IMAGE ANALYSIS MODEL FOR SKIN DISEASE DETECTION USING MOBILE APPLICATION

BY

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ABSTRACT

Skin disease is one of the common form of disease form in the world. Diagnosis of the skin diseases may requires a high level of dermatologist expertise. The advancement in computer and IT capabilities can offer a good opportunity and provide support to help in skin diseases diagnosis, which still suffer from shortage many countries and computer aided skin diseases diagnosis system can provide more objective and reliable solution to this issue. There are many researches in detecting skin disease like detection of skin cancer, and tumor skin. However the accurate recognition of disease is extremely challenging due to: low contrast between lesions and skin, visual similarity between disease and non-disease areas, and this study aims to detect skin disease by captured image and apply enhancement techniques in image for make it ready to diagnosis the skin diseases by apply segmentation the image by two of clustering algorithms for give more accurately result which there are K-Means clustering algorithm with the fixed number of clusters to do processing, and second one is Fuzzy C-Means algorithm which allows one piece of data to belong to two or more clusters so it is more flexible. By using two of segmentation algorithm, the study can achieve more accurately result in the project, whereas it reach to 94% within the dataset and 85% with the external data, making it a competitor for the rest of the projects especially it is processing four types of skin disease to detect which are: acne, psoriasis, melanoma, and heat rashes. The useful information that will help to detect the disease using mobile application with save time, its need to 5-8 minutes to get the final analysis result. The project is built successfully and the interface application is connecting properly database, and all the project functionalities is working properly, despite that there are some problems occurred through the image analysis with the data collected that are distorted by a watermark that obstacle the classification process. Moreover tips and instructions if possible to do them as a quick ambulatory are discussed all system functionalities is working properly, despite that there are some problems were we faced.

خلاصة البحث

الامراض الجلدية هي أحد الأمراض الشائعة في العالم. وقد يتطلب تشخيص الأمراض الجلدية درجة عالية من الخبرة في مجال الأمراض الجلدية. قدرات الكمبيوتر وتكنولوجيا المعلومات المتقدمة والهواتف الذكبة يمكن ان توفر فرصة جيدة وتقديم الدعم للمساعدة في تشخيص الأمراض الجلدية ، التي لا تزال تعاني من نقص كبير، ويمكن لنظام تشخيص الأمراض الجلدية المدعومة بواسطة الهواتف الذكية أن توفر حلاً أكثر موضوعية وموثوقية لهذه المشكلة.

هناك العديد من الأبحاث في الكشف عن أمراض الجلد مثل الكشف عن سرطان الجلد والكشف عن ورم الجلد. لكن التشخيص الدقيق للمرض صعب للغاية بسبب: التباين المنخفض بين منطقة الجلد المصابة والجلد ، والتشابه البصري بين المرض وغير المرض ، إلخ. تهدف هذه الدراسة إلى اكتشاف المرض الجلدي عن طريق الصورة الملتقطة عبر الهاتف المحمول، وتطبيق تقنيات التعزيز في الصورة لجعل الصورة جاهزة لتشخيص الأمراض الجلدية عن طريق تطبيق التجزئة بواسطة اثنين من خوارزميات التجميع لإعطاء نتيجة أكثر دقة خوارزمية التجميع K-Means مع عدد ثابت من الكتل للقيام المعالجة ، و والثانية هي خوارزمية Fuzzy C-Means التي تسمح لجزء واحد من البيانات بالانتماء إلى مجموعتين أو أكثر من المجموعات بحيث يكون أكثر مرونة. باستخدام خوارزميات التجزئة، يمكن للدراسة أن تحقق نتائج أكثر دقة في المشروع ، حيث تصل إلى 94 ٪ داخل مجموعة البيانات و 85٪ مع البيانات الخارجية ، مما يجعلها منافسا لبقية المشاريع وخاصة أنها تعالج أربعة أنواع الأمراض الجلدية التي يجب اكتشافها وهي: حب الشباب ، الصدفية ، سرطان الجلد ، الطفح الجلدي. المعلومات المفيدة التي ستساعد على اكتشاف المرض باستخدام تطبيق الهاتف المحمول مع توفير الوقت ، حيث يحتاج إلى 5-8 دقائق للحصول على نتيجة التحليل النهائي. تم بناء المشروع بنجاح وتربط واجهة التطبيق قاعدة البيانات بشكل صحيح ، وجميع وظائف المشروع تعمل بشكل صحيح ، على الرغم من أن هناك بعض المشاكل التي حدثت من خلال تحليل الصور مع البيانات التي تم جمعها مشوهة بواسطة علامة مائية تعوق عملية التصنيف. علاوة على ذلك ، تتم مناقشة النصائح والتعليمات ، إن أمكن القيام بها كإسعاف سريع ، جميع وظائف النظام تعمل بشكل صحيح ، على الرغم من وجود بعض المشكلات التي واجهناها

APPROVAL PAGE

I certify that I have supervised and read this study and that in my opinion; it conforms to acceptable standards of scholarly presentation and is fully adequate, in scope and quality, as a dissertation for the degree of Master of Science (Computer and Information Engineering).

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Ahmad Faris Ismail
Dean, Kulliyyah of Engineering

DECLARATION

I hereby declare that this dissertation is the result of my own investigations, except where otherwise stated. I also declare that it has not been previously or concurrently submitted as a whole for any other degrees at IIUM or other institutions.

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Signature Date

I wish to dedicate this thesis to my late father, Walid,

He taught me to persevere and prepared me to face the challenges with faith and humility.

He was constant source of inspiration to my life.

Although He is not here to give me strength and support I always feel him

Presence that used to urge me to strive to achieve my goals in life.

My Mother,

who always had confidence in me and offered me

Encouragement and support in all my endeavors.

To my Wonderful husband,

who encouraged me, to achieve my dream, and have made me stronger,

for his steadfast support and invaluable belief in my success was, and continues to be a priceless, and continuous gift

Thank you, Ali, for your love, wisdom and support.

To my little princess daughter Celina.

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LIST OF ABBREVIATIONS

ADK	Android Software Development Kit
ANN	Artificial Neural Network
BoF	Bag of Features
CAD	Computer-Aided Detection
DDDIPNN	Dermatological Disease Detection using Image Processing and Neural Networks.
FCM	Fuzzy c-means
FCMC	Fuzzy C-Means Clustering
GUI	Graphical User Interface
IAMSDD	Image Analysis for Skin Diseases Detection
IDE	Integrated Development Environment
IT	Information Technology
KNN	k-Nearest Neighbours
MIC	Medical Image Computing
SIFT	Scale Invariant Feature Transform
SURF	Speeded Up Robust Features
SVM	Support Vector Machine

LIST OF SYMBOLS

d	Euclidian distance
D(X,M)	minimize distance
I(Y)	The original image
I(X)	The result of smoothing filtered image
J(U,V)	one piece of data to belong to two or more clusters
k	cluster centroids
mk	nearest cluster
n	partition number of data points
P	prescription error rates
ϕ(r)	Gaussian radial basis function

CHAPTER ONE

INTRODUCTION

1.1 BACKGROUND

Skin is the largest organ in the human body, which is important to cover human bone, and to protect human from any harm (Sumithra, R., Suhil, M., & Guru, D. S., 2015), fight the bacteria and other kind of diseases, and may have numerous potential abnormalities, where there are about 1000 distinct skin diseases. However, in this research will focus on four type of the most common skin diseases which are: Acne, Psoriasis, Melanoma, Heat Rash. The symptoms of the majority of these diseases are relatively ignored although knowledge is rapidly increasing (Kumar, S., & Singh, A., 2016), however, that makes it a challenge for dermatologist to diagnose them (Jafari, M. H., Nasr-Esfahani, E., Karimi, N., Soroushmehr, S. R., Samavi, S., & Najarian, K., 2017).

Nowadays technologies and especially smartphone have changed our day-to-day life in all aspects and the medical field is not an exception where many medical systems have been developed to help both patients and doctors in different ways, starting from registration process ending with the use of technologies for diagnosing diseases (Jafari, M. H., Nasr-Esfahani, E., Karimi, N., Soroushmehr, S. R., Samavi, S., & Najarian, K., 2017).

This chapter gives an overview about the problem statement of the research, the objectives to be achieved and brief view about the methods used in the implementation. In addition, an overview of thesis outline will be presented.

1.2 PROBLEM STATEMENT

The aim of this thesis is to investigate image analysis for disease detection, many of these diseases are very dangerous, particularly if not treated at early stages. In order to, the recognition of the disease can be quite complex that requires high level of experience. Diagnosis by human depends on subjective judgment of the dermatologists so it's almost impossible to be accurate, unlike computer aided diagnostic systems which are more realistic and reliable.

1- The dermatologist's diagnosis need to more effort and time. Skin diseases rate has been increasing for past few decades, also the dermatologists can make a fault in diagnosis.
2- Procedures and algorithms for skin disease diagnosis still in need for improvement.
3- Lack of mobile application that help in skin disease detection.

Thus, this study will propose an image analysis model for skin disease detection using mobile application.

1.3 RESEARCH OBJECTIVE

In order to investigate problems of the study and make it more effective a mobile-based skin diseases detection application has been developed. In this application, the user with an Android operating system installed with the proposed application can be used as a diagnosis tool to find the potential skin lesions in a persons' skin and compare the skin lesions detected by the mobile phone with sample stored in a database. In the Android applications, the key step is to compare the similarity between two boundaries. K-Means and Fuzzy C-Means algorithms are applied in the study for accurate results considering reliable initial diagnosis of skin disease.

The research aimed to achieve the following objectives:

1- To study image analysis model for skin disease.

2- To improve image analysis techniques by using two types of algorithms segmentation K-Means and fuzzy C-Means, to get analysis result disease more accuracy.

3- To assess the performance of the proposed system in terms of diagnosis time and classification accuracy.

1.4 METHODOLOGY

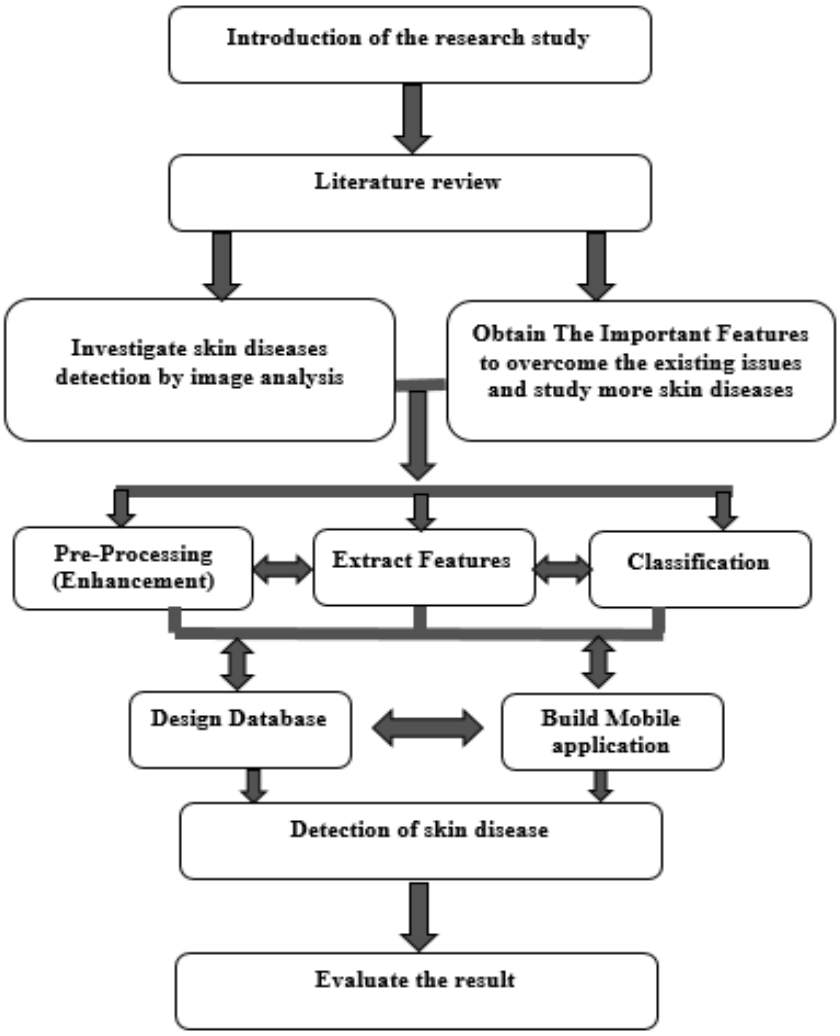

Figure 1.1 Methodology for IAMSDD.

Diagnosis by human depends on subjective judgment of the dermatologists so it's hardly reproducible, the recognition of the disease can make a fault in diagnosis also may be quite complex that requires high level of experience unlike computer aided diagnostic systems which are more realistic and reliable.

Proceeding from the Figure 1.1 as shown previously, with increasing rates and subjectivity in a different type of current clinical skin detection global methods, there is a need for skin disease detection decision support system in which feature extraction is a sharp critical and valuable step in skin disease decision support system. The percentage of validation and accuracy was 90.09% and it's achieved by using KNN (Neural Network) algorithm (Zanotto, M., 2010). Melanoma is the most dangerous form of skin cancer if left untreated. The rates of melanoma have increased, especially among young adults, but survival rates are high if detected earlier. While several research papers analyze only one disease like Melanoma cancer scope (Zanotto, M., 2010) Depend on digital images to detect apart of lesion area easily and propose skin lesion segmentation algorithm to seperate lesion area and extract features and classify the region, is it normal or lesion in terms of the risk of melanoma (Glaister, J. L., 2013). The matching of test and reference images compared that yields the percentage of skin diseases in the captured skin texture image. The analysis result of the research paper Glaister, J. L., 2013) is not accurate and unreliable. So that is achieving the percentage of validation and accuracy about 38%. The research of automatic detection of eczema (Lin, L., 2015) using image processing, detects eczema regions and classify the identified region as mild or severe based on image color feature and texture feature. It achieves good result of validation and accuracy of about 92% (Gu, Y., 2014).

To evaluate the model, the accuracy is the basic criteria that is used in the model, which the accuracy of the model is the number of positive prediction divided by the total

number of the positive class value predicted, and is one of the key element when working with different methods.

The project will implement image analysis technique to diagnose the skin diseases, firstly, the input data to the project is an image of the infected skin, then the model will determine the type of disease. The image will classify between 4 famous diseases which are Acne, Psoriasis, Melanoma, Heat Rush. The model architecture can assume in several steps shown in the Figure 1.1 that is show how analysis image and skin diseases detection. The input image this is first and important step, because without the image, no further process is possible. Enhancement process is to apply modification filter to destroy from unwanted element in the image like noise by applying median filter. Skin region detection for discarding non skin region pixels and make the image simpler for the next step is process. Segmentation aim to distinguish between diseases and skin area. To detect the diseases area correctly, segmentation method with high accuracy is used feature extraction pulls out meaningful features of the image diseases area that can help in identification and evaluation or diseases state. Classification are obtained with different visual vocabularies then each image is described using these vocabularies. All of the previous process are need to build the mobile application and connect it to the database to achieve the requirements. After connecting to the database and comparing the analysis image with images in database, the result of skin diseases detection need to be evaluated, and the predictive value and percentage of accurate diagnosis of disease are show and can be adopted as a reliable initial diagnosis.

1.5 SCOPE OF RESEARCH

The focus of this research on mobile application is the design of an efficient system that includes easy and simple user interface.

When human captured photo or choose it from the gallery, it will enter the system to analysis and get useful information that help in diagnose and detect skin disease nature and give accurate and reliable results based on World Dermatology Diagnostic Database by using two strong segmentation algorithms that gives the correct diagnosis and get the accurate results.

1.6 THESIS OUTLINE

This thesis is composed of five chapters that are organized as follows:

Chapter 2: This chapter presents some related work, also an overview of previous skin diseases detection theories and the technologies implemented.

Chapter 3: This chapter presents a detailed look of the design process for the learning model of the proposed model, and the development processes of the applications used in this model, and explains the functionalities of application and the problems during the development process.

Chapter 4: This chapter presents the results of the final learning model of the skin diseases detection model, and the overall integrated system performance.

Chapter 5: The conclusion of the project is represented in this chapter, illustrating the project objective, how far they were met, features and limitation of the application and the future work that can be implemented to improve the model.

CHAPTER TWO

LITERATURE REVIEW

2.1 INTRODUCTION

Due to diagnose requirement for skin disease thoroughness and cost for many tests to diagnose the disease, there are several researchers by application on mobile, programs on the computer or online help by applying different methods of processing on image to detect useful data to achieve the destination. All of these studies will be illustrated in this chapter. Assistance in medical scope also, is very important to develop and enhance to cover all possible cases for analysis image for skin disease detect.

2.2 HEALTH CARE

Information technology (IT) has the potential to improve the quality, safety, and efficiency of health care. Diffusion of IT in health care is generally low (varying, however, with the application and setting) but surveys indicate that providers plan to increase their investments. Drivers of investment in IT include the promise of quality and efficiency gains. Barriers include the cost and complexity of IT implementation, which often necessitates significant work process and cultural changes (Glaister, J. L., 2013). By providing new ways for providers and their patients to readily access and use health information, IT (Gu, Y., 2014) has the potential to improve the quality, safety, and efficiency of health care. However, relatively few health care providers have fully adopted IT.

Low diffusion is due partly to the complexity of IT investment, which goes beyond acquiring technology to changing work processes and cultures (Indupriya, K., & Kumar, D. G. R., 2015), and ensuring that physicians, nurses, and other staff use it.

2.3 IMAGE ANALYSIS

Using a computer instead of a trained specialist in the medical sector could potentially be life-threatening for patients. That is why this technology is only a helping hand for medical staff (Gindhi, E. S., Nausheen, A., Zoya, A., & Ruhin, S., 2017). Yet, the advantages are undeniable and include an increase in quality, accuracy, and predictability. Saving diagnosis time and early detection of certain diseases are also important, alongside the reduction of costs.

2.3.1 Advantages using computer in image analysis

2.3.1.1 Quality and Replicability

While diagnosis relying on human experience can vary greatly, the accuracy provided by algorithms is superior and easily replicable over similar data sets. Cameras and GPUs (Gindhi, E. S., Nausheen, A., Zoya, A., & Ruhin, S., 2017) are never tired and if the underlying model is executed correctly, they can pick-up details which are easily missed by the naked eye.

2.3.1.2 Lifesaving Time

Early detection of life-threatening conditions like cancer can mean the difference between life and death. Some forms evolve very rapidly, in a matter of weeks or months. By the time the condition becomes visible (Kotian, A. L., & Deepa, K., 2017), it could be too late for a treatment to be effective. Computer vision systems can be trained to