

EARLY-STAGE DISEASE PREDICTION FROM HUMAN NAILS USING IMAGE PROCESSING

Submitted in partial fulfillment of the requirements for the award of Bachelor of
Technology degree in Bio-Medical Engineering

by

N.Steffy Reena (39240038)

B.Sheeba Sri (39240036)

G.Geethanjali (39240017)



DEPARTMENT OF BIOMEDICAL ENGINEERING

SCHOOL OF BIOMEDICAL ENGINEERING

SATHYABAMA

**INSTITUTE OF SCIENCE AND TECHNOLOGY
(DEEMED TO BE UNIVERSITY)**

**Accredited with Grade "A" by NAAC
JEPPIAAR NAGAR, RAJIV GANDHI SALAI, CHENNAI – 600 118**

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BONAFIDE CERTIFICATE

This is to certify that this interdisciplinary Project Report is the bonafide work of **N.Steffy Reena (39240038), B.Sheeba Sri (39240036), G.Geethanjali (39240017)** who carried out the Interdisciplinary project entitled "**EARLY STAGE DISEASE PREDICTION FROM HUMAN NAILS USING IMAGE PROCESSING**" under my / our supervision from **Jan 2022 to May 2022**

Internal Guide - **Ms.SINDU DIVAKARAN**

Head of the Department - **Dr.T.SUDHAKAR**

Submitted for Viva-voce Examination held on **30-04-2022**

Internal Examiner
Dr.S.Krishnakumar

External Examiner
Ms.Sindhu Divakaran

DECLARATION

We N. Steffy Reena (39240038), B.Sheeba sri(39240036), G.Geethanjali(39240017)

hereby declare that the Interdisciplinary Project Report entitled "EARLY-STAGE
DISEASE PREDICTION FROM HUMAN NAILS USING IMAGE PROCESSING"

done by me under the guidance of MS. SINDHU DIVAKARAN at Sathyabama institute of science and technology is submitted in partial fulfillment of the requirements for the award of a Bachelor of Technology degree in BIO-MEDICAL ENGINEERING.

DATE: 27-04-2022

PLACE: CHENNAI

SIGNATURE OF THE CANDIDATES

B. S. L. S. J.

N. Steffy Reena.

G. Geethanjali.

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I wish to express my thanks to all Teaching and Non-teaching staff members of the Department of Biomedical Engineering who were helpful in many ways for the completion of the Interdisciplinary project.

Abstract

Human's hand nail is analysed to identify many diseases at early stage of diagnosis. Study of person hand nail color helps in identification of particular disease in healthcare domain. The proposed system guides in such scenario to takeThe system will process an image of nail and extract features of nail which is used for disease diagnosis. Human nail consist of various features, out of which proposed system uses nail color changes for disease diagnosis. Here, first training set data is prepared using Weka tool from nail images of patients of specific diseases. A feature extracted from input nail image is compared with the training data set to get result. In this experiment we found that using color feature of nail image average 65% results are correctly matched with training set data during three tests conducted.

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CHAPTER - 1

INTRODUCTION

In healthcare domain many diseases can be predicted by observing color of human nails. Doctors observe nails of patient to get assistance in disease identification. Usually, pink nails indicate healthy humans. The need of system to analyze nails for disease prediction is because human eye is having subjectivity about colors, having limitation in resolution and small amount of color change in few pixels on nail would not be highlighted to human eyes which may lead to wrong result whereas computer recognizes small color changes on nail.

The proposed system will extract color feature of human nail image for disease prediction. The system is focusing on image recognition on the basis of human nail color analysis. Many diseases could be identified by analyzing nails of human hands.

In this system, a human nail image is captured using camera. Captured image is uploaded to our system and the region of interest from nail area is selected from uploaded image manually. The selected area is then processed further for extracting features of nail such as color of nail. This color feature of nail is matched using simple matcher algorithm for disease prediction. In this way, the system is useful in prediction of diseases in their initial stages. In literature study we mentioned some of the diseases with its related color change in nails.

CHAPTER - 2

LITERATURE SURVEY

AUTHOR NAME	YEAR OF PUBLICATION	TITLE	ABSTRACT
R.Sharine, J.Sharon, & Dr.G.S. UdhayaKumar	April 2021	Early-Stage disease diagnosis using human nail in image processing.	The proposed system guides in such scenario to take decision in disease diagnosis. The input to the proposed system is person nail image. The system will process an image of nail and extract features of nail and extract features of nail which is used for disease diagnosis.
Ms.Mali Supriya Bhupal, Ms.Kore Reshma Ananda, Ms.Patil Poonam Bhinrao, Ms.Mujawar Saniya Yunus, & Mr.A.A.Salunkhe.	February 2018	Disease Diagnosis System by human nail Image Processing.	The system will process an image of nail and extract feature nail which is used for disease diagnosis. Here, the first training data is prepared using MATLAB from nail image of patient of specific disease. In this project we found that color feature of nail image is correctly matched with training set data.

AUTHOR NAME	YEAR OF PUBLICATION	TITLE	ABSTRACT
Dr.Suguna, K.Hemanandhini, Dr.H.Salome Hemachitra	November 2020	Detection of Nail peculiarities using Nail Image processing techniques.	The diseased nail image recognition system is established in this research context using two important phases that include the enhanced nail image identification techniques for extraction of morphological features of the defected nail with disease varieties.
Trupti S.Indi, Yogesh A.Gunge	July 2016	Early-Stage disease diagnosis system using human nail image processing.	System analyzes the human nail and gives probable disease for person including healthy case. Here, for disease prediction nail color value used as a nail feature.
Priya Maniyan, B.L.Sivakumar	June 2018	Early disease detection through nail image processing based on Ensemble of KNN classifier and Image features.	The ability to detect various diseases in their early stages is very useful to work for society. Through the proposed system NIPS-K which is based on Digital Image Processing, Nail Color, Shape, Texture analysis, and KNN classifier has been designed and it helps in recognizing various diseases.

2.1 A system for nail color analysis in healthcare:

It is focused on the system of image recognition on the basis of color analysis. In healthcare domain, study of human nail color is very important. Many diseases could be identified by analyzing nails of hands. Human eye is having limitation in resolution as well as subjectivity in color analysis. The proposed system is based on the algorithm which automatically extracts only nails' area from scanned back side of palm. These selected pixels are processed for further analysis. The system is computer based, so small discontinuities in color values are also observed, and we can detect color changes in the initial stage of disease. In this way, system is quite useful in prediction of diseases in their initial stages.

2.2 Computer-Vision-Based Identification of Nail's Surface Shape:

The principle and application of a computer-vision-based method of identifying the surface shape of human' s nail. The method first acquires two images of a human nail respectively with the same light source but different light angles, obtains from the two images the information on the nail and calculates the surface shape of the nail in the end.

There are different ways of disease diagnosis such as through various tests (blood test.etc) and symptoms available on various parts of body guides toward disease diagnosis patient should wait for the report to analyze the problem.

CHAPTER – 3

Proposed System

The proposed processes the image of the affected nail by the available pre-processing techniques. Input image is pre-processed to reduce the noises and for enhancing the input image for processing. After the stage of pre-processing averaging of RGB values are done to save the space and to reduce the size for making the processing easier. Then the input image is sent to the trained model where it is get compared with predefined available features of affected nail. Based on the analysis of input image over the trained model the respective disease can be identified for that particular disease.

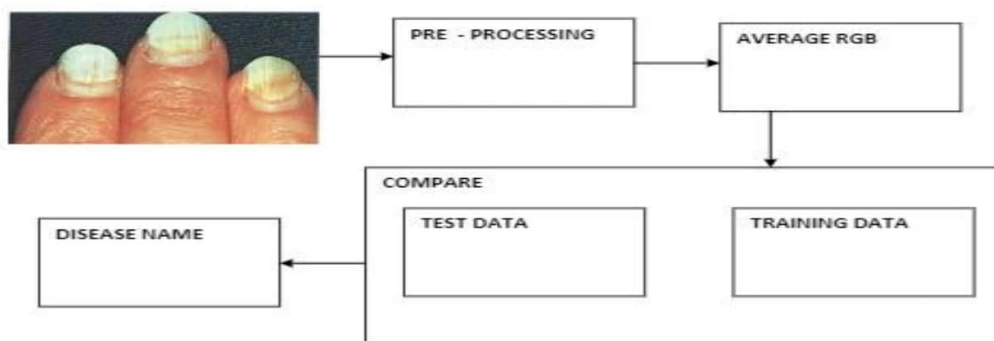


Fig 3.1 block diagram

3.1 DIGITAL IMAGE PROCESSING:

The identification of objects in an image would probably start with image processing techniques such as noise removal, followed by (low-level) feature extraction to locate lines, regions and possibly areas with certain textures.

The clever bit is to interpret collections of these shapes as single objects, e.g. cars on a road, boxes on a conveyor belt or cancerous cells on a microscope slide. One reason this is an AI problem is that an object can appear very different when viewed from different angles or under different lighting. Another problem is deciding what features belong to what object and which are background or shadows etc. The human visual system performs these tasks mostly unconsciously but a computer requires skillful programming and lots of processing power to approach human performance. Manipulating data in the form of an image through several possible techniques. An image is usually interpreted as a two-dimensional array of brightness

values, and is most familiarly represented by such patterns as those of a photographic print, slide, television screen, or movie screen. An image can be processed optically or digitally with a computer.

3.2 CLASSIFICATION OF IMAGES:

There are 3 types of images used in Digital Image Processing. They are

- Binary Image
- Gray Scale Image
- Color Image

3.2.1 BINARY IMAGE:

- A binary image is a digital image that has only two possible values for each pixel.
- Typically, the two colors used for a binary image are black and white though any two colors can be used.
- The color used for the object(s) in the image is the foreground color while the rest of the image is the background color.
- Binary images are also called bi-level or two-level. This means that each pixel is stored as a single bit (0 or 1).

3.2.2 GRAYSCALE IMAGE:

- A grayscale image is a digital image in which the value of each pixel is a single sample, that is, it carries only intensity information.
- Images of this sort, also known as black-and-white, are composed exclusively of shades of gray (0-255), varying from black (0) at the weakest intensity to white (255) at the strongest.

3.2.3 COLOUR IMAGE:

- A (digital) color image is a digital image that includes color information for each pixel.
- Each pixel has a particular value which determines its appearing color. This value is qualified by three numbers giving the decomposition of the color in the three primary colors Red, Green and Blue.

CHAPTER – 4

EXPERIMENTAL OR MATERIALS AND METHODS; ALGORITHMS USED

An image is defined as an array of matrix of square pixels arranged in rows and columns. Image processing is a technique in which image is converted into digital form and performs some operations on that image to get helpful information. Digital image processing has many applications such as medical image processing, signature recognition, face recognition, military applications, iris recognition etc.

4.1 MODULES:

- Image Acquisition
- Preprocessing
- Segmentation
- Feature extraction.
- Comparison with database.

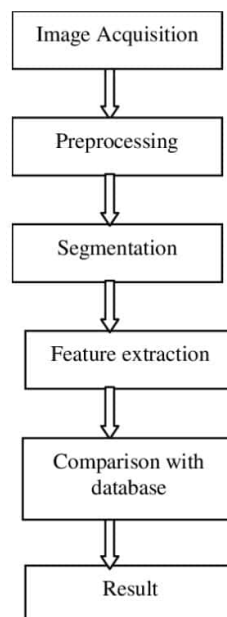


Fig 4.1 algorithm

4.1.1 Image Acquisition:

This is the first step in image processing. Commonly this involves pre-processing such as scaling etc. The image can be taken as an input through scanner or digital camera. High resolution images help in accurate image analysis.

4.1.2 Pre-processing:

- Image pre-processing is the term for operations on images at the lowest level of abstraction. preparing the data for further analysis.it have the following techniques
 1. Resize
 2. Color convention
 3. Filtering
- These operations do not increase image information content but they decrease it if entropy is an information measure.
- The aim of pre-processing is an improvement of the image data that suppresses undesired distortions or enhances some image features relevant for further processing and analysis task.

4.1.3 Average RGB:

- RGB colors is to add up all the red, green, and blue values, and divide each by the number of pixels to get the components of the final color.
- There's a better way! Instead of summing up the components of the RGB color, sum their squares instead.

4.1.4 Segmentation:

In this step image is divided into regions with extracting features.

4.1.5 Feature extraction:

This step constitutes finding and extracting the features that can be used to determine the meaning of image. Features of an image are various attribute or characteristics of image field. Natural and artificial are the types of features. Visual appearance of an image followed in natural while artificial features is result from some manipulations of an image. Natural features include gray scale textural region, brightness of a region of pixel, edge outline of object etc. and artificial features include image amplitude histograms and special frequency spectra.

4.1.5 Comparison with database:

The output generated from the phase of feature extraction is compared with the database.

Data Set Collection:

- In this we collected images of nails of data set. From the online data set. And we should give training. And create proper data set from the online data set.
- We can divide the data set into test and train data from the whole data set.



Fig 4.2 nail image 01



Fig4.3 nail image 02

4.1.6 Result:

By considering the result in the previous phase disease detection is made. Many ways are available to detect the disease in the human body such as pathological test, observation of eyes, tongue and nails, etc. In this paper images of nails are considered to identify diseases. Nails are the envelope of a fingertip and are the last to receive oxygen because they are farthest from the heart. Due to this, they are often the first to show signs of disease. The structure of the fingernail is shown below:



Fig 4.4 the structure of fingernail

4.1.7 Nail Texture and marking analysis:

<i>Nail Texture and marking</i>	<i>Disease symptoms</i>
Vertical Ridges and Split Nails	Vitamin A deficiency, nervous problems, poor digestion/absorption in the small intestine, Adrenal gland problems, arthritic tendencies, asthma, broken heart, bronchitis, calcium deficiency, chronic fatigue, chronic inflammation, chronic stress, depression, emotional trauma, excretory system conditions, hyperactivity or overexertion, iron deficiency, kidney problems, laryngitis, , chemicals from food, dieting, protein deficiency, respiratory problems, unhappiness, yeast and other fungi, lupus, chemo or radiation side effect.
Horizontal Dips	Less essential nutrients, Poor circulation, picking at the nail bed, heart disease, stress, trauma.
Red Bands at the Tip	Allergies, liver overload, inflammation of the gastrointestinal tract
Yellow Tips	Liver problems, melanoma, poor digestion
White Spots	Vitamin-A deficiency, Kidney or hormone imbalances, zinc deficiency, calcium deficiency
Brittle or cracked nails	Calcium deficiency, weak function of kidney, iron deficiency, malnutrition, protein deficiency, thyroid problems, Vitamin A and D deficiency
Soft and Thin nails	Deficiency of protein and Vitamin-C, Adrenal Gland problems, can be associated with leg cramps, poor nutrition

CHAPTER – 5

SOFTWARE REQUIREMENT

- Python Idle
- OpenCV

5.1 PYTHON:

- Python is an object-oriented, high-level language, interpreted, dynamic and multipurpose programming language.
- Python is easy to learn yet powerful and versatile scripting language which makes it attractive for Application Development.
- Python's syntax and dynamic typing with its interpreted nature, make it an ideal language for scripting and rapid application development in many areas.
- Python supports multiple programming pattern, including object-oriented programming, imperative and functional programming or procedural styles.

Python's statements include:

- The assignment statement, using a single equals sign =
- The if statement, which conditionally executes a block of code, along with else and elif (a contraction of else-if)
- The for statement, which iterates over an iterable object, capturing each element to a local variable for use by the attached block
- The while statement, which executes a block of code as long as its condition is true
- The try statement, which allows exceptions raised in its attached code block to be caught and handled by except clauses; it also ensures that clean-up code in a finally block is always run regardless of how the block exits
- The raise statement, used to raise a specified exception or re-raise a caught exception
- The class statement, which executes a block of code and attaches its local namespace to a class, for use in object-oriented programming
- The def statement, which defines a function or method
- The with statement, which encloses a code block within a context manager (for example, acquiring a lock before it is run, then releasing the lock; or opening and closing a file), allowing resource-acquisition-is-initialization (RAII)-like behaviour and replacing a common try/finally idiom
- The break statement, which exits a loop

- The `continue` statement, which skips the current iteration and continues with the next
- The `del` statement, which removes a variable—deleting the reference from the name to the value, and producing an error if the variable is referred to before it is redefined
- The `pass` statement, serving as a NOP, syntactically needed to create an empty code block
- The `assert` statement, used in debugging to check for conditions that should apply
- The `yield` statement, which returns a value from a generator function (and also an operator); used to implement coroutines
- The `return` statement, used to return a value from a function
- The `import` statement, used to import modules whose functions or variables can be used in the current program

5.2 OpenCV:

- “OpenCV was designed for computational efficiency and with a strong focus on real-time applications.
- Adopted all around the world, OpenCV has more than 47 thousand people of user community and estimated number of downloads exceeding 14 million.
- Usage ranges from interactive art, to mines inspection, stitching maps on the web or through advanced robotics.”

OpenCV's application areas include:

- 2D and 3D feature toolkits
- Ego motion estimation
- Facial recognition system
- Gesture recognition
- Human–computer interaction (HCI)
- Mobile robotics
- Motion understanding
- Object detection
- Segmentation and recognition
- Stereopsis stereo vision: depth perception from 2 cameras
- Structure from motion (SFM)
- Motion tracking
- Augmented reality

CHAPTER - 6

RESULTS AND PERFORMANCE ANALYSIS

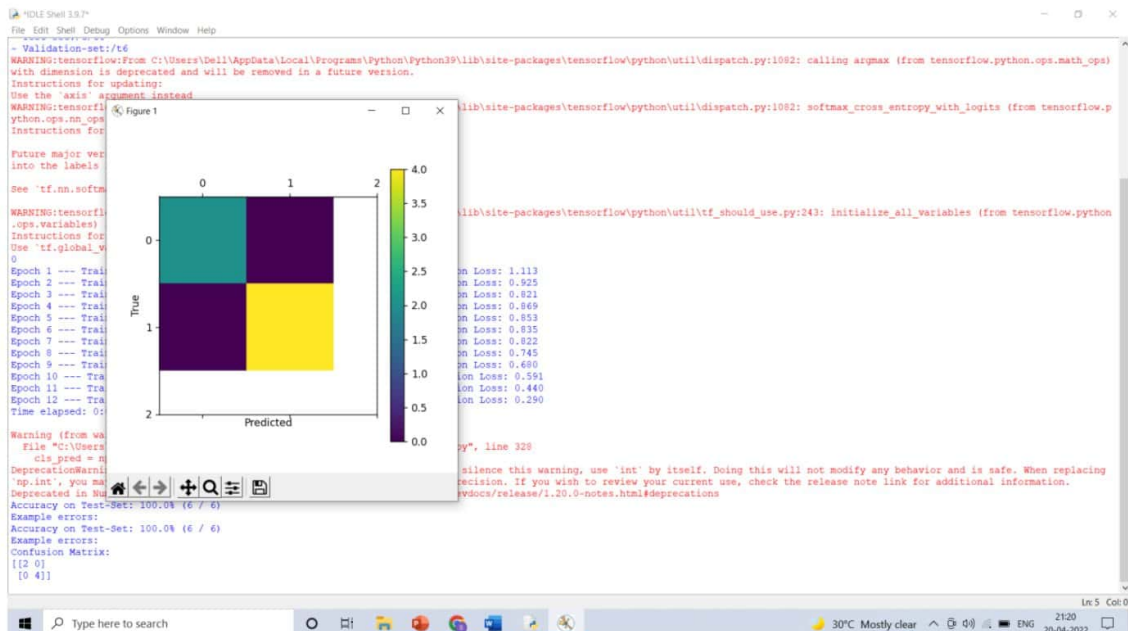


Fig 6.1 result 01

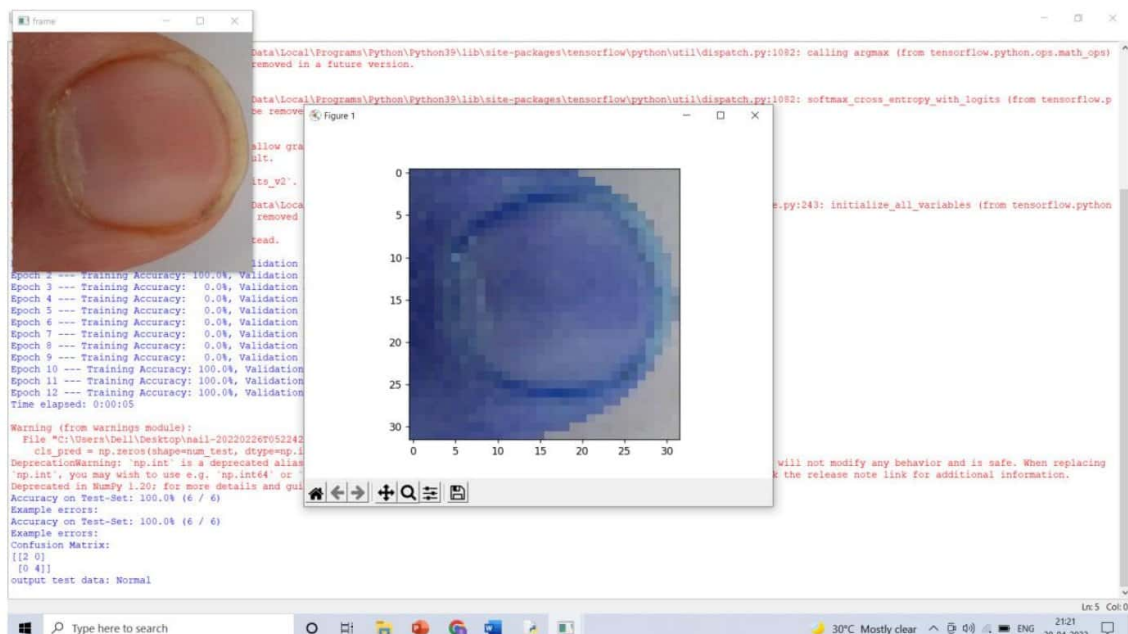


Fig 6.2 result 02

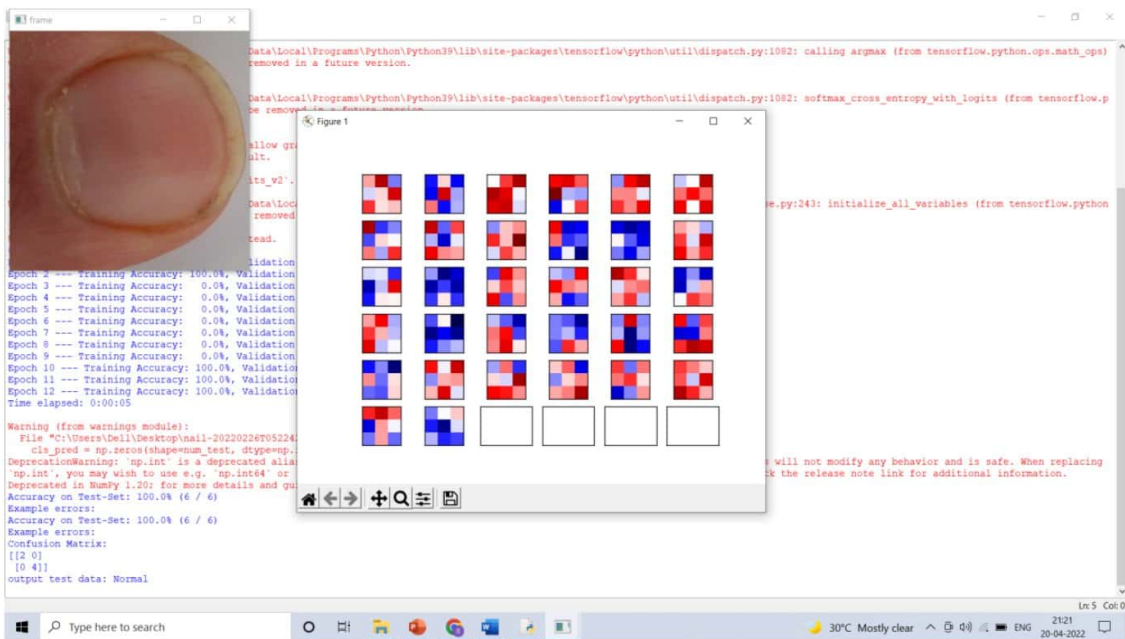


Fig 6.3 result 03

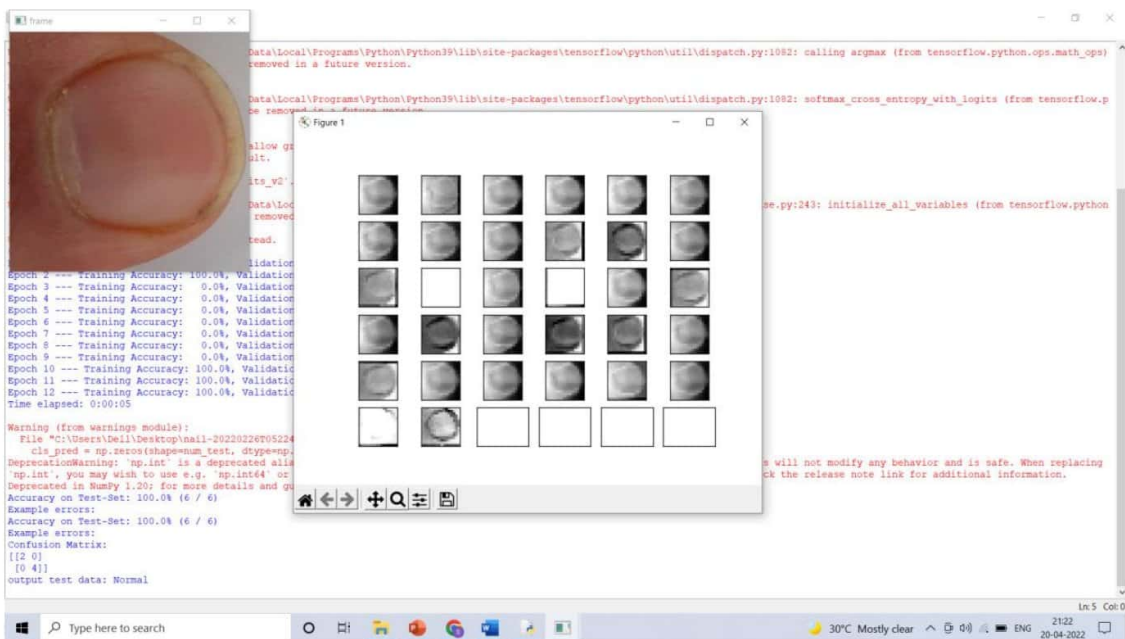


Fig 6.4 result 04

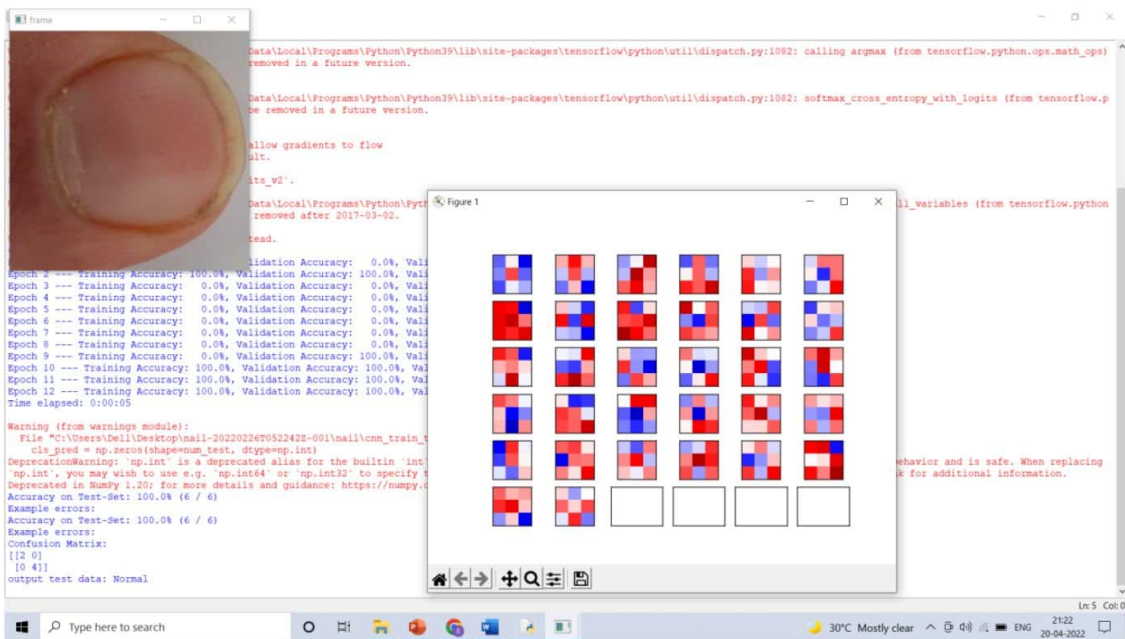


Fig 6.5 result 05

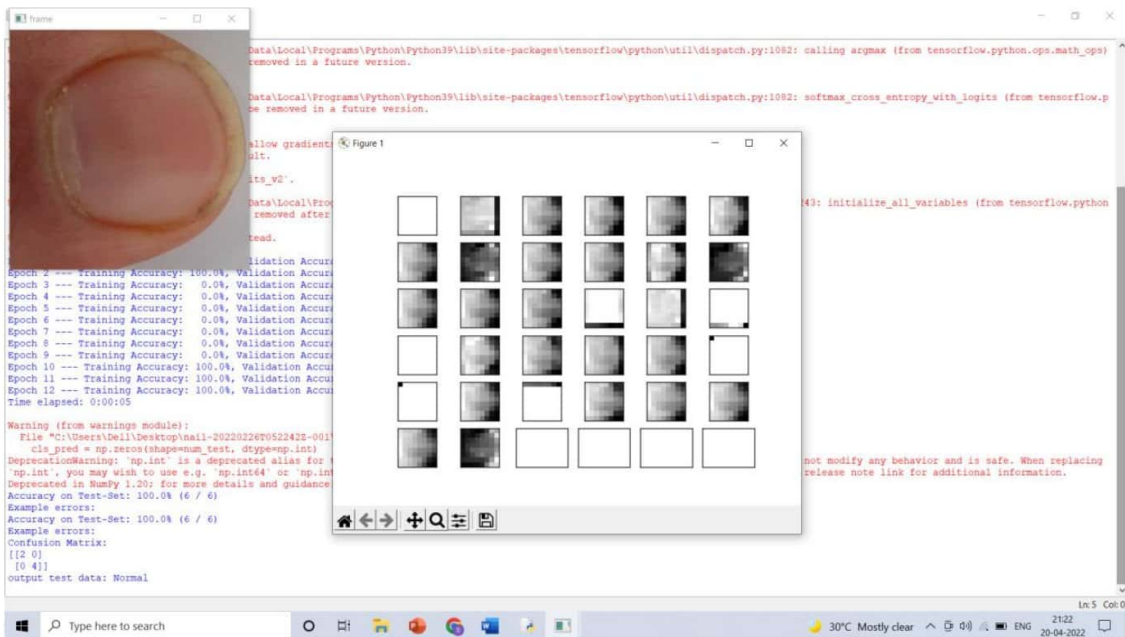
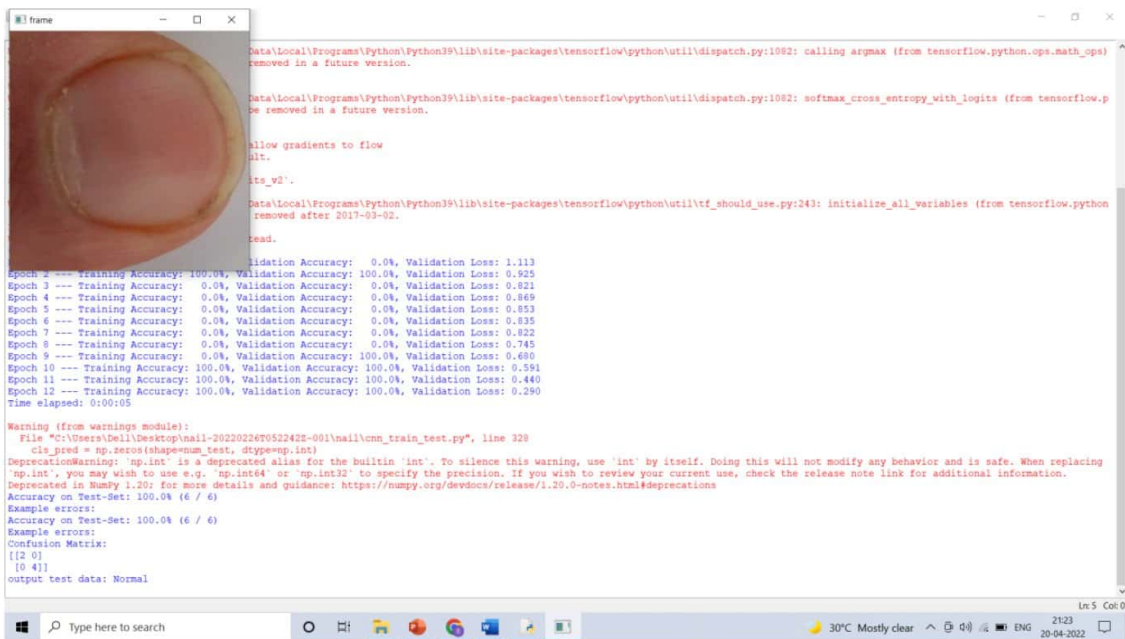


Fig 6.6 result 06



```

Data/Local/Programs/Python/Python39/lib/site-packages/tensorflow/python/util/dispatch.py:1082: calling argmax (from tensorflow.python.ops.math_ops)
removed in a future version.

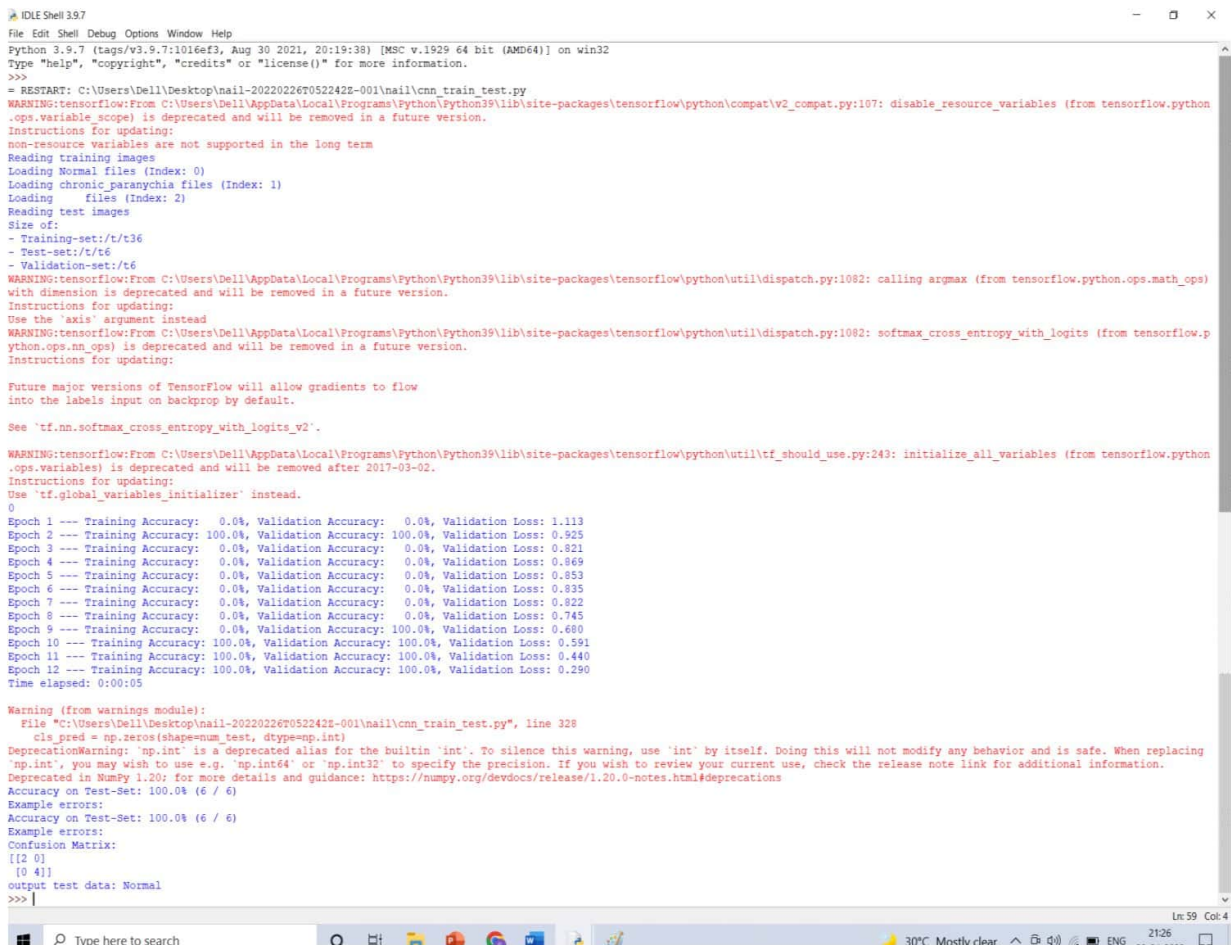
Data/Local/Programs/Python/Python39/lib/site-packages/tensorflow/python/util/dispatch.py:1082: softmax_cross_entropy_with_logits (from tensorflow.p
be removed in a future version.

allow gradients to flow
plt.
its_v2'.
Data/Local/Programs/Python/Python39/lib/site-packages/tensorflow/python/util/tf_should_use.py:243: initialize_all_variables (from tensorflow.python
removed after 2017-03-02.
read.
Validation Accuracy: 0.0%, Validation Loss: 1.113
Epoch 2 --- Training Accuracy: 100.0%, Validation Accuracy: 100.0%, Validation Loss: 0.925
Epoch 3 --- Training Accuracy: 0.0%, Validation Accuracy: 0.0%, Validation Loss: 0.821
Epoch 4 --- Training Accuracy: 0.0%, Validation Accuracy: 0.0%, Validation Loss: 0.869
Epoch 5 --- Training Accuracy: 0.0%, Validation Accuracy: 0.0%, Validation Loss: 0.853
Epoch 6 --- Training Accuracy: 0.0%, Validation Accuracy: 0.0%, Validation Loss: 0.835
Epoch 7 --- Training Accuracy: 0.0%, Validation Accuracy: 0.0%, Validation Loss: 0.822
Epoch 8 --- Training Accuracy: 0.0%, Validation Accuracy: 0.0%, Validation Loss: 0.745
Epoch 9 --- Training Accuracy: 0.0%, Validation Accuracy: 100.0%, Validation Loss: 0.680
Epoch 10 --- Training Accuracy: 100.0%, Validation Accuracy: 100.0%, Validation Loss: 0.591
Epoch 11 --- Training Accuracy: 100.0%, Validation Accuracy: 100.0%, Validation Loss: 0.440
Epoch 12 --- Training Accuracy: 100.0%, Validation Accuracy: 100.0%, Validation Loss: 0.290
Time elapsed: 0:00:05

Warning (from warnings module):
  File "C:\Users\Dell\Desktop\nail-20220226T052242Z-001\nail\cnn_train_test.py", line 328
    cls_pred = np.zeros(shape=num_test, dtype=np.int)
DeprecationWarning: 'np.int' is a deprecated alias for the builtin 'int'. To silence this warning, use 'int' by itself. Doing this will not modify any behavior and is safe. When replacing
'np.int', you may wish to use e.g. 'np.int64' or 'np.int32' to specify the precision. If you wish to review your current use, check the release note link for additional information.
Deprecated in Numpy 1.20: for more details and guidance: https://numpy.org/devdocs/release/1.20.0-notes.html#deprecations
Accuracy on Test-Set: 100.0% (6 / 6)
Example errors:
Confusion Matrix:
[[2 0]
 [0 4]]
output test data: Normal

```

Fig 6.7 result 07



```

IDLE Shell 3.9.7
File Edit Shell Debug Options Window Help
Python 3.9.7 (tags/v3.9.7:1016ef3, Aug 30 2021, 20:19:38) [MSC v.1929 64 bit (AMD64)] on win32
Type "help", "copyright", "credits" or "license()" for more information.
>>>
= RESTART: C:\Users\Dell\Desktop\nail-20220226T052242Z-001\nail\cnn_train_test.py
WARNING:tensorflow:From C:\Users\Dell\AppData\Local\Programs\Python\Python39\lib\site-packages\tensorflow\python\compat\v2_compat.py:107: disable_resource_variables (from tensorflow.python
.ops.variable_scope) is deprecated and will be removed in a future version.
Instructions for updating:
non-resource variables are not supported in the long term
Reading training images
Loading Normal files (Index: 0)
Loading chronic_paronychia files (Index: 1)
Loading files (Index: 2)
Reading test images
Size of:
- Training-set: t/t36
- Test-set: t/t6
- Validation-set: t/t6
WARNING:tensorflow:From C:\Users\Dell\AppData\Local\Programs\Python\Python39\lib\site-packages\tensorflow\python/util/dispatch.py:1082: calling argmax (from tensorflow.python.ops.math_ops)
with dimension is deprecated and will be removed in a future version.
Instructions for updating:
Use the 'axis' argument instead
WARNING:tensorflow:From C:\Users\Dell\AppData\Local\Programs\Python\Python39\lib\site-packages\tensorflow\python/util/dispatch.py:1082: softmax_cross_entropy_with_logits (from tensorflow.p
ython.ops.nn_ops) is deprecated and will be removed in a future version.
Instructions for updating:
Future major versions of TensorFlow will allow gradients to flow
into the labels input on backprop by default.

See 'tf.nn.softmax_cross_entropy_with_logits_v2'.

WARNING:tensorflow:From C:\Users\Dell\AppData\Local\Programs\Python\Python39\lib\site-packages\tensorflow\python/util/tf_should_use.py:243: initialize_all_variables (from tensorflow.python
.ops.variables) is deprecated and will be removed after 2017-03-02.
Instructions for updating:
Use 'tf.global_variables_initializer' instead.
0
Epoch 1 --- Training Accuracy: 0.0%, Validation Accuracy: 0.0%, Validation Loss: 1.113
Epoch 2 --- Training Accuracy: 100.0%, Validation Accuracy: 100.0%, Validation Loss: 0.925
Epoch 3 --- Training Accuracy: 0.0%, Validation Accuracy: 0.0%, Validation Loss: 0.821
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DeprecationWarning: 'np.int' is a deprecated alias for the builtin 'int'. To silence this warning, use 'int' by itself. Doing this will not modify any behavior and is safe. When replacing
'np.int', you may wish to use e.g. 'np.int64' or 'np.int32' to specify the precision. If you wish to review your current use, check the release note link for additional information.
Deprecated in Numpy 1.20: for more details and guidance: https://numpy.org/devdocs/release/1.20.0-notes.html#deprecations
Accuracy on Test-Set: 100.0% (6 / 6)
Example errors:
Confusion Matrix:
[[2 0]
 [0 4]]
output test data: Normal
>>>

```

Fig 6.8 result 08

CHAPTER - 7

CONCLUSION

- In this way the system is useful in the prediction of diseases in their initial stages.
- This model gives a more accurate result than human vision because it overcomes the limitation of human eyes like subjectivity and resolution power.
- The diseases can be cured, when it is in the early stage itself.

Future Enhancement

- In future, Even a small change in the nail can be observed and the early stage diseases can be diagnosed.
- The diseases can be cured, when it is in the early stage itself.
- In further we can add the pattern of the nails for classifying diseases.
- Along with the feature we can also collect other symptoms observed in patients as an input to our system for disease prediction.

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