
# Automatic Imaging System for Inspection of Pigmented Skin Lesions and Melanoma Diagnosis

By

**Eng. Mariam Ahmed Mohamed Ismael Sheha**

A Thesis Submitted to the
Faculty of Engineering at Cairo University
In Partial Fulfillment of the
Requirements for the Degree of
MASTER OF SCIENCE

In

SYSTEMS AND BIOMEDICAL DEPARTMENT

FACULTY OF ENGINEERING, CAIRO UNIVERSITY
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Under the Supervision of

**Ass. Prof. Dr. Amr Sharawy**

.....

Ass. Professor of System & Biomedical Engineering

System & Biomedical Department
Faculty of Engineering, Cairo University

**Ass. Prof. Dr. Mai Mohamed Saeed Mahmoud Mabrok**

.....

Ass. Professor and Department head of Biomedical Engineering Department

System & Biomedical Department
Faculty of Engineering, Must University

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Approved by the
Examining Committee

_____
Prof. Dr. Samia Abdel-Razek Mashali, External Examiner

_____
Prof. Dr. Yasser Mostafa Kadah, Internal Examiner

_____
Assist. Prof. Dr. Amr Abd El-Rahman Sharawy, Thesis Main Advisor

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# DEDICATION

This thesis is dedicated to my Mother “Sahar Mahmoud Ramdan” who had scarified by her own dreams to help and support me so I can achieve my dreams, supported me all the way since the beginning of my studies.

*“This thesis is dedicated to all those who scarify for others happiness”*

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# List of Abbreviations

| | |
|---|---|
| CAD | Computer Aided Diagnosis |
| ANN | Artificial Neural Network |
| KNN | K-Nearest Neighbor |
| SVM | Support Vector Machine |
| TDV | Total Dermoscopic Value |
| UV | Ultraviolet |
| BCC | Basel cell carcinoma |
| SCC | Squamous Cell Carcinoma |
| ELM | Epiluminescence microscopy |
| GUI | Graphical User Interface |
| JPEG | JPEG joint photographic experts group |
| ROI | Region of Interest |
| PSL | Pigmented skin lesion |
| GLCMs | Gray level Co-occurrence Matrices |
| IDM | Inverse difference moment normalized |
| MLP | Multilayer Perceptron |
| MSE | Mean square error |
| SSE | Sum square error |

# Abstract

Skin cancer appears to be one of the most dangerous types among others by the presence of malignant melanoma as one of its forms. Malignant melanoma is the deadliest type of skin cancer and its incidence and mortality rates have been steadily increasing worldwide over the past decades. Clinicians usually found difficulties to differentiate between malignant melanoma and melanocytic nevus. A lot of effort has been made in the last two decades to enhance the clinical diagnosis of melanoma. Dermoscopy was the first non-invasive technique introduced for that purpose, where it allows magnified and clear visualization of skin morphological structure in vivo clinical examination. Depending on that other several clinical diagnosis algorithms were proposed such as pattern analysis, ABCD rule of dermoscopy, Menzies method, and 7-points checklist. Computerized monitoring of these algorithms improves the diagnosis of melanoma compared to simple naked-eye examination.

This thesis proposes computer-aided diagnosis of melanoma to provide quantitative and objective evaluation of skin lesion as opposed to visual assessment, which is subjective in nature. For the aim of globalizing that work, two different image sets are used to examine the system, a set of images acquired by standard camera represented by clinical images and another set of dermoscopic images captured from the magnified dermoscope. Images are enhanced and segmented to separate the lesion out of the background. Different features type such as geometric, chromatic, and texture features are extracted from the region of interest resulted from segmentation. Then, the most prominent features that can cause an effect are selected by different selection methods; which are F-test, T-test and the Fisher score method. Selected features are fed into three different classifiers, the Artificial Neural Network (ANN) that presented through two different techniques of classification, the K-Nearest Neighbor (KNN) and Support Vector Machine (SVM); which also presented by three different techniques of classification.

Adding to previously mentioned system; it had been interesting to design automated software for one of the applicable clinical diagnosis algorithm. The ABCD diagnosis system is a multiple model implementing different types of features, and classified by the

proposed classification methods and also by calculating Total Dermoscopic Value (TDV). The Performances of all those algorithms were measured by means of sensitivity, specificity, and accuracy. As data charts were displayed out of those terms to clarify the result comparison.

According to the different methods used for feature extraction, selection and classification, multiple experiments are conducted that makes the result field hard and complex. To simplify the process of result determination and discussion, experiments were categorized into single and multiplied models that present different approaches according to the features used for each. Results are analyzed for each approach then accuracy is compared. Finally, The approach achieved the best results is recommended for the purpose of melanoma diagnosis.