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A stand alone device for skin disease analysis using image processing techniques

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ABSTRACT

Skin disease is an abnormal condition of the skin. Skin plays an important role in protecting the body from harmful bacteria, fungal and parasitic infections. Hence the correct diagnosis of skin disease is crucial. Various factors causing skin diseases and affecting skin disorder pattern are genetics, occupation, nutrition, habits, etc. Geographical factors like season and climate also affect. In developing countries, overcrowding and poor hygiene are responsible for spreading of skin diseases. The pattern of skin diseases varies from country to country. Moreover, remote areas are severely affected.This paper proposes a skin disease detection method based on image processing techniques. This method is mobile based and hence very accessible even in remote areas and it is completely non-invasive to patient's skin. The patient provides an image of the infected area of the skin as an input to the prototype. Image processing techniques are performed on this image and the detected disease is displayed at the output. The proposed system is highly beneficial in rural areas where access to dermatologists is limited.

Keywords: DCT, DWT, SVD, Wavelet Packets Image Processing.

INTRODUCTION

Skin cancer, the most common human malignancy is primarily diagnosed visually, beginning with an initial clinical screening and followed potentially by dermoscopic analysis, a biopsy and histopathological examination. Automated classification of skin lesions using images is a challenging task owing to the fine-grained variability in the appearance of skin lesions.

The pattern of skin diseases varies from country to country. Moreover, remote areas are severely affected. The prevalence of skin diseases in a tertiary care center of Garhwali hills, North India was recorded in 2014 and it was found to vary from 6.3% to 11.2%. Of the total population, 16.7% were affected by acne, 3.4% by psoriasis, 3.4% by urticaria, 3.6% by melasma and 3.3% by vitiligo.

In this paper, image processing is used to detect skin diseases in humans. This paper describes the current methods employed for detecting skin diseases, proposes a digital method to detect skin diseases and states the benefits of this method. This paper also includes a detailed description of the transforms used to implement the proposed method. The transforms implemented are compared on accuracy parameter.

LITEARTURE SURVEY

WHO (World Health Organization) has emphasized the severity of skin diseases in India which accounts for 10 to 12 percent of India's population. There are only 6000 dermatologists present to cater to a population of 121 core people

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and most of these dermatologists are concentrated in the cities. Due to this, rural areas are lacking dermatologists.

The current practices used by dermatologists include biopsy, scrapings, diascopy, patch testing and prick Test which are invasive methods of detection. In patch testing and prick test, the allergen is directly applied to the infected area. The skin might take a long time even several days to react to the allergen.

There are also certain disadvantages of the current image processing techniques used for skin disease detection.

The main problem with the median filter is its high computational cost. Also, the software implementation of median filter does not provide accurate results. The issue with sharpening filter is that when a high pass mask is applied to the image, there are negative pixel values in the output image.

EXISTING METHOD

As can be seen from the two block diagrams, the existing system consists of two processes: Training and Testing. Training process analyses and performs image processing on the training database whereas the testing process analyses the input image provided by the patient. Before any analysis on the input image is done, image pre-processing is done so that all images are consistent in desired characteristics.

Resolution matching is done on the image so that they are all the same size (128x128). 128x128 is chosen so that the processing time generated.

since this is a object query recognition, application, the feature vector of the two process are compared and are classified by a matching algorithm. According to dermatologist the ten most common disease in india are eczema, psoriasis, acne, warts, vitiligo, tineacorporis, scabies, hives, rosacea and shingls. out of this, the six diseases are considered for creating the database are eczema, psoriasis, acne, warts, vitiligo, tineacorporis, scabies, hives, rosacea and shingls respectively.

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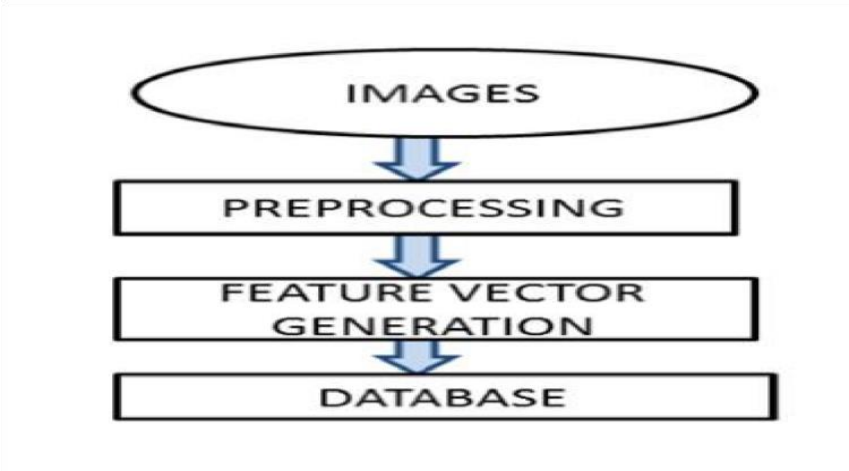


Fig.4.1. Block Diagram for Database Creation

In the training process, the training database first undergoes pre-processing and then its feature vectors are generated.

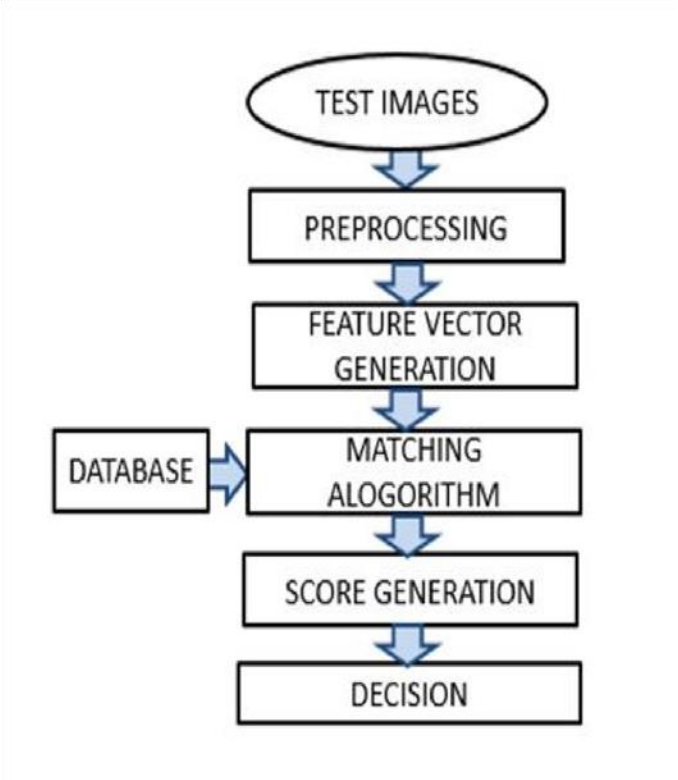


Fig.2 Block Diagram for Testing.

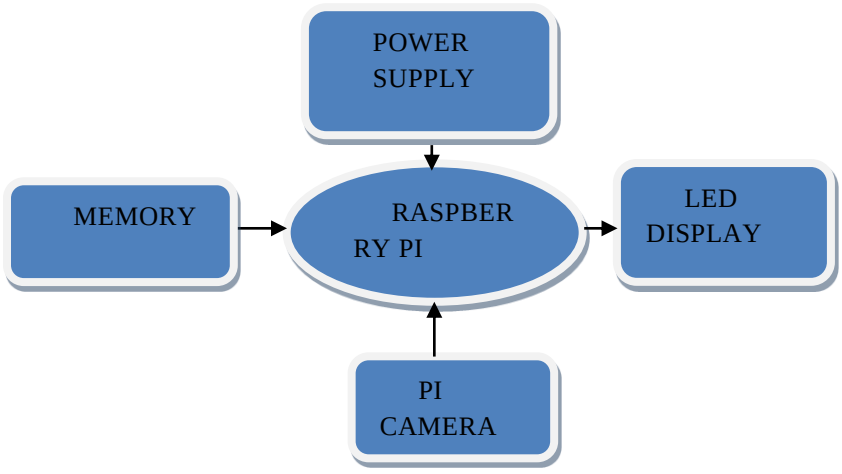
The testing process consists of an image provided by the patient who undergoes preprocessing and its feature vectors are generated. Since this is an object query recognition application, the feature vectors of the two processes are compared and are classified by a matching algorithm.

PROPOSED METHOD

The proposed solution in this paper is a prototype with database skin diseases, using which a patient can self-diagnose and get some prior knowledge of their skin disease before consulting a dermatologist.

The diseases were first detected using DCT then with DWT, SVD and wavelet packets. The higher accuracy is achieved by combing these four techniques. Hence highest accuracy of correct disease detection is obtained for combination of four transforms. In the proposed method raspberry is used in which python coding were implemented. The database is created which is called as training phase and image captured undergoes the process called testing phase. In this two phases image undergoes preprocessing and features vector generation. This two phase are matched using matching algorithm which uses template matching. Basing on its matching score generation will done and output will be displayed.

The proposed prototype provides a noninvasive method of skin disease detection where the patient provides a picture of the infected area as an input to the prototype and any further analysis is done on this input image. No pricking or prodding of the skin is required.



SKIN DISEASE IMAGES

According to dermatologists, the ten most common skin diseases in India are eczema, psoriasis, acne, etc.

ALGORITHMS

Discrete Cosine Transform

Discrete Cosine Transform (DCT) transforms a signal or an image from spatial domain to frequency domain. In case of images, it separates the image into parts (or spectral sub bands) of differing importance. In DCT transformed image, most of the visually significant information about the image is concentrated in the upper left corner of a 2D matrix i.e. few DCT coefficients. Hence, the feature vector of a DCT transformed image is generated by zigzag scanning.

Discrete Wavelet Transform

Wavelet transform has become a powerful statistical tool in signal processing, data compression, finger print verification, speech recognition and in finance as well, the properties of quick verification values. Wavelet transform is based on wavelets. Wavelets have zero mean and they exist for finite duration.

These wavelets hierarchically decompose functions in the frequency domain as well as preserve the spatial domain. Discrete Wavelet Transform (DWT) decomposes the signal into mutually orthogonal set of wavelets. It treats images as 2-D signals and hence 2-D DWT is applied to images. DWT provides frequency components information as well as indicates these components' time of occurrence. Separability property can be used to implement2D-DWT. 2D-DWT can be performed by implementing 1DDWTalong the rows followed by 1D-DWT along the columns [1-5].

SINGULAR VALUE DECOMPOSITION

Singular value decomposition (SVD) plays an important role in linear algebra. It is used for computing pseudorandom of a matrix, solving a set of homogenous linear equations, decomposing a matrix into weighted, ordered sum of separable matrices and in Kaabasuch algorithm to compute optimal rotation. In addition to these applications, it is also applied to signal processing, in numerical weather forecast to generate ensemble forecast and in recommender systems to predict
People's item ratings.

HARDWARE TOOLS USED

RASPBERRY PI

The Raspberry P**i** is a low cost, credit-card sized computer that plugs into a computer monitor or TV, and uses a standard keyboard and mouse.The Raspberry Pi 2 V1.2 was upgraded to a Broadcom BCM2837 So with a 1.2 GHz 64-bit quad-core ARM Cortex-A53 processor, the same So which is used on the Raspberry Pi 3, but it is under clocked to the same 900 MHz CPU clock speed as the V1.1. The **Raspberry Pi 3 Model A+** is the latest board for the minimalist Pi fan. Like the Raspberry Pi 3 Model B+, it boasts a 64-bit quad core processor running at 1.4 GHz, dual-band 2.4 GHz and 5 GHz wireless LAN, and Bluetooth 4.3/BLE. This low-cost Pi uses the same processor as the model 3 B+, but does away with the Ethernet jack and three of the USB ports. It's still compatible with all Pi operating systems and software, and has the exact same 40 pin GPIO connector and camera/display sockets, so any HATs or Pi Plates or other things that plug into the model B+ will work just the same. It also has the same HDMI, sound/composite connector, and micro USB connector for power [6-10].

Fig: 6.1 The Raspberry Pi 2B uses a 32-bit 900 MHz quad-core ARM Cortex-A7processor.

PI CAMERA

The Raspberry Pi camera module can be used to take high-definition video, as well as stills photographs. It's easy to use for beginners, but has plenty to offer advanced users if you're looking to expand your knowledge. There are lots of examples online of people using it for time-lapse, slow-motion and other video cleverness. You can also use the libraries we bundle with the camera to create effects.

If you're interested in the nitty-gritty, you'll want to know that the module has a five megapixel fixed-focus camera that supports 1080p30, 720p60 and VGA90 video modes, as well as stills capture. It attaches via a 15cm ribbon cable to the CSI port on the Raspberry Pi. It can be accessed through the MMAL and V4L APIs, and there are numerous third-party libraries built for it, including the Pi camera Python library.

The camera module is very popular in home security applications, and in wildlife camera traps. You can also use it to take snapshots.

CAMERA DETAILS

The camera consists of a small (25mm by 20mm by 9mm) circuit board, which connects to the Raspberry Pi's Camera Serial Interface (CSI) bus connector via a flexible ribbon cable. The camera's image sensor has a native resolution of five megapixels and has a fixed focus lens. The software for the camera supports full resolution still images up to 2592x1944 and video resolutions of 1080p30, 720p60 and 640x480p60/90.

Installation involves connecting the ribbon cable to the CSI connector on the Raspberry Pi board. This can be a little tricky, but if you watch the videos that demonstrate how it is done, you shouldn't have any trouble.

When you purchase the camera, you will receive a small camera board and cable. You'll want to devise some method of supporting the camera in order to use it. Some camera stands and Raspberry Pi cases are now available. You can also rig up something simple yourself if you wish. I attached mine to a case using a small piece of plastic and double-sided tape. Once the hardware is set up, you can move on to configuring the software.

LED DISPLAY

LED Display (light-emitting diode display) is a screen display technology that uses a panel of LEDs as the light source. Currently, a large number of electronic devices, both small and large, use LED display as a screen and as an interaction medium between the user and the system. Modern electronic devices such as mobile phones, TVs, tablets, computer monitors, laptops screens, etc., use a LED display to display their output.

SOFTWARE TOOL USED

Virtual Network Computing (Vnc)

Virtual network computing (VNC) is a type of remote-control software that makes it possible to control another computer over a network connection. Keystrokes and mouse clicks are transmitted from one computer to another, allowing technical support staff to manage a desktop, server, or other networked device without being in the same physical location.

VNC works on a client/server model: A VNC viewer (or client) is installed on the local computer and connects to the server component, which must be installed on the remote computer. The server transmits a duplicate of the remote computer's display screen to the viewer. It also interprets commands coming from the viewer and carries them out on the remote computer.

VNC is platform independent and is compatible with any operating system. Computers must be networked with TCP/IP and have open ports allowing traffic from the IP addresses of devices that may need to connect.

VNC was developed at AT&T Laboratories. The original VNC source code is open source under the GNU General Public License, and other variations are also available commercially [1-5].

OPERATION

The VNC server is the program on the machine that shares some screen (and may not be related to a physical display – the server can be "headless"), and allows the client to share control of it. The VNC client (or viewer) is the program that represents the screen data originating from the server, receives updates from it, and presumably controls it by informing the server of collected local input. The VNC protocol (RFB protocol) is very simple, based on transmitting one graphic primitive from server to client ("Put a rectangle of pixel data at the specified X,Y position") and event messages from client to server.

In the normal method of operation a viewer connects to a port on the server (default port: 5900). Alternatively (depending on the implementation) a browser can connect to the server (default port: 5800). And a server can connect to a viewer in "listening mode" on port 5500. One advantage of listening mode is that the server site does not have to configure its firewall to allow access on port 5900 (or 5800); the duty is on the viewer, which is useful if the server site has no computer expertise and the viewer user is more knowledgeable.

Although possible even on low bandwidth, using VNC over the Internet is facilitated if the

user has a broadband connection at both ends. However, it may require advanced NAT, firewall and router configuration, [11-14]. Such as port forwarding in order for the connection to go through. Users may establish communication through Virtual Private Network (VPN) technologies, including instant VPN applications (such as Log Mein Hamachi) to ease usage over the Internet, or as a LAN connection if VPN is used as a proxy, or through a VNC repeater (useful in presence of a NAT).

In addition, the display that is served by VNC is not necessarily the same display seen by a user on the server. On Unix/Linux computers that support multiple simultaneous X11 sessions, VNC may be set to serve a particular existing X11 session, or to start one of its own. It is also possible to run multiple VNC sessions from the same computer. On Microsoft Windows the VNC session served is always the current user session

Security

By default, RFB is not a secure protocol. While passwords are not sent in plain-text (as in telnet), cracking could prove successful if both the encryption key and encoded password are sniffed from a network. For this reason it is recommended that a password of at least 8 characters be used.

On the other hand, there is also an 8-character limit on some versions of VNC; if a password is sent exceeding 8 characters, the excess characters are removed and the truncated string is compared to the password.

Ultra VNC supports the use of an open-source encryption plugin which encrypts the entire VNC session including password authentication and data transfer. It also allows authentication to be performed based on NTLM and Active Directory user accounts. However, use of such encryption plugins make it incompatible with other VNC programs. Real VNC offers high-strength AES encryption as part of its commercial package, along with integration with Directory. Work spot released AES encryption patches for VNC.

An additional security concern for the use of VNC is to check whether the version used requires authorization from the remote computer owner before someone takes control of their device. This will avoid the situation where the owner of the computer accessed realizes there is someone in control of their device without previous notice.

Python (programming language)

Python is interpreted, high-level, general-purpose programming language. Created by Guido van Rossum and first released in 1991, Python has a design philosophy that emphasizes code readability, notably using significant whitespace. It provides constructs that enable clear programming on both small and large scales. Python features a dynamic type system and automatic memory management. It supports multiple programming paradigms, including object-oriented, imperative, functional and procedural, and has a large and comprehensive standard library.

Features

Python is a multi-paradigm programming language. Object-oriented rogramming and structured programming are fully supported, and many of its features support functional programming and aspect-oriented programming (including metaprogramming and metaobjects (magic methods). Many other paradigms are supported via extensions, including contract and logic programming.

Python uses dynamic typing, and a combination of reference counting and a cycle-detecting garbage collector for memory management. It also features dynamic name resolution (late binding), which binds method and variable names during program execution.

Applications

Python's large standard library, commonly cited as one of its greatest strengths, provides tools suited to many tasks. For Internet-facing applications, many standard formats and protocols such as MIME and HTTP are supported. It includes modules for creating graphical user interfaces, connecting to relational databases, generating pseudorandom numbers, arithmetic with arbitrary precision decimals, manipulating regular expressions, and unit testing.

CONCLUSION

The proposed system was implemented in raspberry pi .Skin Diseases being extremely

common must be detected at the earliest stage. The proposed system in this paper provides a feasible solution for skin disease detection providing up to 90% efficiency. The average training time for the three transforms and the parallel combination was found to be 2 seconds. And the average testing time was found to be 0.78 seconds.

This paper gives the description, result analysis and comparison of the efficiency between the three transforms DCT, DWT, SVD and wavelet packets.From implementation of the proposed system, we can conclude that the parallel combination of the four transforms provides the maximum and efficient detection. With the exclusion of SVD transform from the proposed system, it can be used as a basic prototype to pave way for faster diagnosis of skin diseases.

Future scope

The proposed prototype consists of three diseases. For commercial viability, the prototype must have a database that includes most skin diseases with pictures of all skin tones and types. This would lead to efficient and accurate detection.

Currently the prototype is an offline application. This prototype can be enhanced by connecting it online to provide immediate online access to dermatologist after initial detection. This further decreases the buffer time before the patient can reach the dermatologist. It can further be improved by providing precautions and immediate relief measures which the patient can follow so as to take care not to aggravate the disease.

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