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VISION BASED SKIN DISEASE IDENTIFICATION USING DEEP LEARNING

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ABSTARCT:

Skin disease is the most common health problems worldwide. Human skin is one of the difficult areas to predict. The difficulty is due to rough areas, irregular skin tones, various factors like burns, moles. We have to identify the diseases excluding these factors. In a developing country like India, it is expensive for a large number of people to go to the dermatologist for their skin disease problem. Every year a large number of population in developing countries like India suffer due to different types of skin diseases. So the need for automatic skin disease prediction is increasing for the patients and as well as the dermatologist. Human Skin detection deals with the recognition of skin-colored pixels and regions in a given image. Skin color is often used in human skin detection because it is invariant to orientation and size and is fast to process. A new human skin detection algorithm is proposed in this paper. The three main parameters for recognizing a skin pixel are RGB (Red, Green, Blue), HSV (Hue, Saturation, Value) and YCbCr (Luminance, Chrominance) color models. The objective of proposed algorithm is to improve the recognition of skin pixels in given images. The algorithm not only considers individual ranges of the three color parameters but also takes into account combinational ranges which provide greater accuracy in recognizing the skin area in a given image

INTRODUCTION

In this modern world, there are numerous technological advancements which are most helpful for the betterment of our lives. Various technological advancement sare being done in the medical fields. Skin diseases are the most common type of diseases. There are many types of skin diseases. Some are due to allergy while some are due to chronic diseases. Classifying the proper skin disease and treating them is a tedious one. Various diseases have various symptoms. Treating skin disease wrongly may lead to various other diseases like skin cancer. Every disease may have a pattern. So understanding the disease pattern is the only way to understand the type of disease. Usually, for a dermatologist understanding the pattern sare a complex task. Using the latest advanced technologies like deep learning &machine learning algorithms skin disease types can be predicted Various type of predictions and analysis are been carried out. The accuracy of the results is improvised. Using Machine Learning algorithms Support Vector Machine, Random Forest, the skin diseasesare predicted. The accuracy of the prediction is biased. The accuracy sometimes may be accurate while sometimes may not. To overcome the accuracy issue,we carry out the transfer learning approach. Transfer Learning is nothing but gaining some basic knowledge on a problem and applying the knowledge known to the similar problem. Application of transfer learning is Deep Learning. Compared to machine learning algorithms, deep learning algorithms are far more improvised in accuracy and efficiency for skin disease prediction. These deep learning algorithms also slightly vary in accuracy. We have used three deep learning models for disease Skin detection is the process of finding skin-colored pixels and regions in an image or a video. This process is typically used as a preprocessing step to find regions that potentially have human faces and limbs in images [2]. Skin image recognition is used in a wide

range of image processing applications like face recognition, skin disease detection, gesture tracking and human-computer interaction [1]. The primary key for skin recognition from an image is the skin color. But color cannot be the only deciding factor due to the variation in skin tone according to different races. Other factors such as the light conditions also affect the results. Therefore, the skin tone is often combined with other cues like texture and edge features. This is achieved by breaking down the image into individual pixels and classifying them into skin colored and non-skin colored [1]. One simple method is to check if each skin pixel falls into a defined color range or values in some coordinates of a color space. There are many skin color spaces like RGB, HSV, YCbCr, YIQ, YUV, etc. that are used for skin color segmentation [1]. We have proposed a new threshold based on the combination of RGB, HSV and YCbCr values. The following factors should be considered for determining the threshold range: 1) Effect of illumination depending on the surroundings. 2) Individual characteristics such as age, sex and body parts. 3) Varying skin tone with respect to different races. 4) Other factors such as background colors, shadows and motion blur. The skin detection is influenced by the parameters like Brightness, Contrast, Transparency, Illumination, and Saturation. The detection is normally optimized by taking into consideration combinations of the mentioned parameters in their ideal ranges.

LITERATURE REVIEW

In today's fast paced life, where personal health care has taken a back seat and lowest priority due to evergrowing hustle for earning more and staying ahead of competition, the significance of health can hardly be overstated. At such crucial junctures, if technology can join hands with health sector, humanity will be blessed. In rural India, just like in any other developing country, ignorance towards personal health care is so rampant that skin diseases often go unnoticed and overlooked. The uneducated Indian rural masses wouldn't even know they have a skin disease until it reaches the last stage (or the most critical and dangerous phase which is often incurable). Thus by logic, an intervention done by technology in the primitive or early stages of disease contraction would greatly help the diagnosis and avert the fatalities. Such a prognosis needs accurate detection of human skin. Skin detection techniques can be broadly classified as pixel-based techniques or region-based techniques. In the pixel-based skin detection, each pixel is classified as either skin or non-skin pixel individually depending on certain conditions. The skin detection based on color values is pixel-based. In region-based skin detection technique, spatial relationship of pixels is considered to define some area from given image as skin region. Initial skin region is grown bigger by adding more pixels based on its neighbors properties [6]. Using machine learning based on available data sets, a classifier can be trained to differentiate the image pixel by pixel (a skin pixel from a non-skin pixel). This can greatly help in setting a range of values which are valid for concluding that the pixel is a skin pixel. Then a set of area from the image is recognized as a skin image, using RGB (Red Green Blue), HSV (Hue Saturation Value) and YCbCr. This paper uses a threshold based methodology to detect whether an image is a skin image or not. It attempts to give a constructive and feasible solution to skin disease detection problem by implementing the different color models on the skin images. It formulates a range for RGB, HSV and YCbCr models which other papers have not ascertained. These ranges attempt to distinguish the skin pixels from the non-skin pixels. Most of the research work in this area highlights the different methodologies that can be used for image recognition; different color models. However after a

comparative study of strengths and weaknesses of these models; combination of RGB, HSV and YCbCr seem to fit for the purpose of recognizing skin images

A. K -means A clustering method for grouping similar data, that is popular for cluster analysis in data mining. K-means clustering[2] aims to partition observations on different categories. The problem occurs if the dataset is very large, complex and computational of clustering is difficult. So, the proposed method directly uses an ensemble of neural network models [10]where clustering is not used for better efficiency.

B. Image gradient The edge detector[15] in most of image processing models uses an image gradient algorithm for edge detection.Using Image Gradient algorithm various points are not detected accurately. Differentiating the background pixels and foreground pixels will not be that much accurate. For example, differentiating the skin and the background will be not accurate. This is the major disadvantage of using image gradient algorithm[3]. The proposed approach overcomes this issue. In the proposed system the features are extracted first various values differentiate the background and foreground pixels.

C. Machine Learning Machine Learning algorithms like Random Forest[2], Support Vector Machine[2] computes the prediction techniques much effectively. But they cannot use transfer learning The error occurs again in differentiating pixels and also during the classification phase. The neural network is much more efficient because there are many interconnected layers in between The main aim of this architecture is for more accuracy and efficiency. Unique features from the medical image are taken and are segmented using Histogram algorithm. The diseases are classified based on the Histogram values[4] and tolerance level value of the image. We taking into consideration of mean values[4] of images

D.RGB (RED, GREEN, BLUE): The values are calculated and the background of the images is considered to be black. This is not applicable for all images where the error in mean values may occur and the background of the image may not be black always. The proposed model does not take mean values and the features are not extracted based on the histogram. So the possibility of the wrong classification of the image is avoided.

1.IN RAHATYASIMD.ASHIQUR RAHMAN AND NOVA AHMED "DERMATOLOGICAL DISEASE DETECTION USING IMAGE PROCESSING AND ARTIFICAL NEURAL NETWORK" INTERNATIONAL CONFERENCE ON ELECTRICAL AND COMPUTER ENGINEERING,20-22 DECEMBER 2014, DHAKA, BANGLADESH

Skin diseases are among the most common health problems worldwide. In this article we proposed a method that uses computer vision based techniques to detect various kinds of dermatological skin diseases. We have used different types of image processing algorithms for feature extraction and feed forward artificial neural network for training and testing purpose. The system works on two phases- first pre-process the colour skin images to extract significant features and later identifies the diseases. The system successfully detects 9 different types of dermatological skin diseases with an accuracy rate of 90%. Dermatology is the branch of medicine dealing with the hair, nails, skin and its diseases, It is a specialty with both medical and surgical aspects A dermatologist takes care of diseases, in the widest sense, and some cosmetic problems of the skin, scalp, hair, and nails. Human skin is one of the most unpredictable and difficult terrains to automatically synthesize and analyze due to its complexity of jaggedness, tone, presence of hair and other mitigating features. In a developing

country like Bangladesh it is expensive for a large number of people to go to dermatologist for their skin disease problem. Every year a large number of populations in the developing countries like Bangladesh suffer due to different types of skin diseases. So, it is very necessary for both the patients and dermatologists to have an automated skin disease detection system especially in developing countries. Even though there have been several researches conducted to detect dermatological skin diseases using Computer Vision based techniques but almost every one worked for only 2-3 diseases. In our wok we have worked to detect 9 different types of skin diseases. They are Eczema, Acne, Leprosy, Psoriasis, Scabies, Foot Ulcer, Vitiligo, Tinea Corporis and Pityriasis Rosea. We have used 8 different types of algorithms for image preprocessing (YCbCr, grey image, sharpening filter, median filter, smooth filter, binary mask, histogram and sobel operator). Our system will take 10 different features from image pre-processing results and user inputs (liquid type, liquid colour, elevation, duration, feeling, gender, age). These features are used for training and testing purpose of our feed forward artificial neural networks (ANN). Using artificial neural networks (ANN) as knowledge base appears to be a promising method for diagnosis and possible treatment routines. In this article next we will discuss in brief about the related works regarding this topic, architecture, methodology, pre-processing algorithms and learning algorithm used in our proposed method. Then we will discuss about result and efficiency of our system. Detecting different types of skin diseases from colour image is a very challenging task in computer vision. Finding out different features from the colour skin images of the infected area of different skin diseases and detecting them with a high accuracy rate is the primary purpose of this research. Researchers are working on several algorithms that can be used to detect different types of skin diseases. Kabari et al [6] crated a artificial neural networks system that predict diagnosis and routine treatment for skin diseases patients and their accuracy rate is 90%. M. SHAMSUL et al [11] proposed an automated dermatological diagnostic system. They have used different pre-processing algorithms like ours and used feed forward back propagation artificial neural networks for training and testing purpose. Shuzlina et al [12] elaborates a prototype with back propagation neural network (BPNN) to assist the dermatologist accuracy rate was 91.2%. Nidhal et al [15] proposed a psoriais diseases detection system using feed forward artificial neural networks. Nasir et al [2], Shang et al [7] and Nibaran et al [13] compared between different features of different types of algorithms. Hashim et al [1] used different matlab tools for image processing and Wahab et al [3] presented a texture classification system. Gerald et al [4] have introduced an approach that produces accurate overlays of thermal and visual medical images. Chang et al [8] proposed an automatic facial skin defects detection and recognition system with an accuracy rate of 98.0%. In this research similar approach like [6],[11] is used in order to detect different types of skin diseases from colour image. The main difference between their system and our system is, they have considered region of interest (ROI) as image extracted feature but we have considered average colour code of infected area, shape, and area size and also some inputs from user as features like elevation of the infected area, liquid colour, liquid type etc.

2.IN "M. Shamsul Arifini, M. Golam Kibria, Adnan Firoze, M. Ashraful Amini, Hong Yan, "Dermatological Disease Diagnosis Using Color Skin Images", 2012 International Conference on Machine Learning and Cybernetics, 15-17 July 2012, Xian, China"

This paper presents an automated dermatological diagnostic system. Etymologically, dermatology is the medical discipline of analysis and treatment of skin anomalies. The system presented is a machine intervention in

contrast to human arbitration into the conventional medical personnel based ideology of dermatological diagnosis. The system works on two dependent steps - the first detects skin anomalies and the latter identifies the diseases. The system operates on visual input i.e. high resolution color images and patient history. In terms of machine intervention, the system uses color image processing techniques, k-means clustering and color gradient techniques to identify the diseased skin. For disease classification, the system resorts to feedforward backpropagation artificial neural networks. The system exhibits a diseased skin detection accuracy of 95.99% and disease identification accuracy of 94.016% while tested for a total of 2055 diseased areas in 704 skin images for 6 diseases.

3.IN "Vinayshekhar Bannihatti Kumar, Sujay S Kumar, Varun Saboo, "Dermatological Disease Detection using Image Processing and Machine Learning", Artificial Intelligence and Pattern Recognition (AIPR) International Conference on, pp. 1-6, 2016"

Dermatological diseases are the most prevalent diseases worldwide. Despite being common, its diagnosis is extremely difficult and requires extensive experience in the domain. In this research paper, we provide an approach to detect various kinds of these diseases. We use a dual stage approach which effectively combines Computer Vision and Machine Learning on clinically evaluated histopathological attributes to accurately identify the disease. In the first stage, the image of the skin disease is subject to various kinds of pre-processing techniques followed by feature extraction. The second stage involves the use of Machine learning algorithms to identify diseases based on the histopathological attributes observed on analysing of the skin. Upon training and testing for the six diseases, the system produced an accuracy of up to 95 percent. Dermatology is one of the most unpredictable and difficult terrains to diagnose due its complexity. In most developing countries, it is expensive for a large number of people to consult a dermatologist. The ubiquitous use of smart phones in a developing country has opened up new avenues for inexpensive diagnosis of diseases. We can use the camera technology present in every smartphone and exploit the image processing capabilities of the device for diagnosis. We have developed an application that utilizes a two staged approach in order to tackle the problem. The first stage involves Image Processing for identification and the second stage involves Machine Learning for a near fool proof solution. Difficulty for the differential diagnosis is that a disease may show the features of one disease in the initial stage and may have the characteristic features of another in the following stages. Usually a biopsy is necessary for the diagnosis but these diseases share many histopathological features as well. This issue is solved by using machine learning models on the clinically evaluated features which are determined by an analysis of the skin samples under the microscope. Owing to the subjective nature of diagnosis, medical students find it difficult to verify their diagnosis. This system acts as an effective learning tool, aiding verification of their results as they have access to clinical data. The training data set was obtained from the machine learning data repository of University of California, Irvine [18]. We have achieved higher accuracies using an ensemble of Computer Vision and Machine Learning algorithms. The system is capable of detecting six of the most commonly occurring diseases, namely – Psoriasis, Seborrheic Dermatitis, Lichen Planus, Pityriasis Rosea, Chronic Dermatitis, and Pityriasis Rubra Pilaris The paper proposed by Muhammad Zubair Asghar et al [16] put forward a rule based web supported expert system to detect certain skin diseases using forward chaining with depth first searching. However, using a rule based system in order to detect the type of dermatological condition

is not practical due to the various manifestations of a single skin disease. A selflearning model developed by us would be a better performer in this regard as the problem we are trying to address is probabilistic in nature and hence we need a system which learns the underlying pattern present in the skin disease which can be inferred by the image and the histopathological inputs. Rahat Yasir et al [2] have proposed a self-learning system which is capable of detecting a skin disease by using image processing and artificial neural networks. Although this is an effective way of detecting a skin disease using an image, we still feel there is inadequacy in the number of features extracted from the image itself. For a successful diagnosis of a skin disease, there is a need to involve other histopathological attributes. Although the system proposed by A.A.L.C. Amarathunga et al [1] proceeds in the direction of including a data mining unit to the system of skin detection, it is lacking in the choice of attributes considered for detection. Neither the data source nor the attributes used for learning/testing has been mentioned. Kabari et al [13] have used an artificial neural network system which diagnoses skin diseases and have been able to achieve accuracy of 90%. M. SHAMSUL et al [14] have also proposed an image processing system with pre-processing algorithms and a feed forward neural network similar to [2]. Shuzlina et al [15] have implemented a back propagation neural network which resulted in an accuracy of 91.2%. Florence et al [20] classifies the image as a bacterial or viral skin infection using image processing techniques. Damilola et al [21] has modelled a system that collates pigmented skin lesions image results, analysis, corresponding observation and conclusions by medical experts using prototyping methodology. It uses computational intelligence technique to analyze, process and classify the image library data based on texture

4.IN ". Er.Shrinidhi Gindhi, Ansari Nausheen, Ansari Zoya, Shaikh Ruhin, "An Innovative Approach for Skin Disease Detection Using Image Processing and Data Mining", International Journal of Innovative Research in Computer and Communication Engineering, Vol. 5, Issue 4, April 2017"

Skin diseases are becoming a common phenomenon these days as different types of allergies are increasing rapidly. Most skin diseases tend to pass on from one person to another and therefore it is important to control it at initial stages to prevent it from spreading. In this paper, we study the problem of skin disease automated detection. We will be constructing a diagnosis system based on the techniques of image processing and data mining. We will be making use of Matlab software to perform the pre-processing and processing of the skin images which will be obtained from the given data set In today's world, people of different age groups are suffering from skin diseases such as eczema, scalp ringworm, skin fungal, skin cancer of different intensity, psoriasis etc. These diseases strike without warning and have been one among the major disease that has life risk for the past ten years.[1] If skin diseases are not treated at earlier stage, then it may lead to complications in the body including spreading of the infection from one individual to the other. The skin diseases can be prevented by investigating the infected region at an early stage. It is important to control it at initial stages to prevent it from spreading. Also damage done to the skin through skin diseases could damage the mental confidence and wellbeing of people. Therefore this has become a huge problem among people and it has become a crucial thing to treat these skin diseases properly at the initial stages itself to prevent serious damage[2]. Many of the skin diseases are very dangerous, particularly if not treated at an early stage. Skin diseases are becomingcommon because of the increasing pollution. Skin diseases tend to pass from one person to another [3]. Human habits tend to assume that some skin diseases are not serious problems. Sometimes, most of the people try to treat these

infections of the skin using their own method. However, if these treatments are not suitable for that particular skin problem then it would make it worse. And also sometimes they may not be aware of the dangerousness of their skin diseases, for instance skin cancers. With advance of medical imaging technologies, the acquired data information is getting so rich toward beyond the human's capability of visual recognition and efficient use for clinical assessment. In this paper we propose a diagnosis system which will enable users to detect and recognize skin diseases. With the help of image processing and data mining techniques and provide the user advises or treatments based on the results obtained in a shorter time period than the existing methods. In this project, we will be constructing a diagnosis system based on the techniques of Image Processing.[4] We will be making use of Matlab software to perform the pre- processing and processing of the skin images of the users. This processing will be conducted on the different skin patterns and will be analyzed to obtain the results from which we can identify which skin disease the user is suffering from. This data will help in early detection of the skin diseases and in providing their cure [5].Through this we will be finding a cost effective and feasible test method for the detection of skin disorders. The results obtained will be classified according to the given prototype and diagnosis accuracy assessment will be performed to provide users with efficient and fast results

5. Kaiming He, Xiangyu Zhang, Shaoqing Ren, Jian Sun"Deep Residual Learning for Image Recognition" Submitted in December 2015.

Deeper neural networks are more difficult to train. We present a residual learning framework to ease the training of networks that are substantially deeper than those used previously. We explicitly reformulate the layers as learning residual functions with reference to the layer inputs, instead of learning unreferenced functions. We provide comprehensive empirical evidence showing that these residual networks are easier to optimize, and can gain accuracy from considerably increased depth. On the ImageNet dataset we evaluate residual nets with a depth of up to 152 layers---8x deeper than VGG nets but still having lower complexity. An ensemble of these residual nets achieves 3.57% error on the ImageNet test set. This result won the 1st place on the ILSVRC 2015 classification task. We also present analysis on CIFAR-10 with 100 and 1000 layers.
The depth of representations is of central importance for many visual recognition tasks. Solely due to our extremely deep representations, we obtain a 28% relative improvement on the COCO object detection dataset. Deep residual nets are foundations of our submissions to ILSVRC & COCO 2015 competitions, where we also won the 1st places on the tasks of ImageNet detection, ImageNet localization, COCO detection, and COCO segmentation

EXISTING SYSTEM

The problem of Skin disease detection has been proposed in the paper "Skin Diseases Detection Models using Image Processing: A Survey" by Nisha Yadav,Virender KumarNarang,UtpalShrivatava,March,2016.In this paper the diseases like ringworm, eczema, etc. were detected using technologies like image processing and Artificial Neural Network(AAN). In the paper "Cancer Detection Using Image Processing Techniques" by Mokhld S. AL-Tarawneh 20, January-June 2012 the problem of Lung cancer detection was studied where the disease was rectified using Image segmentation and feature extraction. The RGB and CIE Lab color space model for detecting the human skin was studied in "Detection and Identification of Human Skin Diseases Using CIE lab Values" paper by] C.B. Tatepamulwar, V.P. Pawar, K.S. Deshpande , H. S. Fadewar , June 6,2016. The

problem of automatic Skin disease detection has been proposed in the paper "Expert System For Diagnosis Of Skin Disease" by A.A.L.C Amarathunga, E.P.W.C. Ellawala, G.N. Abeysekara and C.R.J. Amalraj,January 2015. This research paper presents a development of a skin diseases diagnosis system which allows user to identify diseases of the human skin and to provide advises or medical treatments in a very short time period. For this purpose, user will have to upload an image of skin disease into the system and answer questions based on their skin condition or symptoms. It will be used to detect diseases of the skin and offer a treatment recommendation. In the paper "An innovative skin detection approach using color based image retrieval technique" by Shervan FekriErshad, Mohammad Saberi2 and Farshad Tajeripour in June, 2012 the article, an approach based on colour based image retrieval technique has been presented to resolve issues. In this approach, firstly a set of features are defined by CBIR technique and histogram analysis, and then by tiling the image and using a train level, a good threshold for classifying the pixels would be achieve. The given approach in this article has the ability of detecting all kinds of skin because of using the train level. Also because of considering the relation of every pixel with its neighbours, it's not sensitive to noise, illumination and changing the orientation of face or body. Also in the paper "Automating skin diseases using image classification" by Damilola A. Okuboyejo, Oludayo O. Olugbara, and Solomon A. OdunaikeOctober,2013, the author has focused on designing and modelling a system that will collate past Pigmented Skin Lesion (PSL) image results, their analysis, corresponding observations and conclusions by medical experts using prototyping methodology. These wealth of information would be used as a library. A part of the system would use computational intelligence technique to analyse, process, and classify the image library data based on texture and possibly morphological features of the images. These papers present an implementation of a skin diseases diagnosis system which helps user to detect human skin diseases and provides medical treatments timely.

3.2. PROPOSED SYSTEM:

COLOR SPACES

Color space is a mathematical model to represent color information as three or four different color components. Different color spaces (models) are used for different applications such as computer graphics, image processing, TV broadcasting, and computer vision. Different color space is available for the skin detection. They are: RGB based color space (RGB, normalized RGB), Hue Based color space (HSI, HSV, and HSL), Luminance based color space (YCBCr, YIQ, and YUV)[5]. These models are explained subsequently in next sections. Color space selection is the primary process in skin color modeling and further for classification. One or more color spaces can give an optimal threshold value for detection of pixels of skin in a given image. The choice of appropriate color space is often determined by the skin detection methodology and the application. We use the following color spaces for recognizing skin pixels.

RED, GREEN, AND BLUE (RGB) COLOR MODEL RGB color space is widely used and is normally the default color space for storing and representing digital images. We can get any other color space from a linear or non-linear transformation of RGB [1]. The RGB color space is the color space used by computers, graphics cards and monitors or LCDs. As shown in fig.1 it consists of three components, red, green and blue, the primary colors. Any color can be obtained by mixing the three base colors. Depending on how much is taken from each base color, any color can be created. Reversing this technique, a specific color can be broken down into its red,

blue and green components as shown in equation 1 to equation 3 [1]. These values can be used to find out similar colored pixels from the image. [7] explains skin color detection based on RGB color space. Normalized RGB is a representation that is easily obtained from the RGB values by a simple normalization procedure [1]. A remarkable property of this representation is that for matte surfaces, while ignoring ambient light, normalized RGB is invariant (under certain assumptions) to changes of surface orientation relatively to the light source

$$r = \frac{R}{R+G+B} \quad (1)$$

$$g = \frac{G}{R+G+B} \quad (2)$$

$$b = \frac{B}{R+G+B} \quad (3)$$

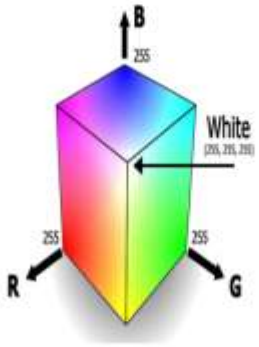

Fig: RGB Model

YCBCR (LUMINANCE, CHROMINANCE) COLOR MODEL YCbCr is an encoded non-linear RGB signal, commonly used by European television studios and for image compression work. As shown in fig. 2 color is represented by luma (which is luminance computed from nonlinear RGB) constructed as a weighted sum of RGB values [4]. YCbCr is a commonly used color space in digital video domain. Because the representation makes it easy to get rid of some redundant color information, it is used in image and video compression standards like JPEG, MPEG1, MPEG2 and MPEG4.The transformation simplicity and explicit separation of luminance and chrominance components makes YCbCr color space [3]. In this format, luminance information is stored as a single component (Y), and chrominance information is stored as two color-difference components (Cb and Cr). Cb represents the difference between the blue component and reference value. Cr represents the difference between the red component and a reference value. YCbCr values can be obtained from RGB color space according to eq. 4 to eq. 6. [7][8][9] uses YCbCr space for skin detection.

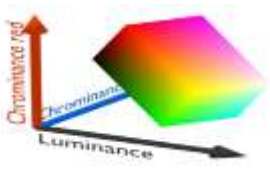

Fig: YCbCr Color Model

$$Y = 0.299R + 0.287G + 0.11B \quad \text{----------eq. 4}$$
$$Cr = R - Y \quad \text{----------eq. 5}$$
$$Cb = B - Y \quad \text{----------eq. 6}$$

HUE SATURATION VALUE (HSV) COLOR MODEL

The HSV color space is more intuitive to how people experience color than the RGB color space. As hue (H) varies from 0 to 1.0, the corresponding colors vary from red, through yellow, green, cyan, blue, and magenta, back to red. As saturation(S) varies from 0 to 1.0, the corresponding colors (hues) vary from unsaturated (shades of gray) to fully saturated (no white component). As value (V), or brightness, varies from 0 to 1.0, the corresponding colors become increasingly brighter. The hue component in HSV is in the range 0° to 360° angle all lying around a hexagon as shown figure 3 [3]. With RGB the color will have values like (0.5, 0.5, 0.25), whereas for HSV it will be (30°, √3/4, 0.5). HSV is best used when a user is selecting a color interactively It is usually much easier for a user to get to a desired color as compared to using RGB [3]. [9][11] explain use of HSV color space for skin detection

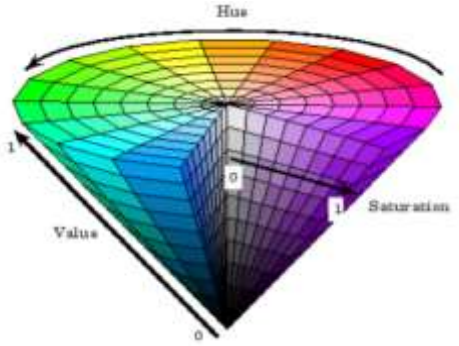

Fig: HSV Color Model

SKIN DETECTION ALGORITHM

The proposed algorithm converts the entire image in a two dimensional matrix in which the column and row size is defined by the width and height of the image respectively. Once the image is divided, each entry consists of a pixel of the image. The ARGB color of that particular pixel is determined. The ARGB value retrieved from the image for each pixel is a 32-bit value. Hence to extract each sub-value i.e. red, green, blue and alpha we right shift this value by 24 bit in order to get the value of alpha. The alpha channel is normally used as an opacity channel. If apixel has a value of 0% in its alpha channel, it is fully transparent (and, thus, invisible), whereas a value of 100% in the alpha channel gives a fully opaque pixel (traditional digital images). Similarly, for red right we shift by 16 bits, for green right shift by 8 bits. The remaining value is of blue color. Bitwise AND operation with 0xff was applied on these calculated values in order to extract only the bits corresponding to that particular color. The above entire procedure is applied to each and every pixel of the image. In order to make the recognition more precise the ARGB value is converted to HSV as well as YCbCr value using conversion factors and built-in functions. The HSV, YCbCr and ARGB value of each pixel is compared to the

standard values of a skin pixel and decision is made whether the pixel is a skin pixel or not depending on whether the values lie in a range of predefined threshold values for each parameter.

The ranges for a skin pixel in different color spaces used by our algorithm are as follows:

0.0 <= H <= 50.0 and 0.23 <= S <= 0.68 and
R > 95 and G > 40 and B > 20 and R > G and R > B
and |R - G| > 15 and A > 15

OR

R > 95 and G > 40 and B > 20 and R > G and R > B
and |R - G| > 15 and A > 15 and Cr > 135 and
Cb > 85 and Y > 80 and Cr <= (1.5862*Cb)+20 and
Cr>=(0.3448*Cb)+76.2069 and
Cr >= (-4.5652*Cb)+234.5652 and
Cr <= (-1.15*Cb)+301.75 and
Cr <= (-2.2857*Cb)+432.85 nothing
{H : Hue ; S: Saturation ; R : Red ; B: Blue ; G : Green ; Cr, Cb : Chrominance components ; Y : luminance component } Figure 4 shows flowchart that illustrates steps of the algorithm.

NEURAL NETWORKS: A neural network[5] consists of multiple neuron-like structures. The input image is feed to multiple neurons. The output we get is a single classified one. Various computations are taken place in the intermediate neuronsThe layers with intermediate neurons are known as Hidden Layers The weights are added for the proper output.In the neural network, the final output is known, so if the calculated output is wrong a back propagation is made and the approximate weights are updated. The activation function is used to speed up the process. In this, we use three convolutional neural network models.Convolutional neural networks are a subclass of neural networks. They are great at capturing local information and predicting based on trained data.Weuse three models namely Inception__v3, MobileNet,Resnet.The weights [5] of all the three models are taken from ImageNet website

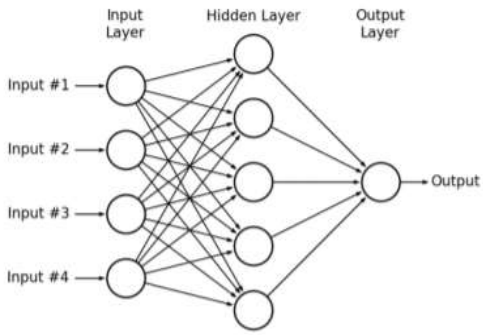

Fig: Architecture diagram of a neural network with 4 inputs and one hidden layer and one output

CONCLUSION: An ensemble-based approach of the neural networks is used to raise more efficiency of individual models. We propose a model in which all three neural networks come under a single architecture. The database that we use is available online. All the medical images are taken from Dermnet[8] .The combined architecture is rather more complex yet the performance evaluation shows increased efficiency and accuracy. The hardware and software requirements are rapidly increasing. One way of improving our model is to add more neural network models for improved efficiency

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