Skin Lesion Classification using Raspberry pi

Sindhu R Machakanur
Department of Electronics and Communication Engineering,
RV Institute of Technology andManagement,
Bengaluru, India
sindhurm_ec19.rvitm@rvei.edu.in

Brundha R
Department of Electronics and Communication Engineering,
RV Institute of Technology and Management,
Bengaluru, India
brundhar_ec19.rvitm@rvei.edu.in

Chihnitha B
Department of Electronics and Communication Engineering,
RV Institute of Technology and Management,
Bengaluru, India
chihnithab_ec19.rvitm@rvei.edu.in

Gaurav Satheesh Rai
Department of Electronics and Communication Engineering,
RV Institute of Technology and Management,
Bengaluru, India
gauravsr_ec19.rvitm@rvei.edu.in

Dr. Kavitha N
Department of Electronics and Communication Engineering,
RV Institute of Technology and Management,
Bengaluru, India
kavithan.rvitm@rvei.edu.in

Abstract— **The primary objective of this paper is to classify skin lesion by leveraging a range of diverse technologies. A skin lesion classification system employing deep learning and CNN technologies will be utilized to enable accurate and reliable identification and categorization of skin lesions, leveraging advanced image analysis techniques. The classification is of paramount importance as it aids in early detection and diagnosis of various dermatological conditions, enabling timely treatment and potentially saving lives. It is possible to accomplish that by integrating hardware and software. The utilization of Raspberry Pi offers a compact and cost-effective solution, enabling efficient deployment of the classification system in various settings, including remote or resource-limited areas. For the software component a program will be written python language, and this portion will be completed using Open CV. The objective of this classification is to accurately differentiate between benign and malignant lesions, enabling early detection and treatment of potential skin cancer cases.**

Keywords Deep Learning, CNN, Raspberry pi, Open CV

I. INTRODUCTION

According to the World Health Organization (WHO), skin diseases affect nearly 900 million people worldwide, with five common conditions responsible for more than 80% of all cases. These conditions often lead to long-term disfigurement, disability, and social stigma. Unfortunately, the late diagnosis of skin diseases is common due to delayed medical attention, resulting in reduced chances of successful treatment. The traditional approach relies on manual inspection of dermatoscopic images by experts, whose experience determines the accuracy and timeliness of skin lesion detection.

The importance of skin lesion classification using deep learning, CNN technologies lie in its ability to enhance the accuracy and speed of diagnosis. These technologies can process vast amounts of data, identify subtle features of skin lesions, and improve classification accuracy. As a result, dermatologists can provide early diagnoses of skin conditions, potentially improving patient outcomes. Additionally, the use of these technologies can reduce the reliance on manual inspection, minimizing subjectivity and improving consistency across diagnoses.Deep learning plays a crucial role in skin lesion classification by leveraging its ability to automatically learn and extract meaningful features from images. Using convolutional neural networks (CNNs), deep learning models can analyze large datasets of skin lesion images and identify complex patterns indicative of benign or malignant conditions. By learning from diverse and representative examples, deep learning models can achieve high accuracy in classifying skin lesions, assisting dermatologists in making timely and accurate diagnoses.

Convolutional neural networks (CNNs) have proven to be highly effective in skin lesion classification tasks. They excel in image analysis due to their ability to automatically learn hierarchical representations of features from raw pixel data. In skin lesion classification, it can capture intricate patterns and textures associated with benign or malignant lesions. By training on large datasets, CNNs can generalize well and achieve high accuracy in distinguishing between different lesion types. The hardware component used in this survey is Raspberry Pi. It is a single-board computer known for its versatility and affordability. The latest models, such as Raspberry Pi 4, offer impressive specifications. It features a quad-core ARM Cortex- A72 processor, ranging from 1.5 to 2.0 GHz, coupled with 2 to 8 GB of RAM. It supports various operating systems, including Linux-based distributions. The board provides HDMI and USB ports for connectivity, a microSD card slot for storage, and GPIO pins for hardware integration. These specifications make Raspberry Pi ideal for a wide range of projects, including skin lesion classification, IoT applications, and educational purposes.

In our survey we use Raspberry Pi 3, which incorporates a 1.2 GHz 64-bit quad-core ARM Cortex-A53 processor, providing ample processing power for various tasks. It is equipped with 1 GB of LPDDR2 SDRAM, enabling efficient multitasking and memory-intensive applications. The board features built-in 2.4 GHz and 5 GHz IEEE 802.11n wireless LAN and Bluetooth 4.2 connectivity, facilitating wireless communication. It includes four USB 2.0 ports for peripheral connectivity and a full-size HDMI port for video output. It also supports a microSD card slot for storage and features 40 GPIO pins for hardware interfacing, making it suitable for a wide range of projects and applications.

II. LITERATURE SURVEY

A. *Skin Lesion Classification Using Deep Learning*

The intelligent system that will be discussed in this paper is the Variable-Centered Intelligent Rule System (VCIRS). VCIRS is a combination of the Rule Based System (RBS) and Ripple Down Rules (RDR) methods with their respective advantages complementing each other with Variable Usage Rates (VUR), Node Usage Rate (NUR) and Rule Usage Rate (RUR) inside. This intelligent system application is an Android based system where users are able to input symptoms that occurs and then the system will process inputs from users. Later, the system will determine whether the user has the disease or not.

.

B. *Skin Lesion Classification using Deep Learning Architectures*

In this paper, we show that a deep neural network model with adaptive piecewise linear units can achieve excellent results in melanoma recognition. Experimental results show that a convolutional neural network model with parameterized adaptive piecewise linear units outperforms the same network with different activation functions in the melanoma classification task. All experiments are performed using the data provided in International Skin Imaging Collaboration (ISIC) 2018 Skin Lesion Analysis towards Melanoma Detection verification.

C. *Non-melanoma skin cancer*

This primary aim of this paper is to a novel mutual loss is proposed to utilize the dependency between the foreground and background networks, thereby enabling the reciprocally influence within these two networks. Consequently, this mutual training strategy enables the semi-supervised learning and improve the boundary-sensitivity. Training with Skin Imaging Collaboration (ISIC) 2018 skin lesion segmentation dataset, our method achieves a dice coefficient of 86.4% and shows better performance compared with state-of-the-art melanoma segmentation methods

D. *Epidemiology of Skin Cancer*

A system for the melanoma skin cancer detection is developed by using a MED-NODE dataset of digital images. Raw images from the dataset contain various artifacts so firstly preprocessing is applied to remove these artifacts. Then to extract the region of interest Active Contour segmentation method is used. Various color features were extracted from the segmented part and the system performance is checked by using three classifiers (Naïve Bayes, Decision Tree, and KNN). The system achieves an accuracy of 82.35% on Decision Tree which is greater than other classifiers.

E. *Review on Different Skin Cancer Detection and Classification Techniques*

In this paper first pre-processing of the skin image is done. After pre-processing lesion part is segmented by using image segmentation technique which is followed by feature extraction in which unique features are extracted from segmented lesion. After feature extraction, classification by using support vector machine is performed for classifying the skin image as normal skin and melanoma skin cancer. The proposed system results shows that support vector machine with linear kernel gives optimum accuracy.

F. *Cancer Detection using Machine Learning Techniques*

The main cause that incites the melanocyte cell is sunburn caused by the bright beams of the sun. This paper focuses on the identification of melanoma during early stage by using image processing. Segmentation process is implemented to ascertain whether the skin is benign, atypical or melanoma. Some techniques such as k-means clustering thresholding and morphological operations have been discussed in this paper.

G. *Convolutional Neural Network for diagnosing skin cancer*

All detection steps were carried out using the Android smartphone. For better performance in the classification step, in addition to the smartphone, a computer was also used. This application is user-friendly and the calculated Accuracy, Sensitivity, and Specificity are 95%, 98%, and 92.19% on average, respectively. It should be noted that these results are more reliable when the lesions are geometrically distinct

H. *Convolutional Neural Network for diagnosing skin cancer*

Firstly, the input images are enhanced for better processing then, the lesion portion is segmented from the enhanced image by two methods 1. Otsu thresholding 2. Morphological operations. The descriptive features are extracted from the segmented lesion. The extracted feature values are used to compute the Total Dermatascopy Score (TDS), which is used to find the presence or absence of melanoma in dermoscopy images. Classification accuracy is calculated to assess the performance of the proposed algorithm

I. *Real Time-based Skin Cancer Detection System using Convolutional Neural Network and YOLO*

A In this context, the proposed project intends to create a model using pre-trained networks (i.e., VGG-16,) based on deep learning (DL) that can successfully predict the melanoma using dermoscopic images. The current study provides clinical support to physicians in the medical decision-making process for the diagnosis of melanoma.
Initially according to those risk factors 200 people's data is obtained from different diagnostic centre which contains both cancer and non-cancer patients' information and collected data is pre-processed for duplicate and missing information. After pre-processing data is clustered using K-means clustering algorithm for separating relevant and non-relevant data to Skin Cancer.

J. ***Skin melanoma classification using ROI and data augmentation with deep convolutional neural networks.***

Our proposed method is capable of generating more discriminative features to deal with large variations within melanoma classes, as well as small variations between melanoma and nonmelanoma classes with limited training data. Extensive experiments are performed to demonstrate the effectiveness of our proposed method. Comparisons with state-of-the-art methods show the superiority of our method using the publicly available ISBI 2016 Skin lesion challenge dataset

K. ***Co-Occurrence Matrix and Its Statistical Features an Approach for Identification Of Phase Transitions Of Mesogens.***

The arrangement was supervised love the predefined categories of the kind of carcinoma. Combining Self organizing map (SOM) and radial basis perform (RBF) for recognition and diagnosing of carcinoma is far and away higher than KNN, Naive Thomas Bayes and ANN classifier. it absolutely was conjointly showed that the discrimination power of morphology and color options was higher than texture options however once morphology, texture and color options were used along the classification accuracy was magnified. the most effective classification accuracy (88%, 96.15% and 95.45% for Basal cell malignant neoplastic disease, malignant melanoma, and epithelial cell malignant neoplastic disease respectively) were obtained

L. ***. Statistical Analysis of Skin Cancer Image –A Case Study***

Melanoma is a dangerous form of skin cancer, but survival rates are high if detected and diagnosed early. This study has been undertaken to identify different methods of skin diseases detection and classification. To develop an EfficientB6 algorithm feature extracted values for improving the accuracy of melanoma classification using dermoscopic images. The classification is done by the accurate value of fully connected layers of CNN model. The main aim is to develop an efficient algorithm for improving the accuracy of melanoma classification, by applying suitable classifier and deep learning techniques

M. ***. Statistical Digital image processing***

A small part of the skin tissue is extracted from the carcinoma patient; this part of the tissue will be processed in various laboratories for the identification of the presence of infected cells and the stage at which the cancer is in. Biopsy was a very time consuming and painful for the patients, and the result of biopsy process was not accurate and correct. To overcome the loner procedure and to increase the accuracy Support Vector Machine Algorithm was used in identifying the infection/ Carcinoma at the early stage and cure the infection before it leads to death

N. ***. Early Prevention and Detection of Skin Cancer Risk using Data Mining***

It is difficult and tedious process. In this paper we present Particle Swarm Optimization (PSO) for segmentation and Hidden Markov Model (HMM) for the classification of skin lesions. The input to the system is the skin lesion image and it goes under different pre-processing method for noise removal and image enhancement. At that point the picture is experienced to division utilizing PSO strategy. A few highlights of picture must be extricated utilizing GLCM system. These highlights are given as the contribution to classifier. Hidden Markov Model (HMM) is utilized for characterization reason. It conclude about the presence of skin cancer or not

O. ***Skin Cancer Detection and Feature Extraction through Clustering Technique***

A Support Vector Machine (SVM) algorithm and image processing techniques are used in the diagnosing methodology. A dermoscopy image of skin cancer is captured, then it is preprocessed using a variety of procedures to reduce noise and improve the image. The segmentation of the image is then performed using the Thresholding approach. The GLCM approach must be used to extract some visual features. These features are given as the input to the classifier. Support vector Machine (SVM) is a charity for classification purposes [16].

III. CONCLUSION

The aim of our project was to give a suitable solution to aid the process of predicting the correct stage of cancer by obtaining inputs from the medical workers. Hence, we have come up with an approach where we took the inputs, preprocessed it using steps viz grayscale conversion, noise cancellation and image enhancement. The later processes involved dividing the picture into numerous segments based on the color distinction, extracting the features, and training it. We were finally able to classify the inputs using SVM.

We have been able to classify the input images using this model. We have also optimized the prediction accuracy by following preprocessing steps like noise cancellation which reduces the error and improves the model's overall performance. Our main objective for taking up this project has been achieved which was of making a user-friendly interface where the user gives the input images and our model predicts the stage of the cancer for being benign or malignant.

Presently the system is semi-automatic. This can be completely automatic by choosing ROI based criterion such as principal components analysis, or choosing the cluster with larger disease area etc. Since the data set, we considered is comparatively of a smaller size, we would also like to focus on increasing the size of the data sets and trying to maintain the same accuracy for larger inputs as well. With proper dataset, this method can be applied to more diseases. Example: liver diseases, breast cancer identification and classification etc.

REFERENCES

[1] Bhardwaj, A., Rege, P.P. (2021). "Skin Lesion Classification Using Deep Learning". In: Merchant, S.N., Warhade, K., Adhikari, D. (eds) Advances in Signal and Data Processing . Lecture Notes in Electrical Engineering, vol 703. Springer, Singapore. https://doi.org/10.1007/978-981-15-8391-9_42

[2] A. C. Salian, S. Vaze, P. Singh, G. N. Shaikh, S. Chapaneri and D. Jayaswal, "Skin Lesion Classification using Deep Learning Architectures," 2020 3rd International Conference on Communication System, Computing and IT Applications (CSCITA), Mumbai, India, 2020, pp. 168-173, doi: 10.1109/CSCITA47329.2020.9137810.

[3] Madan, V., Lear, J. T., & Szeimies, R.-M. (2010). "Non-melanoma skin cancer". The Lancet, 375(9715), 673–685. doi:10.1016/s0140-6736(09)61196-x

[4] Leiter, U., Keim, U., Garbe, C. (2020). "Epidemiology of Skin Cancer": Update 2019. In: Reichrath, J. (eds) Sunlight, Vitamin D and Skin Cancer. "Advances in Experimental Medicine and Biology", vol 1268. Springer, Cham. https://doi.org/10.1007/978-3-030-46227-7_6

[5] K. V. Keerthi and V. V. Kumar, "Review on Different Skin Cancer Detection and Classification Techniques," 2020 International Conference on Communication and Signal Processing (ICCSP), Chennai, India, 2020, pp. 0426-0431, doi: 10.1109/ICCSP48568.2020.9182096.

[6] M. Vidya and M. V. Karki, "Skin Cancer Detection using Machine Learning Techniques," 2020 IEEE International Conference on Electronics, Computing and Communication Technologies (CONECCT), Bangalore, India, 2020, pp. 1-5, doi: 10.1109/CONECCT50063.2020.9198489.

[7] Ottom, Mohammad Ashraf. "Convolutional Neural Network for diagnosing skin cancer." Int. J. Adv. Comput. Sci. Appl 10.7 (2019): 333-338.

[8] Rashid, J.; Ishfaq, M.; Ali, G.; Saeed, M.R.; Hussain, M.; Alkhalifah, T.; Alturise, F.; Samand, N. "Skin Cancer Disease Detection Using Transfer Learning Technique". Appl. Sci. 2022, 12, 5714. https://doi.org/10.3390/app12115714

[9] H. F. Hasya, H. Hudan Nuha and M. Abdurohman, "Real Time-based Skin Cancer Detection System using Convolutional Neural Network and YOLO," 2021 4th International Conference of Computer and Informatics Engineering (IC2IE), Depok, Indonesia, 2021, pp. 152-157, doi: 10.1109/IC2IE53219.2021.9649224.

[10] Hosny, K.M., Kassem, M.A. & Foaud, M.M "Skin melanoma classification using ROI and data augmentation with deep convolutional neural networkse". Multimed Tools Appl 79, 24029–24055 (2020). https://doi.org/10.1007/s11042-020-09067-2

[11] C.Nageswara Rao, S.Sreehari Sastry and K.B.Mahalakshmi "Co-Occurrence Matrix and Its Statistical Features an Approach for Identification Of Phase Transitions Of Mesogens", International Journal of Innovative Research in Engineering and Technology, Vol. 2, Issue 9, September 2013.

[12] Santosh Achakanalli & G. Sadashivappa ," Statistical Analysis Of Skin Cancer Image –A Case Study " , International Journal of Electronics and Communication Engineering (IJECE), Vol. 3, Issue 3, May 2014.