail disease. The majority of people on Earth have to deal with this. As a result, there are many fruitful and encouraging initiatives underway in the field of nail disease by dedicated researchers. Most researchers have relied on image processing to identify diseases in their early stages, and the amazing precision with which they have done so is noteworthy. Rahul and et al. [7] present a new deep learning procedure for nail disease detection. Their article achieved an accuracy of 84.58% using different method and combining Convolutional Neural Networks (CNNs) with other techniques. The method overcomes the difficulties posed by small datasets and prioritizes the optimization of feature extraction. Comparative analysis using Support Vector Machine (SVM), Artificial Neural Network (ANN), K-Nearest Neighbors (KNN), and Random Forest (RF) shows that these models perform at the same level. The literature review examines the application of computer vision in disease detection, with a specific focus on the use of image processing and deep learning techniques for skin disease detection. The technique is comprehensive, and the results are shown, establishing the framework as highly promising in the field of healthcare computer vision. In summary, the study makes a valuable contribution to the field by successfully addressing barriers and providing a robust solution for nail disease diagnosis. In the study of Juhal et al. [12] find the use of deep learning and image processing more specially use of EfficientNet-B2 to achieve a maximum accuracy of 72% in seventeen different types of nail disorders can detect accurately. Focusing on the effectiveness of the model in the detection of nail diseases their work gets importance on dataset which contain 656 image samples. The implemented algorithm model has 72% of success rate which can consider patients to give sample images of fingernails for accurate and quick diagnosis. The work of this paper not only advances the detection of diseases on the sector of deep learning but also can get awareness of disease of symptoms in general people. It gives useful information about diseases that can contribute for future in this section. A research are done by Laura et al. [11] work on specially using k-Nearest Neighbor(KNN) algorithm for detecting Terry Nail diseases and classified it by using Gray Level Co-occurrence Matrix(GLCM) for feature extraction. In this paper the work achieved the high amount of accuracy which is 70.93% in particular scenario indicate the dataset from google and relevant article. The method indicates many steps to detect corium area, which define as highly sensitive and it contain cuticle. The steps add image preprocessing, transform the image to grayscale and other pre processing like cropping, scaling and recognize spatial relationships after use of GLCM based method. This study creates a clear framework of nail abnormalities of fingernail that give a systematic approach also s substantial contribution to make the field. The method describes by Tripti et al. [5] early detection of diseases is analyzed by using human nails. It precisely outlines color change as an important indicator in health side. Patient nail

photos are implemented in a dataset that can system extract every feature and achieve 65% of accuracy in color feature matching in the testing part. Here the system uses the C4.5 formula, which is utilize to prioritize time and const efficiently. It classifies data by using decision trees by consider the factor as knowledge gain and instance of unknown classes which are not known by a person. The approach gives a promising amount for health sector applications. It contributes to the early detection of diseases significantly. The study of Professor Mahendra et al. [13] describe a method that deep learning and artificial intelligence can classify nail disease which can detect accurately. The model specially focuses on yellow nail syndrome and subungual melanoma. Here author notice the lack of perfect dataset by utilizing a new VGG-16 based artificial neural network (ANN) model with necessary layers. After applying this the model perform 93% of accuracy nearly. In this work they faced various problem from the paucity of training dataset and noise of the dataset. The paper analyzes the potential of improving their result by increasing the size of dataset to add a wide range category of diseases which also include various symptoms and other factors. This will give the advancement of future work for progress in the sector. 2.2 Scope of the Problem There are several benefits with the use of image classification for nail diseases detection. Mainly it helps in transforming the process of early diagnosis and treatment planning. Since the nail can be used as indicators for various diseases it has a wide reach in medical study. It allows for quick and non-intrusive detection of diseases and provides plan of timely management to prevent additional deterioration. This method improves accuracy in detecting various diseases even if they are in their early stages. This model should be able to assist every individual in delivering proactive and least intrusive treatments. The precision and accuracy of technology exceed that of the human eye and can guarantee comprehensive and precise diagnosing and treatment. It can result in more customized and efficient treatment strategies. These innovations not only conserve a greater amount of the original nail structure but also provide patients with visual information of their nail. This information can inspire a person to take care of their nail. Furthermore, the implementation of more efficient processes and improved productivity in medical practices, combined with the possibility of reaching underserved areas, holds the potential for a future in which high-quality nail care sector becomes more widely available and tailored to individual needs. This will ultimately lead to better persons results and a reduction in invasive procedures. 2.3 Challenges Various research challenges consider on this study which are following: • Data Collection: Collecting actual image data is difficult in medical imaging. However, our study encountered challenges in acquiring true medical data. For this reason, we used datasets from the "Roboflow" open source website. Consequently, it was a laborious task to gather the image data from the field of nail illness. • Raw Image Processing: This study aims to enhance the accuracy of the model by utilizing image processing techniques to address the presence of noise and artifacts in the nail disease dataset images. Image processing is an essential initial stage in training a deep-learning model due to the presence of noise and artefacts commonly found in photos. • Choose the option of deep learning Approach: Numerous researchers employ various deep learning methodologies to accomplish tasks with ease. The task at hand is to identify the most suitable deep learning algorithm that can accurately detect various categories of nail illness. • Enhancing Accuracy: Another formidable task is to enhance the precision of the model. Furthermore, another formidable concern lies in the process of choosing the most optimal model. CHAPTER 3 RESEARCH METHODOLOGY 3.1 Working Process The whole process consists of four separate steps. These are the ones that follow: • Primary data sets • Preparation of Images • Chosen model • Analysis of results Figure 3.1.1 shows the entire process, beginning with image collecting and ending with analysis, which is further explained in detail in the parts that follow. Figure 3.1.1: An overview of the classification process 3.2 Dataset Preparation The dataset includes 7460 images that will be used for this study. In all, the dataset contains thirty different classes: "alopecia areata, beau's line, bluish nail, clubbing, darier nail, eczema, koilonychia, leukonychia, lindsay's nail, median nail, melanoma, muehrck lines, normalnail, onychocryptosis, onychogryphosis, onycholysis,onychomycosis, pachyonychia congenita, paronychia, pincer nails, pseudomonas, psoriasis, red lunula, ridging beading, splinter hemmorage, subungual hematoma, terry nail, trachyonychia, white nail, yollow nail". The picture sizes stored in the databases are all over all over the place. We used the "Roboflow" website to get the dataset. The dataset is divided into its component pieces as shown in Table 3.2.1. Table 3.2.1: Description of the dataset utilized in this paper Name Description Images 7437 Color Gradings RGB Data Formats jpg alopecia areata 52 beau's line 237 bluish nail 813 clubbing 179 darier nail 16 eczema 188 koilonychia 208 leukonychia 79 lindsay's nail 43 median nail 185 melanoma 183 muehrck lines 153 normalnail 890 onychocryptosis 118 onychogryphosis 825 onycholysis 818 onychomycosis 393 pachyonychia congenita 39 paronychia 279 pincer nails 94 pseudomonas 170 psoriasis red lunula ridging beading splinter hemmorage subungual hematoma terry nail trachyonychia white nail yollow nail 395 14 164 37 198 175 218 71 196 Figure 3.2.1: Example image of dataset 3.3 Image Pre-processing The main purpose of this work is to increase the accuracy of the model through the application of image processing. This is due to the fact that the images contained within the nail disease dataset contain a significant amount of noise and artifacts. Image processing is the first step in the process of training a model. This is because images are frequently rife with noise, both of

which need to be eliminated before the model can be taught appropriately. A couple different orientations were applied to this photo in order to clean it up and get rid of the artifacts that were there. 3.3.1 Image resizing The method of resizing allows us to lower the size of an image without compromising its quality in any way. Whenever the proportions of an image are altered, it frequently leads to a decrease in the image's quality as well as an increase in the file size. Our models for transfer learning are able to train more quickly when they are given smaller images. Our network will have to learn from eight times as many pixels if the dimension of the input image is doubled, which will result in an increase in the amount of time it takes to learn. In our collection, there are a great number of merged photos that are both large and little. We downsized the photos in our dataset so that they were 128 pixels by 128 pixels in order to achieve the ideal form for the photographs. 3.3.2 Auto orient It is possible to automatically detect and correct the orientation of an image using auto- orientation methods used in automatic image processing. Various techniques are used to achieve this goal, including text recognition, edge analysis, template matching, machine learning, and data manipulation. By automatically correcting photographs taken in different orientations, Auto-Orientation makes the user experience easier. Systems that include image analysis and processing have improved significantly as a result of the efficiency contribution of these systems. 3.4 Proposed Model CNN Image classification tasks are the focus of the proposed convolutional neural network (CNN) architecture, which consists of multiple essential parts. An image preprocessing module is placed in a sequential layer at the beginning of the model. Two important levels comprise this module. The first, the resizing layer, scales the input images to the given dimensions (128 x 128). The second, the rescaling layer, divides the pixel values by 255 to normalize them to the range [0, 1]. Three convolutional layers and an AveragePooling2D layer form the central structure of the model. An operation called Conv2D with 64 filters and a kernel size of (3, 3), the first convolutional layer uses the rectified linear unit (ReLU) activation function to introduce non-linearity. For better classification and utilizing feature extraction on the dataset is reduced a little scope by applying an AveragePooling2D layer after every convolutional layer where pool size is (2,2). After that data is ready for connected layers in convolutional layer which is used for a flat layer to convert the tree dimension tensor output to another tensor which is one dimensional. Dense layer with 1024 units and "ReLU" activation made every layer connected. This creates the extraction of high-level feature from the representation of flat layer. In this modified model there are thirty classes are set and end layer is another small size layer with thirty class units. It generates class detection using "softmax" activation function and the layer is finally ready for detecting multiclass detection. In this model regularization is not necessary because of accuracy decreasing. At conclusion of the model overview, the architecture of the model for detecting nail diseases is robust and much flexible. It allows to specify dataset nature and training need in the dataset. The model combines convolutional and every connected layers with perfect activation functions and processed stage. Figure 3.5.1: Basic structure of CNN architecture with parameters 3.4.1 Ablation Study It is standard practice to conduct ablation research when working with CNN-based applications to assess the model's stability and performance following the removal or modification of several layers or hyper parameters. Using hyper parameter ablation, this research achieves the development of durable and highly tuned networks. In this work, the nail disease preprocessed dataset has been tested with six different case studies. CHAPTER 4 EXPERIMENTAL RESULTS AND DISCUSSION 4.1 Results and Discussion The mathematical formulas for these performance metrics are as follows: $\boldsymbol{Rrre\ Pnririrer + Rrre\ Negarirer\ Accrracy = Rnral\ Inrrancer}$ $\boldsymbol{Precirinn = Rrre\ Pnririrer\ Rrre\ Pnririrer + Falre\ Pnririrer\ Recall = Rrre\ Pnririrer\ Rrre\ Pnririrer + Falre\ Negarirer}$ $\boldsymbol{1(Precirinn * Recall)\ F1 - Rcnre = Precirinn + Recall}$ 4.2 Result of ablation study Reliable design modifications may improve the accuracy of categorization. A modification to the seven ablation experiments in order to implement an enhanced CNN architecture. Case Study 1: Changing regularization layer Table 4.2.1: Finding best Regularizer Configuration Regularizer Regularization Epoch Test No. factor accuracy (%) 2 L1 0.1 20 23.17 3 L1 0.01 20 33.07 Findings Accuracy dropped Accuracy dropped 4 L1 0.001 20 48.70 5 L2 0.1 20 41.01 6 L2 0.01 20 58.07 7 L2 0.001 20 68.09 Highest accuracy Accuracy dropped Accuracy dropped Accuracy dropped Case Study 2: Changing pooling layer Table 4.2.2: Finding best Pooling Layer Configuration Pooling layer types Epochs Test No. accuracy (%) 1 Global Max pooling 20 70.70 2 Global Average 20 71.74 pooling Findings Accuracy dropped Highest accuracy Case Study 3: Changing the batch size Table 4.2.3: Finding best Batch Size Configuration Batch Size No. 1 16 2 32 3 64 Epochs Test accuracy Findings (%) 20 80.31 Modest accuracy 20 81.93 Highest accuracy 20 80.16 Modest accuracy Case Study 4: Changing Loss Function Table 4.2.4: Finding best Loss Function Configuration Loss Functions Epochs Test No. accuracy (%) 1 Binary Crossentropys Error Error 2 Categorical Error Error Crossentropys 3 Sparse Categorical 20 81.38 Crossentropys 4 Mean Squared Errors 20 03.38 5 Mean absolute errors 20 03.12 6 Mean squared 20 02.21 logarithmic errors Findings Error Error Highest accuracy Accuracy dropped Accuracy dropped Accuracy dropped Case Study 5: Changing Optimizer Configuration No. 1 2 3 4 5 6 Table 4.2.5: Finding best Optimizer Optimizers Epochs Test accuracy Findings (%) Adam 20 81.38 Highest accuracy SGD 20 44.27 Accuracy dropped Nadam 20 80.67 Accuracy dropped Adamax 20 75.26 Accuracy dropped Adagrad 20 28.25 Accuracy dropped RMSprop 20 75.39

Accuracy dropped Case Study 6: Changing Learning Rate Table 4.2.6: Finding best Learning Rate Configuration Learning rates Epochs Test accuracy (%) Findings No. 1 0.01 20 11.45 Accuracy dropped 2 0.001 20 81.90 Highest accuracy 3 0.0001 20 60.93 Accuracy dropped 4.3 Performance Analysis of Best Model Table provides a brief overview of CNN's final setup. Configuration Image sizes Epochs Optimization Functions Learning rates Batch sizes Activation functions Regularizer Pooling layer Loss function Accuracy Table 4.3.1: Configure Best Model Value 128 x 128 200 Adam 0.001 32 Softmax L2 (0.001) Global avarage pooling Sparse Categorical Crossentropys 94.55 4.4 Statistical Evaluation Accuracy (%) 94.40 Table 4.4.1: Statistical Analysis Precession (%) Recall (%) 94.38 93.99 F1 Score (%) 94.52 Figure 4.4.1: Confusion Matrix of CNN 4.5 Model Description The training accuracy and validation graphs are shown in this image graph. As the loss decreases, the accuracy increases. Our accuracy on the test set is 94.55%. Figure 4.5.1: Training and Validation Accuracy with Loss Here is the final result of diseases detection with sample images which acquired. Figure 4.5.2: Disease's detection CHAPTER 5 IMPACT ON SOCIETY, ENVIRONMENT AND ETHICAL ASPECTS 5.1 Impact on Society Nail disease detection has the potential to revolutionize healthcare and have far-reaching societal consequences. These advances have led to a sea change in preventive healthcare by enabling early intervention through user-friendly apps and cutting-edge technology. In addition to reducing pressure on healthcare systems, it promotes a fairer allocation of medical resources, allowing them to reach disadvantaged communities around the world. Automated disease detection enables people to take charge of their health; This improves overall public health and drastically reduces the incidence of serious illness. In addition to improving our knowledge of nail-related health issues, the use of AI and image processing in dermatological treatment signals a shift towards data-driven and personalized healthcare. This strategy has far-reaching consequences that go beyond individual health and holds the promise of a future where technology improves global healthcare by making it more educated, connected, and resilient. 5.2 Impact on Environment Analyzing nail disease has acceptable influence in everywhere but it is on the surface indirectly. The improvement shows the reduction in the environment steps which is with the production and keep away of medical resources. It is done because of make it easier for detect and treat disease in first stage. If it detects in time then it reduces the need for expensive and resource consuming treatment. It also reduces the production of medical waste. The availability of useful solution can take part to reduce carbon emissions. It also reduces the amount of healthcare facilities which is not need. It also reduces the time spent traveling to these facilities. The total scenario of healthcare can deliver in low number of technological advances that make healthcare activities much reduced and efficient. A large amount of effort can promote sustainability in healthcare industry. At last, the benefit in these consequences of nail disease detection model emphasize the connection between the increase of health sector and the wellbeing of people. 5.3 Ethical Aspects Nail debases detection technology increase several important ethical queries. It may raise privacy concern of people collecting nail image and storing it. That's why we have to maintain strong privacy to store the data. For maintain ethical concern it is less safe to communicate everyone about the data. To guarantee equitable healthcare performance for diverse populations the potential for mini-algorithmic decision-making needs to be identified. creator of this technology also has an ethical accurate obligation to ensure. it is easily accessible and well coming to everyone so that healthcare this parties and not perpetuate. a middle ground has to be found carefully for ethical concerns between the benefits of early detection of diseases. also, handle the risk of treatment and anxiety. in the time of implementing the model to detect nil diseases, it is essential to add here the ethical consideration of SSS openness fairness confidentiality and respect for individual information. CHAPTER 6 CONCLUSION AND IMPLICATION FOR FETURE RESEARCH 6.1 Summary of the Study For nail disease detection by using image classification here proposed a model which is a convolutional neural network. This model is applied after completing pre-processing techniques to the input data. The processing techniques such as resizing layer, rescaling and adjusting standardize pixel values. The main component of this model contains three combination layers with rectified linear unit activation. This activation is followed by averaging pulling layers to reduce the special dimension of an image. This architecture converts the extraction of sequential parts that are necessary for distinguishing between individual nail conditions. After that, the process result is then input to the fully connected layer which contains a dance layer of 1024 units and (ReLU) activation. By using this it can extract advanced features of the data set. The last dance layer which has the same number of units as the number of nail diseases classes is 30, active softmax activation to generate probability for every class. Now the model can include regularization options such as a regular density layer and drop-out layer. It can adjust according to the specific characteristics of the data set. In the end convolutional and fully connected layers for extract silent features from nail images and produce precise classification. 6.2 Conclusion A fine-tune convolutional neural network in our approach to identify 30 distinct nail disorders. This gave us an impressive result with an accuracy rate is nearly 95%. Also, our model indicates impressive performance in increasing its flexibility and effectiveness in detecting every disease. The difficulty of our work has slightly increased because of the limitations of the data set which are needed for additional studies and data collection to increase the model robustness. In future, the goal of this model is

to develop a much better and more impactful model that can detect every problem not only in nails but also in other diseases. the productive implications of this model go beyond every disease classification. This model can detect diseases at a very early stage and it allows for repeat medical treatment. Also, the model can be a useful tool for every sector for the examination of patient data and disease detection with less effort on human labor. As change and betterment navigate our efforts lay the foundation for future advances in computer-generated diagnostics and healthcare. 6.3 Implication for Further Study The model CNN for nail disease classification has significant success and valuable insights that have important implications for future work. We need a large amount of data for developing a larger and more diverse data set of diseases to dedicate this model. It increases the detection capability and increases the performance of the model. Also, it can be initially beneficial for future learning to a broad range of models including the ability to detect more disorders as those affecting another part of the body. By testing and refining the structure of the model we can improve its ability to handle a wide range of medical imaging data sets that increase its utility in many healthcare fields. In addition, research with emerging technology transfer learning has good potential to improve diagnostic accuracy. Working together with health sector professionals can help integrate real-world clinical observation and ensure the model's practical utility and significance. The study implicates including and enhancing the model's performance to expand its capability and promote interdisciplinary collaboration to develop a computer-aided diagnostic tool in the health sector. Additionally, working together with healthcare professionals can help integrate real- world clinical observations, therefore ensuring the model's practical utility and therapeutic significance. Additional study implications include enhancing the model's performance, expanding its capabilities, and promoting interdisciplinary collaboration to develop computer-aided diagnostic tools in healthcare. REFERENCES [1] Saranya, V. and Ranichitra, A., 2017. Image segmentation techniques to detect nail abnormalities. Scholar, 2(1). [2] Sharma, V. and Ramaiya, M., 2015. Nail color and texture analysis for disease detection. International Journal of Bio-Science and Bio-Technology, 7(5), pp.351-358. [3] Indi, T.S. and Patil, D.D., 2019. Nail feature analysis and classification techniques for disease detection. Int. J. Comput. Sci. Eng, 7(5), pp.1376-1383. [4] Maniyan, P. and Shivakumar, B.L., 2018. 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