Industrial Engineering Journal
ISSN: 0970-2555
Volume : 52, Issue 4, April : 2023

RECOGNITION OF NAIL ANOMALIES THROUGH MACHINE LEARNING ALGORITHMS

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Abstract- *The state of a person's health is revealed in great detail by their nails. Patients' nails were typically examined by physicians to identify the disease type, but this method was time-consuming and didn't always yield accurate results because human eyes couldn't see minute changes. The proposed model help us recognize the disease in a short span of time with a great accuracy. The system's input is an image of human nail. The features of the nail are extracted which are thus used to form a feature vector. The classifier technique is then used to compare the feature vector of the testing image to the feature vector of the training dataset. As a result, the technique is effective in early disease detection.*
Keywords-*Processing of nail image, Nail Analysis, Machine Learning Techniques (SVM, KNN), Prediction of Disease.*

1. INTRODUCTION

Nails are unique structures formed of keratin. Human nails are considered to be an excellent indicator of one's well-being. Many alterations can occur in the nails, determining systemic and dermatological illnesses. The changes in the nails are broadly classified as

1. Color/Shade change
2. Shape/Form change
3. Texture change

The nail shade can be changed due to an injury, vitamin or mineral deficiency or specific diseases. Thus specific diseases may be indicated by certain shade changes. In addition to shade and texture change the change in the form of our nails is also a great indicator of certain diseases. Texture is the physical feel of something-smooth, rough, fuzzy, slimy, etc. Nails can grow brittle and break easily as they age. Repeated soaking and drying, as well as exposure to strong cleaning chemicals or cosmetics such as cuticle and nail removers, can aggravate the condition.

Table1: Abnormalities related to Nail Color Change [3]

COLOR	IMAGE	DISEASE
Bluish nails		Inadequate blood oxygen levels
Luminous nails (White colored nails)		Diabetes and diseases related to liver
Faded nails		Vitamin B12 deficiency, Malnutrition
Nails with a pink and white split		Renal Impairment, Vitamin B3 deficiency
Yellow nails		Thyroid, Psoriasis, Vitamin E deficiency
Blue half moons		Possibly a symptom of poisoning

Table2: Abnormalities related to Nail Shape Change

SHAPE	IMAGE	DISEASE
Spoon nails (Koilonychia)		Iron deficiency, heart disease
Clubbed nails		Cardiovascular diseases, liver diseases

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Table3: Abnormalities related to Nail Texture Change

TEXTURE	IMAGE	DISEASE
Frangible nails		Poor diet particularly lacking in vitamin A
Nail pits		Tissue disorders, Iron deficiency
Vertical Ridges		Aging, Thyroid disease, Iron deficiency
Horizontal ridges		Zinc deficiency, Diabetes

2. LITERATURE SURVEY

Dr. B L Shivakumar, Priya Maniyan, and others spoke on the classifier approach called SVM, as well as different nail-related disorders, work done on nail picture processing to identify an anomaly, and other characteristics derived from nails. [1]

Dr. A. Ranichitra, V. Saranya, and others talked on how to analyse digital nail pictures using unsupervised image capture, pre-processing, and popular segmentation methods as Watershed segmentation, Thresholding segmentation, and K-means segmentation. Feature extraction is also covered. [2]

Trupti S. Indi, Yogesh A. Gunge, and others explored the five primary components of a nail, including the cuticle, nail plate, nail lines, nail root, and lunula. The nail plate is employed in the ESDD system. They concluded their research with the use of WEKA tool to perform the analysis, and they had utilised a color detection algorithm for the disease prediction.. [3]

Rose Verma Rahul Nijhawan, Shashank Bhushan, Ayushi, Ankush Mittal and Rajat Dua had explained the performance of the proposed system by using different classifier methods. In their work they had compared SVM, RF, KNN, SCENARIO 1, SCENARIO 2, SCENARIO 3(PA), SCENARIO 4 and observed that SCENARIO 4 got the highest accuracy whereas SVM got the least accuracy . [4]

Dr. S. Suguna, K. Hemanandhini, and Dr H. Salome Hemachitra conducted study on nail disorders and published a paper on the subject. The paper generally explains the basic structure of a human nail and the detection of nail abnormalities and in specific the research work is about the use of different

segmentation techniques and the determination of the best technique that suits the specified research. [5]

3. PROPOSED MODEL

3.1 DATA COLLECTION

A crucial factor in deciding how accurate the model is the training dataset. The better and stronger the dataset we have, the more accurate results we obtain [4].
The dataset comprises 480 fingernail images of 8 diseases collected from Kaggle datasets.

Table4: Dataset

Disease class	No. of images
Beau lines	32
Black lines	32
Clubbing	32
Mees lines	31
Normal	32
Onycholysis	32
Terry lines	32
White spots	32
Total	255

3.2 FLOW GRAPH OF PROPOSED MODEL

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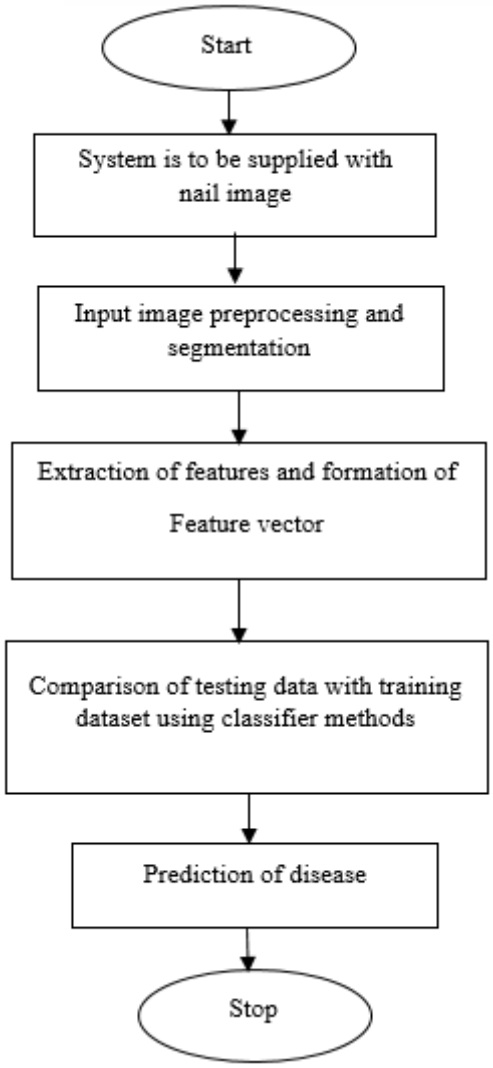

Fig 1: Flowchart

4. METHODOLOGY

4.1 IMAGE ACQUISITION:

The system should be supplied with finger or toe nail image. The image of the nail is shot with a camera, and then it is resized.

4.2 PREPROCESSING AND SEGMENTATION:

The input image is preprocessed [6],[8] through filtering [5], and thus the noise content present in it is removed. Then the preprocessed nail image is segmented [2], [14] to acquire the infected portion.

4.3 FEATURE EXTRACTION AND FEATURE VECTOR FORMATION:

The shape, color and texture features [1],[5] of both the input image and the images of the training dataset are extracted and thus, from the obtained values, the training feature vector and testing feature vector are formed.

- The color features include mean, standard deviation, skewness, kurtosis [1],[3].
- The shape features include area, perimeter, compactness, eccentricity [1].
- The texture features include entropy, contrast, homogeneity and correlation [1].

4.4 CLASSIFIER METHODS USED:

a) SUPPORT VECTOR MACHINE (SVM)

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Support Vector Machine (SVM) is one of the classifier method in machine learning which came into existence in the early 1990's. They became popular because of their success in handwritten digit recognition. Experimentally, it was proved that SVMs have low error rates. SVMs are now regarded as an important example of "kernel methods", one of the key areas in machine learning [10] – [12].
The support vector machine (SVM) is both a classifier and regressor technique. However, it is mainly used for classification problems in machine learning. The SVM regression works with continuous variables. The main moto of an SVM algorithm is to detect a hyperplane that distinctly classify the data points.
The technique identifies the points closest to the hyperplane from both classes and these points are referred to as support vectors. All the data points are called vector(points) in the space.

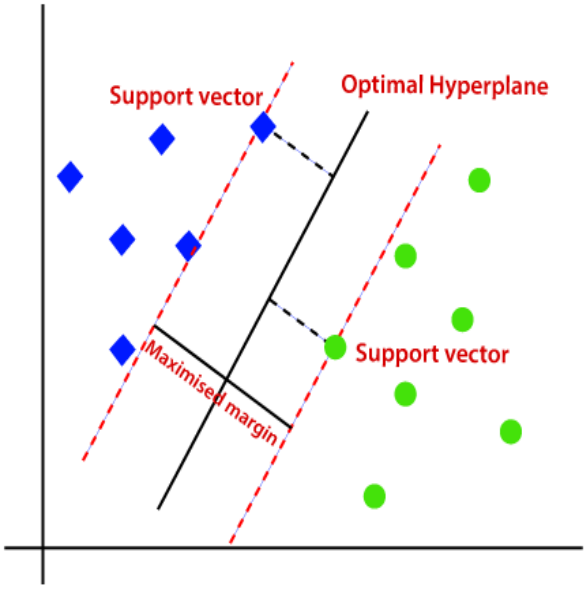

Fig 2: Multiclass SVM

The line that differentiates between classes is called a hyperplane. The SVM technique is primarily designed for binary classification problems. However, it can also be extended to handle multiclass classification by breaking down the problem into a series of binary classification sub-problems. In this approach, the data is separated into multiple groups, with each group representing a unique binary classification problem.

b) K – NEAREST NEIGHBOR (KNN)

K-nearest neighbours (KNN), is one of the Instance-based learning method. The instance-based learning is a supervised learning technique which is used for classification and regression tasks. The instance-based learning performs operation after comparing the current instances (examples) with the previous instances. It is also called as "Lazy Learning" or "Memory-based Learning". Because, in this technique the next step is taken only after the next instance is arrived [9], [11], [12].
The K-Nearest Neighbour algorithm is a most widely used supervised learning algorithm. It can be used for both classification and regression but mostly it is used for classification task only.

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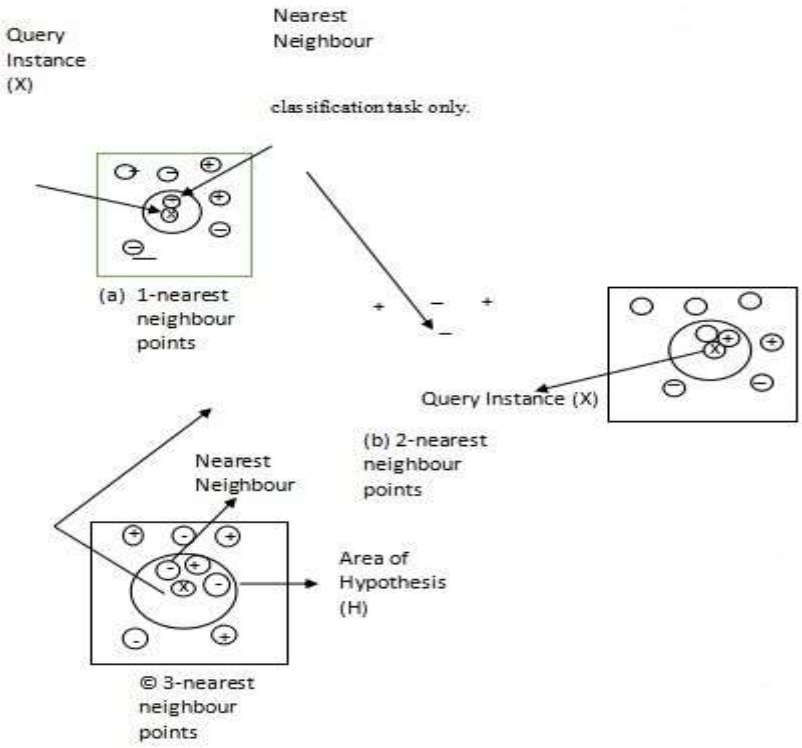

Fig 3: K-Nearest Neighbours data points of query instance(x)

5.RESULTS AND DISCUSSION

The results obtained in each step of processing the image are given as follows:

i. **INPUT IMAGE:**

The RGB picture of the nail serves as the system's input. It is provided below

Fig 4: Input nail image

ii. **PREPROCESSED AND SEGMENTED IMAGE:**

The image after preprocessing i.e.,
The removal of noise is given below

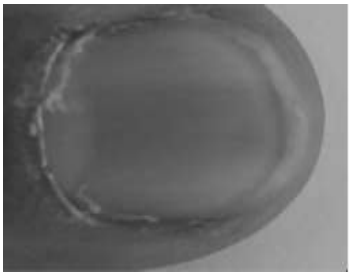

Fig 5: Preprocessed image

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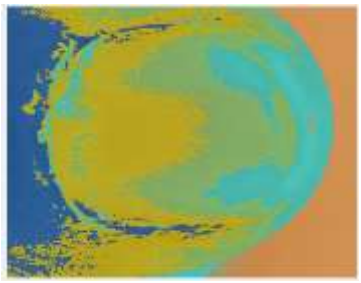

Fig 6: Segmented image

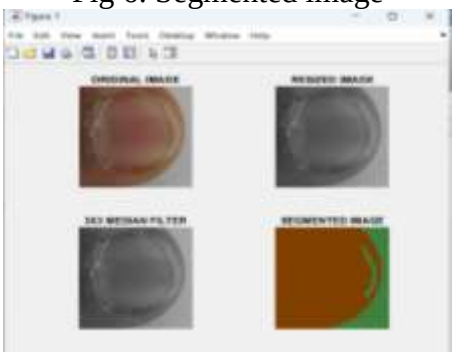

Fig 7: Mixed Plot

iii) **FEATURE EXTRACTION**:

The process of extracting the color, texture, and form features is referred to as feature extraction. The obtained output upon feature extraction is given as follows:

Fig 8: Colour Features

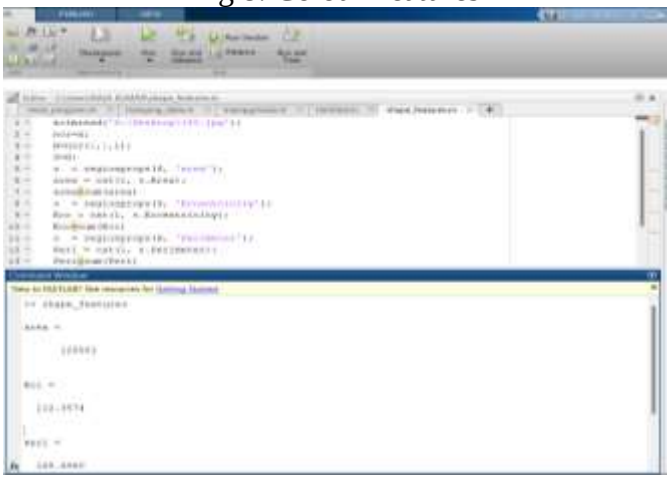

Fig 9: Shape Features

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ISSN: 0970-2555
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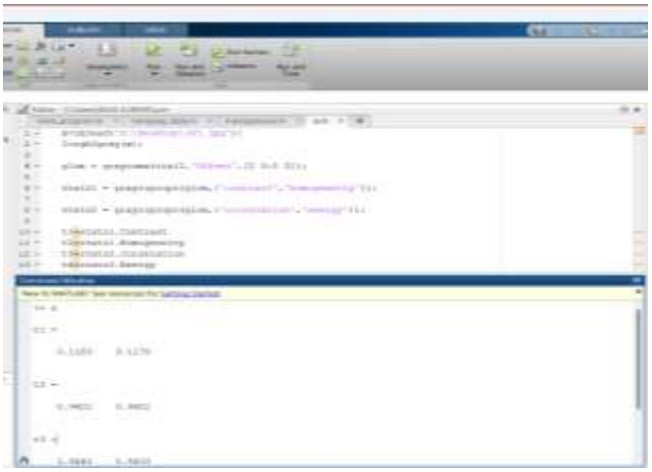

Fig 10: Texture Features

iv) PREDICTION OF DISEASE:

Finally, we may forecast the illness type after extracting the input image's feature vector and comparing it to the dataset's feature vector using the suitable classifier approach.

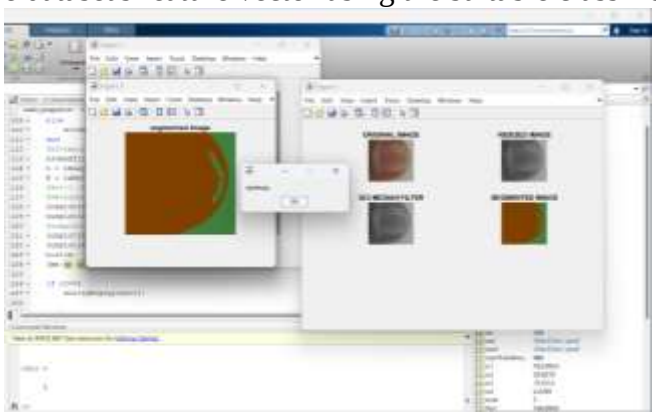

Fig 11: Output from SVM

Fig 12: Output from KNN

PERFORMANCE ANALYSIS

a) Support Vector Machine (SVM)

Table5: Performance analysis of the system using SVM [4]

S.No.	Disease	Accuracy (in %)
1	Beau lines	81.96

2	Black lines	83.92
3	Clubbing	87.05
4	Mees lines	83.92
5	Normal	83.53
6	Onycholysis	85.88
7	Terry nails	81.18
8	White spots	83.14
	Average (%)	83.82

b) K NEAREST NEIGHBOR (KNN)

Table6: Performance analysis of the system using KNN [4]

S.No.	**Disease**	**Accuracy (in %)**
1	Beau lines	98.82
2	Black lines	97.25
3	Clubbing	97.25
4	Mees lines	96.47
5	Normal	94.90
6	Onycholysis	98.03
7	Terry nails	94.11
8	White spots	97.64
	Average (%)	96.81

6.CONCLUSION

On using both the SVM and KNN classifier methods, it was found that the KNN algorithm's classification accuracy, which is 96.81%, is higher than the SVM algorithm's classification accuracy, which is 83.82%. As a result, KNN classifier method is better suited for early disease detection. So the proposed model is best suited for early stage disease diagnosis through the analysis of human nails which gives accurate results that are both economical as well as consumes less time.

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