Study of Deep Learning Methods Applied To Skin Disease Detection

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Abstract- *Human Skin detection is an important and challenging problem in computer vision. The differences in illumination and ranges of skin colours have made skin detection a challenging task. This research tries to extract useful features from the skin and then classify these features under certain conditions. The main objective of this study is to detect the skin diseases early and classify them for correct treatment, using improved classifier ISVM. This research also aims to build system of skin disease detection using the CNN technique and a pre-trained VGG19 Model. Deep Learning methods are new techniques in learning that have shown improved classification power compared to neural networks.The proposed technique is evaluated and compared with method of classification by ISVM on colour image databases.*

Keywords- Feature Extraction, Segementation, Skin-Disease diagnosis

I. INTRODUCTION

Human skin detection is among the most commonly applied algorithms in visual field literature and has been used directly and indirectly in numerous applications. Some attention has been paid to the field of face analysis and human detection, tracking and recognition systems. It has proven intimidating to detect human skin in complex images because the appearance of human skin may vary significantly due to a number of factors including illumination, ethnicity, hair effect, imagery and complexity background. Researchers have struggled over these difficulties over the past twenty years, leading to hundreds of articles being published. The fast-growing research to detect human skin is built around the idea of extracting information from colourful images about individuals, intentions, mode and image and computer content and then being able to react appropriately.

There are some survey papers reviewed on human skin detection [1], skin detection in coloured images [2] and skin tone detection using colour spaces [3]. This paper is aimed at collecting information about human skin detection techniques in literature and to summarize key ideas and issues in human skin detection.We attempted to summarize the most important and remarkable distinctions between these methods. their strengths and limitations, and characteristics. This research also studied colour spaces, challenges, Journal real-time system, datasets and measurements in statistical, threshold, region and machine learning methods researches. This research presented the statistics of study as well.

Skin colour appearance provides us a sign of the person's ethnicity, health, and age. Human skin contains of three primary epidermis, dermis and subcutaneous layers [4]. Every layer has a purpose and works together on every layer. The skin surface is coated by dead skin cells that do not reflect regularly while sweat or skin oil causes skin gloss. The encounters between light and skin can lead to complex phenomena. A combination of skin and light is initial spectrum of the skin: the layers transmit, absorb and reflect the skin. Human skin spectrums normally form an ongoing series of homologues due to the characterization of absorbed melanin and haemoglobin, where melanin plays the dominant role in dermis in the spine and haemoglobin and mainly determines the skin appearance. The appearance of human skin colour may differ dramatically with a variety of image types and sources, making accurate skin detection a challenging task. The skin detection challenges can be assigned to certain variables such as differences in illumination, ethnicity, image conditions, image montage and reproduction, cosmetics, maturing, and compound landscape.

In real-world situations, the most important issue is the variation in illumination that severely degrades segmentation efficiency. Changing the spread of light sources or light levels (indoor, outdoor, highlights, shades, non-white lights) results in a skin colour shift. The dark shadow on the face is usually the lead of powerful directional illumination that partially obscured certain facial regions. This is because of the non-plane form of the facial characteristics. Occasionally, a face has a "bright spot" due to heavy lighting reflection. In some other drawback, the appearance of skin colour differs from person to person caused by physical variation between groups of human races. For instance,

Europeans (Caucasians), Africans, Asians, etc., have distinct skin colours ranging from white to brown to dark.

Once the picture is developed, variables including lens features (sensor reaction, lenses) influencethe skin appearance. Overall. separate colour cameras do not automatically create the same colour for the same scene in the same picture circumstances. In addition, various internet image collections, films. newspapers, and scanned pictures are typically unmanageable and have almost infinite assembly processes.Using colour transfer technique, tools are available to replicate skin colours, including setting fresh pigment concentration and altering skin colour image. Some images have already been taken using colour filters This makes it even harder to handle colour information. Besides that, makeup changes colour of the skin.

Human skin differs from smooth, flexible skin to dry, tough skin with wrinkles. For example, furniture, clothing, blonde hair, rocks, etc. For example, furniture, clothing, blonde hair, rocks, and so on. The variety of backgrounds is substantially limitless. This leads to incorrect detections by the skin sensor.

II. RELATED WORKS

Researchers have been exploring human skin detection, detecting skin and non-skin pixels. In addition, there are a few studies in this field that compile current developments. In others word, some researchers are focusing on investigating color space with human skin detection methods. An evaluation on human skin detection accuracy using accuracy metrics was presented by Vezhnevets et al. They attempt to fill this vacuum by examining the methods and techniques most widely used in statistical-based and thresholding-based methods. They evaluated the metrics components as well. However, they did not specify challenges in human skin detection. A survey of skin-color modeling and detection methods was conducted by Kakumanu et al. They explore the useful human skin detection techniques for human skin detection tasks of skin pixel and non skin pixel. In their survey they provide the discussion human skin detection techniques. They provided a crucial current review of statistical-based, machine learning-based, thresholding-based and region-based methods based on color information of the visual spectrum. They also mentioned illumination effect but meanwhile not refer to the hair effect. Another survey on the detection and numerical analysis of skin tones using color space showed an investigation of the most commonly used methods and techniques. This paper focused on pixel-based approaches besides machine learning-based methods. Among various

frameworks, statistical approach has been studied and most widely used in skin detection based on color information. Despite that, this paper evaluates skin type's challenges only. To review the work on neural network perspective, Hani K Al-Mohair et al, submitted an extensive study of current work neural network perspective based human skin color detection. The aim of this article is to show different algorithms that used artificial neural network systems to detect skin color, define their technique.

III. SKIN DETECTION METHODS

In this segment, we analysis current methods for identifying colour image skin regions. We categorize the identification techniques of single images into two classifications; pixel-based methods and region-based methods. Pixel-based skin detection methods categorize each pixel independently as skin or non-skin without taking neighbours into account. The skin detector will inspect colour pixels that match the skin colour model [26]. These methods are classified into three categories: statistical, machine learning -based and threshold-based methods. Statistical-based methods focus on data collection, study structure, data summary, producing a model to illustrate awareness of how data is linked, and predicting the future (i.e., classification). Statistics can use the companion's Probability topic. These methods include: histograms, Lookup tables, distance-based detectors, Bayes theorem, and Gaussian distribution. Machine learning-based methods are attempting to construct skin sensors with the potential to be discovered from data collection training without creating a clear skin colour model.Usually these techniques use supervised learning. These methods involve different machine learning techniques, for instance Artificial Neural Networks (ANN), Support Vector Machines (SVM), and Fuzzy Logic. Thresholding-based methods depict the threshold-oriented skin model using basic classification laws. Typically, multiple threshold levels are used for each colour component. Many techniques are suggested to select threshold values. Consumers can select a threshold amount individually and view the outcomes interactively. Trial and error come in and you want the outcome to be as great as it is. Other techniques calculate the value automatically using a thresholding algorithm recognized as automatic thresholding. During the segmentation process, adaptive thresholding method can also be used to dynamically update threshold values.

Region-based skin detection methods spatial data is helpful as most real-life object segments made up of spatially linked pixels. The primary concept of region-based segmentation methods is to distinguish different regions in images with identical characteristics [27]. Approaches based

on the region can be classified into: region growing and watershed segmentation. Some studies used a combination of color spaces or hybrid techniques. The upcoming segments discuss the purpose and overall strategy of each method. The statistics of number of researches that used in human skin detection with statistics, threshold, region and machine learning methods for 1998-2019 periods, as can be seen in Figure 1, gives brief information about this topic. There is significant period, 2009-2017, shows that researches in this area are increasing with the highest number of 10 in 2012, whereas, in 2006 and 2018 we could not find any research in this topic.
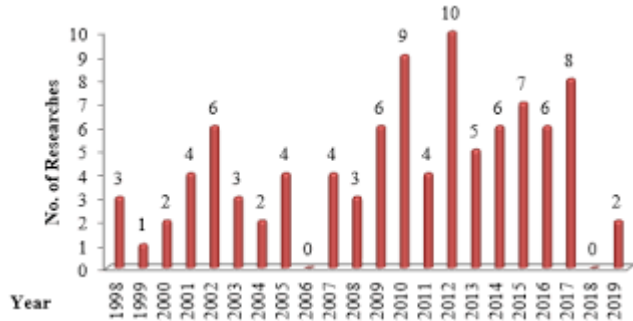
Figure 1. Number of researches from 1998-2019 for skin detection statistical, threshold, region and machine learning methods

There are more than 20 types of datasets that used in human skin detection from same period. FERET, AR, Pratheepan, and HGR are four datasets which have slightly higher number than most of the dataset as illustrated in Figure 2. As presented, Compaq and ECU are the highest datasets, 18 and 12 respectively, which put to use in this topic. These datasets have full body images with ground truth as mentioned in Table 3. From this, we can draw a conclusion that these datasets are the best used for human skin detection.
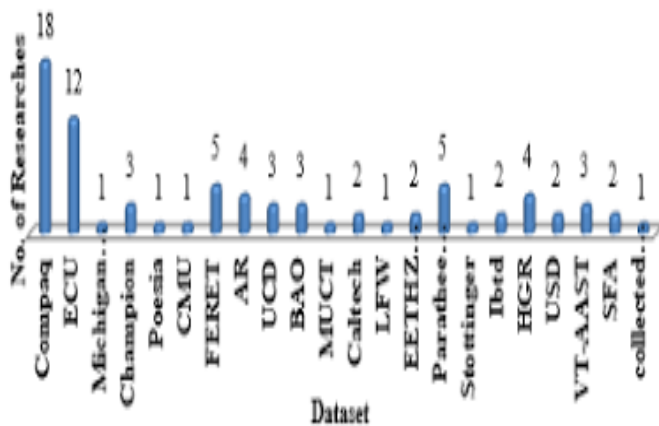

Figure 2. Type of Datasets for skin detection with statistical, threshold, region and machine learning methods in 1998-2022

The summary of color spaces that have been used in human skin detection researches within 1998-2019 periods is represented in Figure 3. There are around 10 color spaces used. The most used color spaces are RGB, YCbCr, HSV and CIE with 49, 39, 37, and 18 respectively. RGB is the most basic color space which represented three primary colors. YCbCrcolor space is widely used for film and digital photography technologies. HSV space is appropriate for image processing as it separates hue (chrominance) data from luminance (intensity) data. And the last one, CIE offers a color-defining instrument, but it does not directly correspond to hardware operation or human vision.
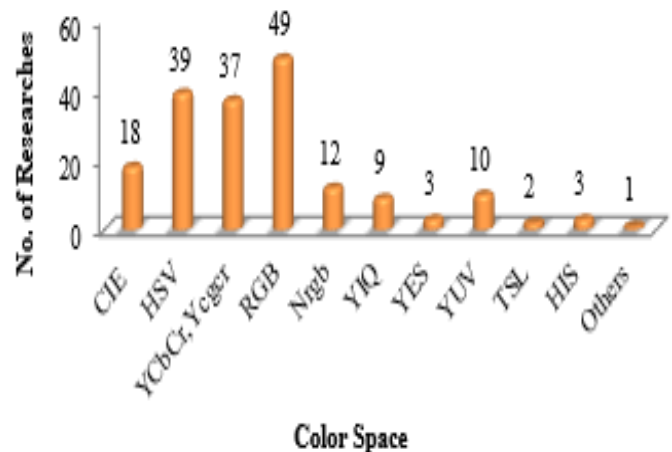

Figure 3. Type of color spaces for skin detection in statistical, threshold, region, and machine learning methods in 1998-2022

Types of statistical, threshold and region methods that have been used in human skin detection researches between 1998-2022 is expressed in Figure 4. Threshold is the most used method with 24 researches. Other than that, GMM, Bayesian and Histogram have more than 10 researches for each. The thresholding technique is the easiest and most popular method of segmentation of images [28]. It can be considered as a quick way to separate items from their background. All of the measurements' types and frequencies of researches that used in measuring the accuracy of human skin detection researches in 1998-2022 periods is represented in Figure 5. With more than 20 measurements Accuracy, FPR, TPR are the most used measurements with 20, 22 and 14mentioned in researches respectively.
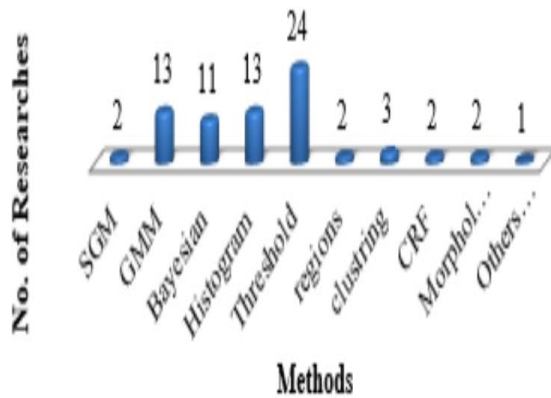
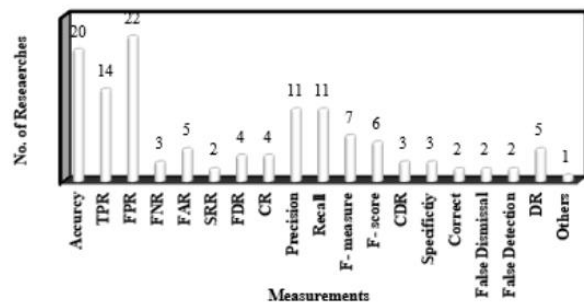Figure 4. Type of statistical, threshold and region methods in 1998-2019

Figure 5. Number of performance matrices used for skin detection researches in statistical, threshold, region, and machine learning methods in 1998-2019

The ratio of researches that mentioned the following challenges; skin types, illumination, hair effect and real time system in statistics, threshold, and region methods in 1998-2019 is represented in Figure 6. As it turns out, from the total of 59 researches, there are 34% of researches which not mention any of these challenges. Likewise, there are 37%, 29%, and 7% researches for illumination, skin types, and real time system respectively. Whereas, there is no research mention about hair effect challenge. These challenges are one of the major challenges in human skin detection. The results of this study show that a small number of special methods were used to reduce illumination and the rest of the research was used, like space colors, because of their effect on illumination. Thus, this is image is not considered a good treatment for dark, shadow and light illumination and the percentage of error in human skin detection is unsatisfied.
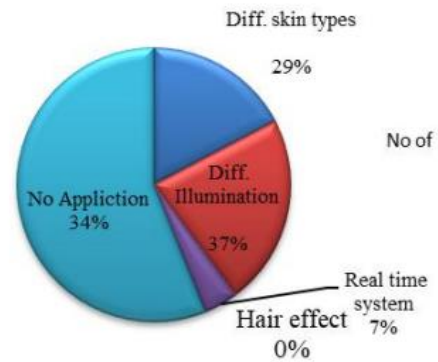

Figure 6. Percentage of researches that considered with different skin types, different illumination, hair effect and real time system in statistical, threshold and region methods in 1998-2019

Ten types of machine learning methods that used in researches in 1998-2019 are described in Figure 7. ANN is the most used method with number of researches is 20. ANN aims to learn unidentified complicated input-output interactions depending on training data and then to be prepared to predict unseen information [13]. Types of training algorithms that used in human skin detection research in same period are portrayed in Figure 8. Back propagation got the highest number of researches by ten among 12 algorithms.
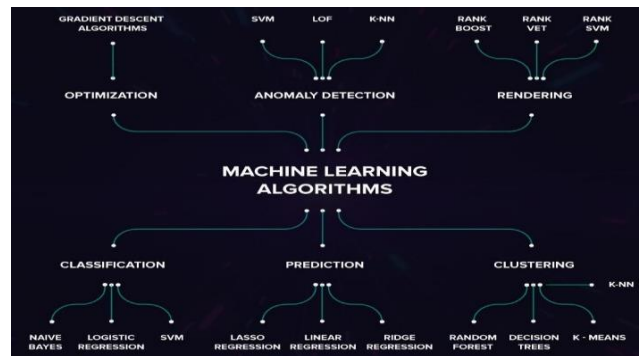

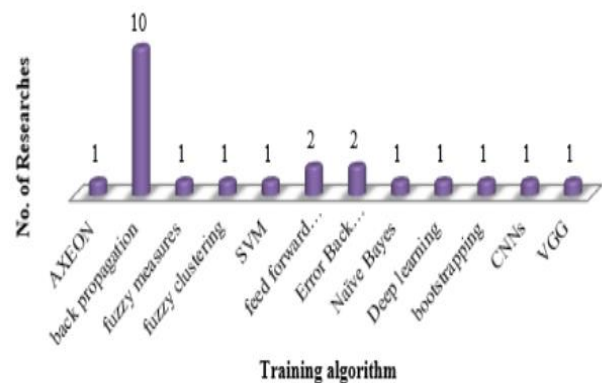Figure 7. Type of machine learning methods

Figure 8. Type Training algorithms

The percentage of researches in human skin detection that mentioned challenges; illumination, hair effect, real time system and hair effect, in machine learning methods in 1998-2019 is illustrated in Figure 9. Out of the total of the researches, which is 37, there is 40% of researches do not mention any of the challenges. While for different skin types, illumination, real time system and hair effect are 14%, 27%, 19%, and 0% respectively.
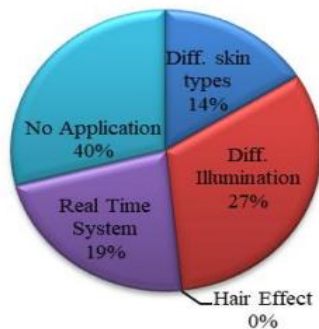

Figure 9. Percentage of researches that considered with different skin types, different illumination, hair effect and real time system in machine learning methods

The related researches of human skin detection are evaluated in Table 5. Several categories are considered in this evaluation, such as color space, method, measurement, application, and time. A few researchers were evaluated the time consuming of skin detection. However, the others were focused on the confection matrix evaluation.

IV. RESULTS AND DISCUSSION

This survey is an effort to present an up-to-date overview of skin detection research methods outlined in over 150 research papers. In an attempt to find any sensitive part of the human body, skin detection seeks to divide the input picture into regions. An enhanced strategy for human skin segmentation with a higher identification rate increases the efficiency of many computer vision systems. This phase is very crucial as image segmentation is perceived to be the first phase in image analysis and therefore the whole achievement or failure of the entire system is largely based on this phase. Although significant development has been produced over the past two decades, there are many opportunities for further work. Researchers need to be alert of the need for a robust skin detector to be effective against diversity in: illumination environments, varying ethnic groups, picture montage and replication, make-up, aging and complicated background.

Where applicable, we observed the overall efficiency of these techniques. That being said, the techniques in

question seemed to use various raw data sets (i.e. training samples) that the researchers collected by hand. The volume and performance of the rough data have a significant impact on the skin color clustering model, although different scientists use the same technique. In other phrases, if new raw skin sample data are assembled from another database, the skin color set may shift dramatically. Hitherto, skin detection techniques have been predominantly subjective, allowing scientists to decide on the effectiveness of these techniques due to the shortage of consistency on how to assess the correctness of a specific clustering model and how these techniques are assessed. In particular, most researchers use their own datasets to conduct their tests and simulations. Despite the same raw data, the use of distinct methods for modeling skin color clusters creates distinct classification boundaries (or clustering models).

V. CONCLUSION

Skin detection plays an important role in human motion analysis and face detection. It is widely needed in image processing applications ranging from face detection, face tracking, gesture analysis, and content-based image retrieval systems and to various human computer interaction domains. In this article, the state-of-the-art studies on human skin studies for human skin detection based on image processing are reviewed. This research presented the statistical study for each issue stated before. This study includes several sections of investigation. The literature is compared according to the skin detection methods. Some techniques are intended for a particular purpose in their strategy and are therefore unsuitable to adapt to other applications without taking into account some fundamental assumptions. Others have one or more controllable parameters that the user must modify instead of instantly learning from the picture itself. Then, the utilised datasets in the literature are presented. In addition, the used color space in the literature are analysed thoroughly. Moreover, the statistical, threshold, region, and machine learning methods for human skin detection are presented and compared. Furthermore, the specific applications of the reviewed studies are also highlighted. The proposed detection methods in the literature are presented based on their measurement's parameters. It is noted that, each particular application focused on as specific measurement parameter according to the application issue. To the best of our knowledge, a few studies were tried to reduce the detection time. And, the real time human skin detection system is the best target of these studies. There are some researchers calculated real time for skin detection and some papers when they detect skin, they detected face, and hands as well depend on the result time. The remaining researches got result with the minimum is 90 ms and the maximum is 926.3 s. further

investigations is recommended to improve the detection time with maintaining a high accuracy and performance. This review gives an advance view of the human skin detection methods and issues to the researchers.

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