

Study of Diseases of the Human Body by Using Nails Images

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Abstract - Digital image processing techniques have played a vital role in many applications and have shown a clear impact on human service, especially in the medical field through the discovery and diagnosis of many diseases, and among the medical sciences that have recently attracted the attention of researchers are skin diseases through which body diseases are diagnosed, including images of human nails, and given that there are limitations on the accuracy of human vision for some human health conditions, which leads to inaccuracy in diagnosing the disease, as well as the lack of an integrated dataset for images of human nail diseases.

As a result, the aim of this research was to provide a study on the most important diseases that affect the human body, which can be identified through images of human nails, and work has been done to create a database that includes more than (600) images that were taken for the nails of people on site using different normal cameras and mobile cameras. Thus, these images were classified into two groups: (normal images and diseased images) with the help of a consultant doctor specializing in dermatology, depending on the shape, color and texture of the nail, to help researchers use them in developing applications related to diagnosing diseases of the human body through nail images. This study showed that the use of images of nails is useful in early diagnosis of health problems and common and dangerous diseases affecting the nails, in addition to that it helps in following up the patient remotely, by evaluating the performance of treatment or to verify the performance of the treatment that is prescribed to the patient by identifying the changes that occur. It is caused by medical treatment on pictures of nails that are sent to the attending physician.

Keywords: Human Diseases, Nail Image, Nail color, Nail Image dataset.

I. INTRODUCTION

Digital image processing techniques and algorithms have played a vital role in many applications. These technologies have shown a clear impact in serving people, especially in the

medical field, by discovering and diagnosing many diseases for millions of people [1]. The disease can be defined as a disorder in the function or structure of one of the parts of the human body and it causes changes in the human body and through these changes the disease can be detected. When the doctor examines the patient and before giving him any medication, he may need to take medical pictures and laboratory tests. Since medical images play a very important role in diagnosing diseases that affect humans, so based on these images and examinations, the doctor can diagnose the disease. But sometimes there may be limitations on the accuracy of human vision for some human health conditions, which lead to inaccuracy in diagnosing the disease, so the use of modern diagnostic technology has become more accurate in identifying the disease, which in turn has led researchers to process medical images for use in many diagnoses [2].

The fields of medical sciences have taken a wide range of emergence. Where there are a lot of modern technologies or methods that help doctors diagnose the patient's disease, and among the medical sciences that have recently attracted the attention of researchers are skin diseases through which diseases of the body are diagnosed [1], including images of human nails, thus the basic and important role of the nail is to protect the fingers. Since, the nails are an important part of the human body, as they reflect the health condition, and that any change in the nail may reveal the presence of unnoticed pathological conditions, and some cases (nail diseases) may be harmless and others may indicate to chronic diseases (including liver disease, cancer, diabetes, or diseases related to other organs), so one of the techniques for diagnosing diseases is to analyze the image of the nail. Thus, the nails can be examined by doctors to know the disease by examining parts of the nail or its characteristics such as: the shape of the nail, the color of the nail plate, the texture of the nail, and others [3].

By looking at previous studies in this field, it was found that there is no comprehensive dataset related to images of human nail diseases. As a result, the aim of this research was to provide an overview of the most important diseases that affect the human body which can be identified through images of human nails. Work has also been done to form data base

includes more than (600) images taken of people's nails locally. These images were classified into two groups: (a group of images of natural nails and a group of images of diseased nails) with the help of a consultant doctor specializing in dermatology (Mustafa Noureddine Abdel Qader / University of Nineveh / College of Medicine) by depending on the form and the color and texture of the nail, to help researchers use it in developing applications related to diagnosing diseases of the human body through nail images.

1.1 Literature Review

The following is a review of the various research works on diagnosing human diseases based on images of human nails to detect diseases. Table (1) includes a summary of previous studies and success rates for a number of researchers.

- 1) Indi & Gunge in 2016 proposed a system to identify a group of diseases in the early stages of diagnosis, based on the colors of the human nails in the hand, in order to know the type of disease in treatment, where the (Weka) tool was used, which is a measure used in preparing data for the early stages of the disease, from training images of the patient's nails, where they are compared with the original image to obtain the result of the disease (or knowledge of the disease), and the ESDD (Early Stage Disease Diagnosis System) was applied using the color detection algorithm and predicting the disease through the images of the nails ; the usual camera was used Or a mobile camera to take pictures. The percentage of the results correctly matching the training data set was about 65%, and the discovery was slow [4].
- 2) Gandhat and others proposed in 2016 a way to detect diseases in the human body through images of human nails based on the color of the nail by designing a disease detection system called DDS (Disease Detection System) to solve the problem of lost time for doctors to discover the disease and obtain inaccurate results; thus, this system increases the accuracy of the results through accurate human nail images and was programmed using MATLAB [5].
- 3) Kumuda suggested in 2017 a method for separating the nails and distinguishing them as parts by means of a microscope in order to display the areola clearly and preserve the quality of the image; thus, the image of the nail under the microscope gives details of the nail in a clearer way, such as: the free edge and the longitudinal skip, where the semicircular plate is separated from the nail plate that has a significant role in the system of accurate diagnosis in the field of medicine and other conditions [6].
- 4) Saranya & Ranichitra in 2017 proposed different image processing techniques to automatically identify the nail area to extract the abnormal area, where segmentation techniques are calculated and analyzed to extract the affected nail areas and their shape features. In the beginning, the image of the nail is segmented to detect its prior deformities, as it was performed using medium filters, and then this is converted to gray scale to increase the efficiency of the process, as Threshold water shade was used, then the segmented nail area shape features are extracted [7].
- 5) Nijhawan et al., 2017, proposed a new framework using deep learning (DEEPLAING) to detect and classify diseases in human nails from images. This framework used a mixture of CNN models to extract features by creating a set of new data to test the effectiveness of the proposed framework. Because the shortage of accurate dataset in this field, the results of the algorithms (SVM .ANN .KNN .R F) were compared, as they were able to identify diseases in human nails with an accuracy of (84%) [8].
- 6) Yani et al. in 2019 proposed a system for early detection of problems in terry nails, where digital images were relied on using the CNN algorithm through a standard model for transfer learning (TENSOFLOW INSAPTION V3), and the accuracy of the results was (94.24%) [9].
- 7) Nithya et al. in 2019 proposed a system to obtain the color feature of the human nail image and then examine the specific disease to predict diseases without causing human harm. This system is very useful in identifying many diseases by analyzing the patient's nails, which are difficult for the human eye to distinguish between changes slight changes in color and this is done using a median filtering technique (the RGB of its input images is averaged and then matched with the training data set). This is a non-linear filtering and it is often used to remove noise from the image and it is called binary noise that you remove using SVM (SPORT VACTOR MACHINE) which by comparing the values of the entered data with the extracted data, the accuracy of success reached (97%) [10].
- 8) Nattavadee & Hongboonmee in 2021, suggested developing a model for the image of human nails to detect health problems using deep learning technology by collecting 400 typical images of five types of nails like: (psoriasis, rheumatism, anemia, melanoma, normal) using CNN to analyze health problems for the nail image, the performance of the system was evaluated (good), with an average detection accuracy of (78%) [11].
- 9) Abdulhadi and others in 2021 proposed a method to treat four types of diseases that affect human diseases like: (pigmentation, clubbing, fungus, nail health), where the transfer learning system was used by applying CNN

algorithms to a large group of algorithms. In fact, the concept of transfer learning useful in the classification of medical images through the use of the trainer model (truing) used on large data to obtain good results. Thus, the CNN was used for five training models (VGG ALEX NET RESNET DENESNET GOOGLE NET), and six criteria were used for each model to determine the percentage of network performance, where they made a comparison between the five models and the results showed the following:

- i. Suffering from lack of data (dataset).
- ii. Using the soft max to show the results faster through several parameters.
- iii. Using TP/(TP+FP) accuracy standards, where (60%) of the data were trained and (40%) of the data were tested.
- iv. Matlab was used to calculate the accuracy of each of the five models of the CNN algorithm and it was found that “Desnet” and “Renset” are the best with a percentage of (96%) [1].

Table 1: Summary of previous studies and success rates for a number of researchers that have been viewed

Researcher Name	Research Year	The Success Rate %	The type of system used
Indi & Gunge [4]	2016	% 65	Application of ESDD (Early Stage Disease Diagnosis System) using color detection and disease prediction algorithm
Gandhat et. al [5]	2016	Not Found	Designing a disease detection system called DDS (Disease Detection System) to solve the problem of lost time for doctors to detect the disease.
[6] Kumuda	2017	%84	Method for separating nails and marking them as fragments by means of a microscope
Saranya & Ranichitra [7]	2017	Not Found	Various image processing techniques to automatically identify the nail area to extract the abnormal area where segmentation techniques are calculated and analyzed to extract the affected nail areas and their shape features
Nijhawanet. al[8]	2017	%84	A new DEEPLLEANING framework for detecting and classifying diseases in human nails from images. This framework used a mixture of CNN models to extract features.
Yaniet, al [9]	2019	%94.24	A system for the early detection of problems in the nails of TERRY, where it was based on digital images using the CNN algorithm through a standard model for transfer learning) (TENSOFLOW INSAPTION V3)
Nithyaet.al [10]	2019	%97	A system for obtaining the color feature of a human nail image and then examining the specific disease to predict diseases without causing harm to humans

			using a median filtering technique (the RGB of the input image is averaged and then matched with the training set data)
Hongboonmee, et. al [11]	2021	%78	Developing a human nail image model to detect health problems using deep learning technology
Abdulhadi et. al [1]	2021	%96	The use of the transfer learning system (transfer LEARNING through the application of CNN algorithms) on a large set of algorithms

II. RESEARCH METHOD

2.1 The Natural Nails

Before identifying the diseases of the body through pictures of the nails, it is necessary to know the parts of the nail through which the disease can be detected [12]. Figure (1) (2) show the parts of the nail (Lunula nail, crescent nail, fold nail, bed nail, plate nail, and matrix nail).

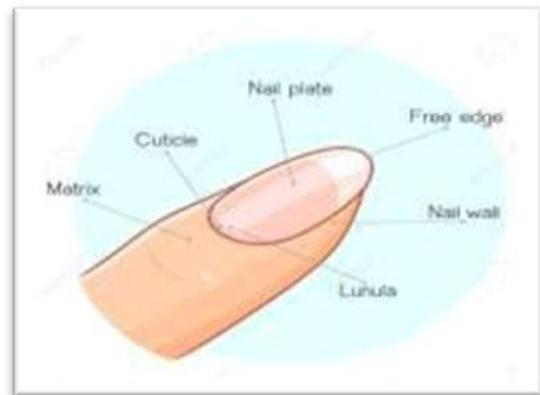


Figure 1: Parts of the Nail [12]

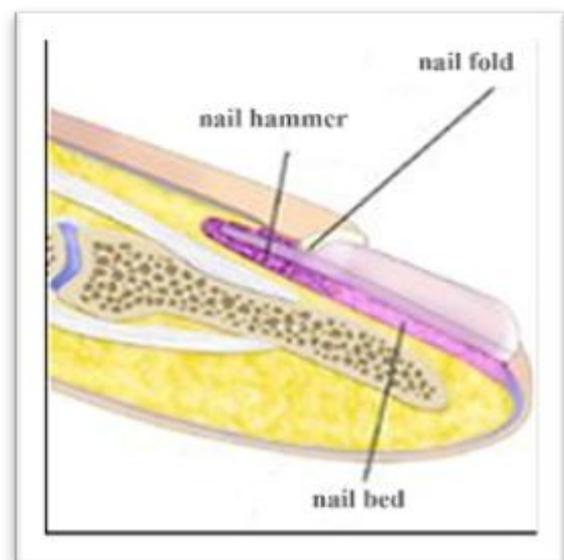


Figure 2: Anatomy of the Nail [13]

Nails are classified as additional organs of the skin produced by epidermal cells that cover the tips of the fingers. Normal nails are generally with translucent pink color (the inner layer is pink, which is the outer layer which is rich in blood vessels), smooth, firm texture, shiny and round shape; healthy nails are characterized by their uniform color and there are no color changes, lines or pits. The color of the nails is white during their growth [13]. See Figure (3)



Figure 3: A Natural Nail

2.2 Skin diseases associated with nails

About (10%) of skin diseases are associated with nails [13] and will be identified in this section as they are classified into two types as follows:

2.2.1 Diseases that can be identified by a picture of the shape and color of the nail

In the field of human health care, many diseases can be predicted by distinguishing the color and shape of human nails, as the color of the nail, if it is white (there are white spots in the nail), may be an indication of the presence of a disease in the human body, such as: diseases of the lungs, liver and heart diseases [12].

- If there is a white part in the nail, this indicates anemia [11]. See Figure (4)



Figure 4: Anemia of the Nail [11]

- If there is inflammation on the nail plate that can be found under the base of the nail, or nails with a split layer, or uneven rough nails, or nails with white spots intermittent, all of these symptoms indicate psoriasis [11] as in Figure (5).



Figure 5: Psoriasis of the Nails [11]

- If there are uneven lines on the nail, holes, roughness and deformities, or the nails are thick with white scales under the nail, this indicates rheumatoid arthritis [11]. See Figure (6)



Figure 6: Rheumatoid Arthritis [11]

- If there is a dark brown or black coating around the nail, this indicates diseases (melanoma) and a tumor in the pigment cells (Melanoma), which is a type of skin cancer [11], as shown in Figure (7).



Figure 7: Melanoma Screws [11]

- Engraved Nails: Engraved nails may be associated with psoriasis, alopecia areata, or eczema, as in Figure (8) [14].



Figure 8: Engraved Nails

- Blue Nails: Blue nails may be an indication of circulatory problems or lung diseases such as:
- White Spots (Leuconychia): These are common with those who suffer from zinc deficiency. They can also appear in serious conditions such as: sickle cell anemia and Hodgkin's disease and can sometimes be hereditary and may disappear over time as in Figure (9) [14].

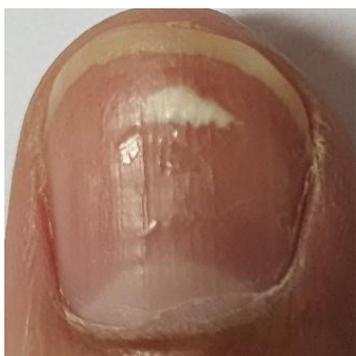


Figure 9: White Spots (Leuconychia)

- Flat Nails: They can be a possible indicator of a thyroid condition, vitamin B12 deficiency or anemia.
- Yellowish Nails: This problem can have several causes, such as: diabetes, or a disorder of the lymphatic system, as shown in Figure (10) [14].



Figure 10: Yellowish Nails

- Horizontal Bumps: These bumps can be an indication of malnutrition or anemia.
- Lover's Lines: This is another type of horizontal bump on the nail. The cause of these dark and horizontal depressions on the nail may be a sign of trauma or disease to poor diet or chemotherapy. Metabolic conditions may also be the cause. Figure (11) [14].



Figure 11: Lover's Lines

It is also possible to diagnose diseases that affect humans through a change in the length and shape of the nail, which is known as Terry Nails. This can be noticed in patients with chronic liver disease, and some other health problems [14] and [9]. See Figure (12).

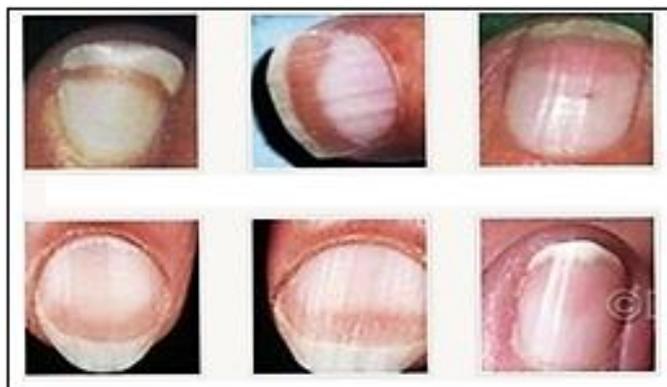


Figure 12: Terry Nails [9]

2.2.2 Diseases that can be identified by the crescent of the nail

In the nails, there is a white crescent shape in the lower part of the nail called the lunula, and it contains nerves and blood vessels that produce cells which make the nail plate more robust, whiter and it takes a small part of the lower part of the nail. This is clearly noticed on the thumb. Sometimes, the color of the crescent changes and this is a sign of a pathological condition. The nail grows from a pocket under the skin that doctors call the "stroma" which helps in the formation of new cells. Then, these cells are aggregated and separated from the skin. The nail crescent is the visible part of the stroma. Some people notice a crescent moon on their

thumb, but skin colour and other factors can make it more or less noticeable. Since crescent nails consist of the newest ingrown part of the nail, they can provide clues about a person's health. However, its absence does not always indicate a serious health problem. The absence of the nail crescent or its poor distinction may indicate the following [15]:

- Malnutrition which occurs due to severe dieting, starvation, or suffering from a condition that hinders the body's ability to absorb essential nutrients.
- Basic vitamin B12 deficiency.
- Vitiligo, a chronic skin disease, in which the skin pigment is lost due to the immune system's attack on melanocytes, which are the skin cells responsible for skin color.
- Anemia, either due to an imbalance in the red blood cells or due to a lack of production of these cells, which leads to a lack of oxygen in the body. This often causes paleness and makes the crescent-shaped area of the nail bed indistinguishable. Anemia is mainly caused by iron deficiency, which usually results from blood loss, as in severe bleeding.
- Those who suffer from kidney failure and are dependent on dialysis may lose the natural nail crescent.
- Heart and lung disease often manifest in the color of the nail crescent, which may appear reddish in people with chronic obstructive pulmonary disease, heart failure, and similar conditions.
- Cirrhosis is a chronic disease that damages the liver, causing a scarring and a damage that impairs the liver function. People with cirrhosis may have redness and whitening of the nail plate, which may obscure the nail plate.
- Argyria, which is a class of poisoning caused by excessive exposure to silver. People who are exposed to chemicals at work or who are frequently exposed to toxic chemical dust may be exposed to this poisoning, and some of them the color of the nail crescent may be changed to blue.

Where any of the above signs can be identified by the patient's history, other physical signs, and the patient's clinical examination.

2.3 Data Set

Nails are an important part in the human body, as they reflect their health and can be used to detect certain diseases. Due to the lack of a comprehensive database, therefore, in this research, images of human nails were collected and a database containing (600) images was formed and classified into two groups: a group of images of natural nails, and a group of images of diseased nails (patients with psoriasis, patients with

paronychia, diseases associated with systemic diseases, and diseases associated with contact eczema, associated with malnutrition and patients with onychomycosis). The photos were taken with an iPhone, Samsung and other various cameras.

III. CONCLUSION

- Through the studies that have been viewed, and since the images of human nails reflect human health, so it can be concluded that it is possible to use modern technology in diagnosing special diseases in the human body based on images of nails, although previous studies succeeded in diagnosing diseases in varying proportions between (80-97%). Although this method does not replace the periodic medical examination, it represents an effective way to determine whether there are health problems affecting the nails. It is an effective and accurate method and can be widely adopted if health characteristics are extracted from the images precisely.
- Studying diseases of the human body using fingernails is a valuable tool for clinicians. By examining the appearance of nails, doctors can diagnose and treat a variety of conditions ranging from fungal infections to lung cancer. Since the appearance of the nails alone cannot provide a definitive diagnosis, it can provide important clues that help direct the physician to order a further testing and treatment from the patient to reach an accurate diagnosis early.
- By providing a data set that contains an appropriate number of images of human nails that reflect the diseases of the human body, researchers will be able to conduct applications on a large scale, which will increase the accuracy of diagnosis, especially by using machine learning and deep learning methods.
- Since the use of nail pictures is useful in early diagnosis of health problems affecting the nails and helps in early detection of some common or dangerous diseases, it will help to provide the right treatment at the right time. As well as setting the dates for the periodic medical examination necessary to monitor the personal health status. It also helps in evaluating the performance of the treatment or to verify the performance of the treatment that is prescribed to the patient by identifying the changes that the medical treatment causes to the nails.

ACKNOWLEDGEMENT

The authors are grateful to the Computer Science Department at the University of Mosul/ Iraq for the support in achieving this work.

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Citation of this Article:

Hani Adel Shukur, Sundus Khaleel Ebraheem, “Study of Diseases of the Human Body by Using Nails Images” Published in *International Research Journal of Innovations in Engineering and Technology - IRJIET*, Volume 7, Issue 5, pp 226-233, May 2023. <https://doi.org/10.47001/IRJIET/2023.705029>
