

Hand held Dermal Scanner

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Abstract

Dermatology is a branch of science dealing with the studies of skin, hair, nails etc. Nowadays skin disorders are more severe and many new disorders are emerging rapidly. Many devices are used for diagnostic as well as therapeutic applications. In this paper, we proposed a diagnostic device which is used to capture the images of affected skin surface through raspberry pi controller module with camera and display the image in LCD screen. The SD card is connected with module is used to store images for further analysis. Real time recording of the images can be obtained, viewed and stored for further analysis. The acquired images can be sent to a dermatologist who is far away from the recording site. Hence Tele-dermatology is possible using this proposed device; both online as well as off line diagnosis can be empowered. The device is easily operated which does not require any specific technical skill to operate. Hence frequent self-examination for the patient with chronic skin disorder is possible with low cost. Thereby diagnosis, treatment, examination, continuous self-monitoring of skin conditions are possible using this proposed work.

1. Introduction

Skin is an organ of the integumentary system made up of multiple layers of ectodermic tissue in mammals. It guards the underlying muscles, bones, ligaments and internal organs. The skin links the interior of the body with the environment and plays a vital role in protecting the body against pathogenic organisms and excessive water loss. Insulation, temperature regulation, sensation, and the production of vitamin D are its other functions. Skin consists of the following layers as shown below in figure 1.

Any malfunction of the skin layers leads to skin disorders such as eczema, acne, alopecia, contact dermatitis, allergies etc. These diseases can be classified according to the area they present, effects, neurological factors [2] etc. Acne is a chronic skin condition characterized by areas of blackheads, whiteheads, pimples, greasy skin, scarring etc. Genetics is estimated to be the cause of 80% of cases. Inflammation of the skin Characterized by itchy, erythematous [3], vesicular, weeping and crusting patches is dermatitis. The skin disorders have to be diagnosed properly and treated in time.

Diagnostic equipment such as Video dermoscope, DL 100 dermoscope, digital dermatoscopes [4], etc. are existing tools in dermatology [5]. The existing tools are high cost and are available only in multi-speciality hospitals. Hence there is a need of low cost hand held dermatoscopic scanner which is affordable by remote hospitals.

This work proposes a standalone derma scanner consists of a microscopic lens fitted on the top of an image sensor. The image sensor captures the image and sends it to raspberry pi system for further processing. The raspberry pi is capable of receiving information, storing, displaying, processing etc. of the images. The image captured is displayed on the LCD display to diagnosis skin problems.

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2. Materials and Methods

The major components used in the proposed standalone derma scanner are Raspberry pi microcontroller system for receiving, storing, processing and retrieving of image data, Web camera (I ball c2.0) for capturing images with high resolution [6], microscopic lens of very small diameter that fits perfectly on the camera and LCD display to show the real time acquired images or stored images. Micro SD card is used to save the images for further analysis.

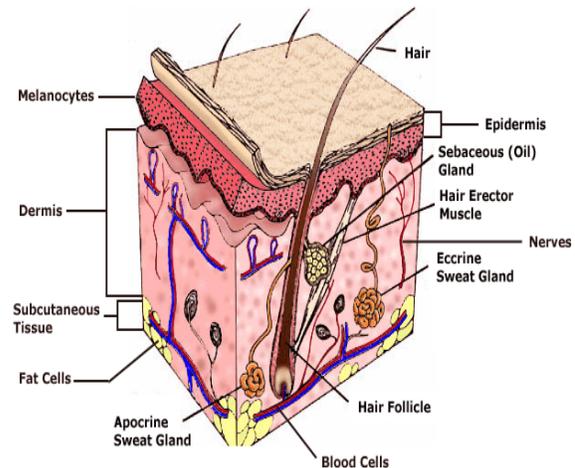


Fig.1 Layers of skin [1]

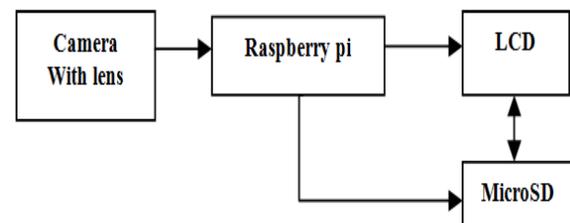


Fig.2. Block diagram of derma scanner

2.1. Camera (I Ball Face To Face C2.0)

The camera used in the derma scanner is shown in figure 2 which has many features such as 2 MP Interpolated resolution, 4X Digital zoom, Automatic low light boost, Image sensor with high quality 1/4 CMOS sensor, 5G wide angle lens, 6 Auto lighting LED for night vision, Video resolution - 1280 x 1024 pixel, Color depth - 24-bit true color, Interface - USB 2.0, White balance - auto, Auto exposure - auto, Zoom - 4X digital zoom and lens - Micro lens 1/4" diameter with 15X to 60X resolution. Instead of this web camera, Raspberry cameras can be interfaced with the raspberry module and the size of the setup can be significantly reduced.

2.2 Raspberry PI module:

The raspberry pi module implied in this imaging device is a B+ 512 MB, ARM processor based CPU operates in LINUX systems shown in figure 3. 700MHZ Broadcom is sufficient for image capturing and processing. Therefore the device will be faster. The Raspberry board contains 40 pin extended GPIO used for the camera, keyboard, LCD interfacing [8]. Micro SD slot is provided for storing and retrieving of the images. Four USB ports present for the external connections. Power supply can be given by two ways. Either a combination of batteries or by adapter plug in.



Fig.3. I-ball webcamera c2.0 [7]

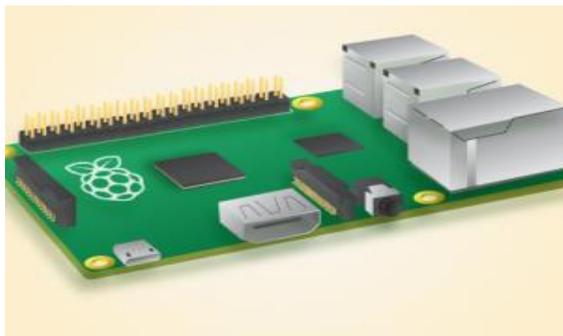


Fig.4. Raspberry Pi module [9]

2.3 LCD display:

A LCD monitor connected to the raspberry by means of RS232 cable is used as the LCD display. Raspberry LCD's are available in the market and if it gets attached with the pi module the module stands as a hand held derma scanner.

The image sensor contained within a web camera acts as the input to the system [10]. The image is captured using the camera and it is sent to the raspberry pi module through the USB cable. A program has been developed in order to receive the image and display it in the LCD screen and it is loaded into Micro SD card fitted at the back side of raspberry pi system. Four USB ports in the Raspberry pi is connected with a keyboard, mouse, camera and a HDMI port is connected to the LCD TFT display as shown in the figure 4.



Fig.5. interfacing of sensor with raspberry pi and LCD display

Once the power supply is turned on, the system boots and the camera starts clicking images. These micro photographs were displayed in LCD and saved in Micro SD card. The image captured is of microscopic in nature due to the presence of MICRO LENS fitted in front of the web camera. The microscopic lens is of 15 to 60 magnification makes the user comfortable to visualize the dermatological diseases, fungal infections, etc.

To get better image on the LCD screen focus the area by rotating the focal tube in camera. After the placing of lens in the correct position click the snapshot button on the image sensor. Position of the camera over the skin and light conditions required for the imaging are the two necessary parameters that have to be considered while working with this equipment.

3. Results and Discussions

Functionality of derma scanner is examined with a subject having rashes on his knees. The positioning of the camera over the skin should be in such a way that clear image is obtained on the LCD screen as shown in the figure 5.

After fixing the position and focus of the camera in the skin epidermis, the device starts to capture the image. The captured images are displayed on the LCD monitor connected with the raspberry pi microcontroller module. Pictures of the skin rashes as well as videos can be obtained and stored for future reference or sent to remote systems for diagnosis. Images of the skin rashes obtained on leg knee is shown in the figure 6. The severity of the rashes can be clearly seen by the use of this imaging device.



Fig.6. Positioning of the camera over the skin area



Fig.7. Images of the rashes obtained using the dermal scanner

This device can be made compact by using raspberry pi cameras, they are very small in size and hence the size of the device can be greatly reduced. In order to prognosis the skin disorder, embedded program for the disease classifier algorithm can be loaded into the microcontroller so that the acquired image can be further analysed to classify the type of skin disease. LCD is particularly meant for raspberry pi such that it can be fitted on the surface of the module. Hence the device will minimize its size leading to a hand held, standalone equipment. Lenses of different magnifications can be used in order to obtain better quality of images or a combination of lenses can be set up to examine deeper penetrations of the wounds, moles, scars etc.

This dermal scanner can be extended by using wireless transmission of the captured images via Zigbee, Bluetooth, etc.

By the use of wireless techniques the device can act as an effective tool for tele-dermatology. The images captured using this device can be processed using software such as MATLAB, SCILAB, etc. and a template can be developed. A classifier consisting of all these templates can be grouped together and an algorithm can be developed in such a way that prediction of skin disorders can be done at the earlier stages. This helps in efficient diagnosis of skin diseases and treatments can be initiated to save life. Continuous monitoring of wound healing, bed sores and other skin diseases can be empowered using this module. The use of miniaturized cameras with high resolution and interfacing raspberry pi with wireless sensors helps diagnosis of skin diseases to ease with full time monitoring and treatment.

Since storage is an advantage in this device, patient database software can be used and case histories can be saved, thereby helping the user. The advantages of this scanner are user friendly, such that there is no need of any skilled personnel requirement. Self-Examination of the diseases, monitoring stage by stage etc. can be done using this scanner. Since it is a standalone device it can be ported as needed.

4. Conclusions

A prototype of the diagnostic device was proposed which is used to capture the images of skin surface via camera interfaced with raspberry pi module and LCD screen have been designed and discussed in this paper. Real time recording of the images can be obtained and the images can be stored in the SD card for future reference. This prototype scanner is user friendly, such that there is no need of any skilled personnel to operate for capturing images. If miniaturized image sensors and raspberry LCD modules are interfaced, then the system will shrink and can act as a portable dermal scanning tool. Therefore prototype of a hand held, user friendly dermatological prognosis tool have been designed and explained in this paper.

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