



# Vein detection using infrared imaging system

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**Abstract** — Infrared vein detection is one of the newest biomedical techniques researched today. Basic principal behind this is, when IR light transmitted on palm it passes through tissue and veins absorb that light and the vein appears darker than surrounding tissue. This paper presents vein detection system using strong IR light source, webcam, Matlab based image processing algorithm. Using the Strong IR light source consisting of high intensity led and webcam camera we captured transillumination image of palm. Image processing algorithm is used to separate out the veins from palm.

**Key words** — infrared light, transillumination image processing algorithm, adaptive threshold.

## I. INTRODUCTION

A huge progress is made in the field of biomedical imaging technologies but they have generally resulted in high product costs. Another major concern is the portability factor. We have addressed these two major concerns in this device to a maximum extent. As compared to infrared imaging, significant amount of work is done in other areas of imaging techniques. The use of infrared imaging technique is a relatively less explored area but promises to deliver high-end results at low development costs. The major clinical problem faced by the physicians is difficulty in accessing veins for intra-venous drug delivery and other purposes. It is also noted that improper location of veins is a cause for delay in several medical treatments. It is relevant in case of paediatrics, obese, dark toned people and also in adult patients. Unnecessary puncturing of veins is done by the physicians because the visibility of veins is not clear. Therefore this causes various problems to the patients and especially in children and aged. The results are swelling, irritation, bleeding and blackening of the skin. Although a significant amount of work has been done in this area and devices like Accurate Vein Viewer have come up, but the major problem lies in their cost and portability factor.

### A. Need for vein detection

When the doctors are treating trauma patients, every second counts. Bruises, bums and other physical injuries

make it difficult to locate veins and administer life saving drugs or solutions. In such cases it becomes very necessary to have a device that detects the exact location of required vein. Also in case of blood transfusion, blood donation, blood with draw, etc. it is necessary to know the exact position of the veins. Even trained nurses and doctors many times find it difficult to exactly locate the blood veins, on the first attempt, especially for obese people. In various medical situations, the exact location of veins needs to be identified. The other situations

Where vein imaging is required are;

**Intravenous injections:** For giving medicines and drugs to the patients, intra- venous injections are given by doctors and nurses.

**Bruises and Bums:** In case of vein diseases like Deep Vein Thrombosis and Varicose Veins, bruises appear on the skin, therefore for the treatment of these diseases, detection of veins is highly essential. Accidents involving first or second degree of bums cause the scarring of the skin. Here appearance of the skin becomes deterred causing the skin to appear whiter or in certain cases darker. The determinations of veins become tough in such cases as well.

**Blood transfusions:** It is a process in which blood is given to the person intravenously. Blood donation, kidney dialysis also need perfect vein detection

**Among children:** Locating veins in young children and infants may be especially difficult and having to puncture them several times with a needle is very frightful and agonizing for the child.

**Geriatrics:** Many elderly people often require numerous blood tests or medicinal injections and an efficient means of puncture would reduce excessive bruise and enhance the patients overall comfort level.

The wrong administration of intra-venous injections will lead to several problems like swelling of the skin, appearance of rashes ,damage to bones and nerves, clotting of blood allergies reactions ,appearance of black spots , darkening of veins due to peripheral venous

scarring, arterial damage which may result in haemorrhage and gangrene.

### B. Near infrared imaging

Human eyes can only detect visible light that occupies a very narrow band (400 - 700nm) of the entire electromagnetic spectrum. However, there is much more information contained in other bands of the electromagnetic spectrum rejected by the objects of interest. For human vein patterns on the periphery, the visibility under normal visible light conditions is very low. However, this can be resolved by using Near-Infrared imaging techniques. The special attributes of Near-Infrared imaging which makes it suitable for vein detection are:

1. NIR can penetrate into the biological tissue up to 3mm of depth.
2. The reduced haemoglobin in venous blood absorbs more of this infrared radiation than the surrounding tissue.

Therefore, by exposing desired body part with the infrared radiation of specific wavelength, the vein image can be captured by an IR camera. In the resulting image, the veins appear darker than the surrounding tissue, biologically; there is a medial spectral window which extends approximately from about 700 to 900 nm, where light in this spectral window penetrates deeply into tissues, thus allowing non-invasive investigation.

The infrared radiation is absorbed in a different wavelength in various types of tissues. In order to achieve visual penetration through the respective tissue, lighting should be performed under a very tight optical window, namely 740 nm up to 960 nm (inside the near infrared part of the electromagnetic radiation spectrum). Hence in this device near infrared technique is chosen rightly to view the veins.

## II. LITERATURE ON RELATED WORKS

Vein detection is one of the latest biomedical techniques researched today. While the concept behind the method is simple, there are various challenges to be found throughout the design and implementation of a device concerning the lighting system and the image processing algorithms at a very low price. While a very few devices based on the infrared

technique have been implemented, there still exists a strong need to develop such medical devices.

Naoya Tobisawa, Takeshi Namita, Yuji Kato and Koichi Shimizu[1] gives system consists of a high-intensity and low-leak light source, near-infrared CMOS camera and a small and light one-eye head mounted display. Using the developed system, they could obtain the transillumination images in all part of the adult forearm with as much as 67 mm. They can obtain a clearer transillumination image of deep-seated blood vessels, it can be used to assist the intravenous injection, the varicose-vein treatment, arterial catheterization,

intraoperative observation of blood vessels and lymph ducts, and so on.

Manam Mansoor<sup>1</sup>, Sravani.S.N<sup>2</sup>, Sumbul Zahra Naqvi, Imran Badshah,<sup>[2]</sup> Mohammed Saleem gives system is composed of a modified web camera with a long-pass, a NIR ring of LEDs is used for illuminating the desired body part with infrared light. The LED ring has a circuit driver and the power is provided from the laptop itself through a USB cable. The software used for processing is Computer Vision (OpenCV) on Ubuntu. It is an open source computer vision library which is originally developed. The library is written in C and C++ and runs under Linux, Windows and MacOS X.

Deepak Prasanna.R<sup>a\*</sup>, Neelamegam.P<sup>a</sup>, Sriram.S<sup>b</sup>, Nagarajan Raju<sup>[3]</sup> they explain various enhancement techniques such as image negative, gray level slicing, histogram equalization, contrast stretching, laplacian sharpening, unsharp masking, high boost filtering, and histogram equalization of high boost filter. These techniques are applied on the hand image using (OpenCV) open source computer vision library developed by Intel. A comparative study of all these enhancement techniques is carried out to find the best technique to enhance hand vein pattern. The result shows the histogram equalization of high boost filtering technique provides better enhancement of vein pattern.

Marcotti, M. B. Hidalgo and L. Mathé, Member, IEEE gives research<sup>[4]</sup> is based on the construction of which an artificial vision system captures an image through a CMOS optical sensor to outline and see the veins network mesh. The acquired image is then processed and optimized using Matlab software to emphasize areas of interest and to eliminate unnecessary information. The project also includes a stage in which is the image obtained projected over the patients' skin, obtaining an artificial visualization of the venous network.

Septimiu Crisan, Ioan Gavril Tarnovan, Titus Eduard Crisan gives<sup>[5]</sup> Vein pattern recognition system. The concept behind the method is simple, there are various challenges to be found throughout the design and implementation of a vein-scanning device concerning the lighting system and the image processing algorithms. To achieve low scanning errors, the acquired image should be almost noiseless and the algorithms should detect the vein pattern in various conditions. Many implementations of this method are now in a commercial phase and there is a great need for low cost systems that can detect human veins with minimum computational requirements.

We take the guidance of doctors and find the dorsal veins in hand which is used to inject the drugs into body. Also these veins are required to inject supplementary in the blood

## III. PROPOSED SYSTEM

As our application i.e. vein detection using infrared imaging, we use strong light source consisting of 100-

150 LED. This light transmitted on palm hand .we get transillumination image of palm. In that image we clearly seen veins appears black dark line and skin appears as in red color. These image is processed using image processing algorithm in that image and find out the clearly veins network. In the resultant image we clearly saw the veins.

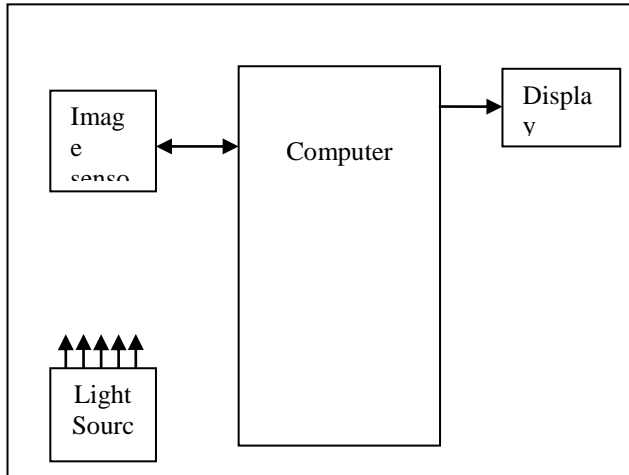


Fig. 1 Block diagram of proposed system

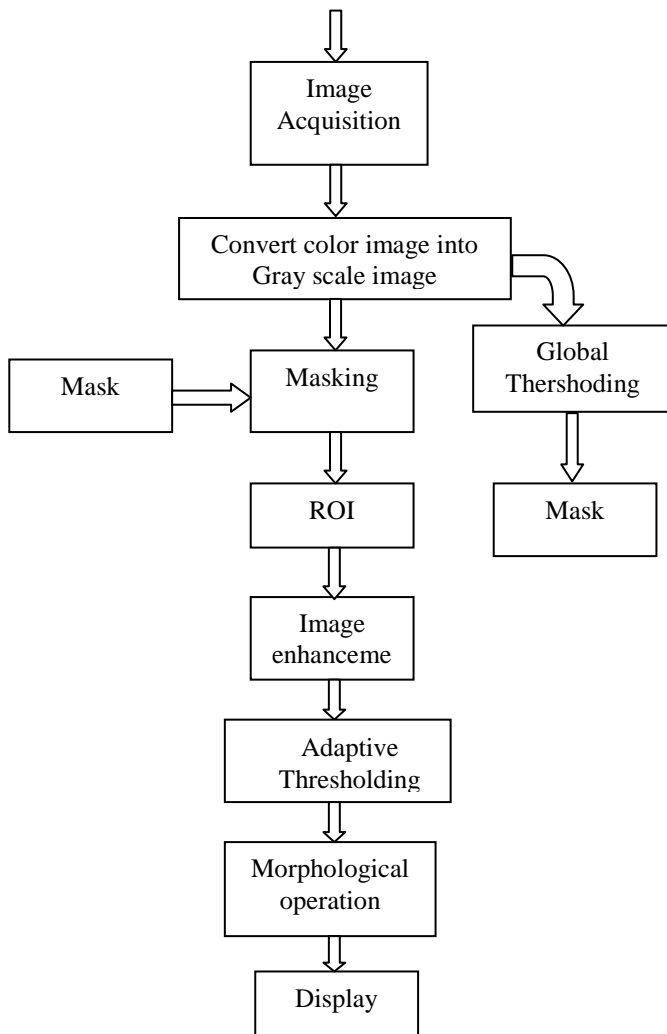


Fig. 2 Flowchart of proposed system

Image acquisition is the first step in any image processing applications from set distance with proper illumination.

Colour to greyscale conversion is used for converting colour image to gray image Converting to gray scale allows for faster processing in the further stages as compared to colour images and still yield discernible visualization of the veins in real-time.

Masking is used to obtain region of interest on which next processing is to be done in order to extract data from acquired image i.e. to enhance foreground and to suppress background image. In this particular case we have to use a mask of predefined size (width\*height) to distinguish the area of interest for further processing from its background image.

ROI select the region of interest that is select which is obtained from masking processing. The image obtained from global Thershoding is mask on gray image which is obtained from colour to gray transformation.

Image enhancement is among the simplest and most appealing areas of digital image processing. The idea behind enhancement techniques is to bring out detail that is obscured or simply to highlight certain features of interest in an image. This is very Subjective area of image processing. The choice of algorithm used depends on the nature of the image acquired.

Thershoding is used for converting gray scale image into binary image

Global Thershoding:-The simplest property that pixels in a region can share is intensity. So, a natural way to segment such regions is through Thershoding, the separation of light and dark regions. Thershoding creates binary images from grey-level one by one turning all pixels below some threshold to zero and all pixels about that threshold to one. If  $g(x, y)$  is a threshold version of  $f(x, y)$  at some global threshold  $T$ ,

$$g(x, y) = \begin{cases} 1 & \text{if } f(x, y) \geq T \\ 0 & \text{otherwise} \end{cases}$$

Adaptive Thershoding:- In this particular case adaptive Thershoding will be used to generate binary image of each segmented digits so as to obtain dark (0's) regions for veins and bright (1's) background. This obtained binary image is display on computer

Display is used for display image final image on computer. In that image we seen the clear difference between vein and background

Morphological operation is used to remove unwanted noise from an image that is dotted part is removed from image.

Also we design for vein detection system GUI window which include capture batten which capture the image of

palm and veins show button which show the vein after applying image processing algorithm

Morphological operation

#### IV. RESULT:-

We design vein detection system using infrared radiation. We use strong light source having 80-100 led. the result of image acquisition is as shown in figure no 3.



Fig. 3 Image acquisition

The result of color to gray conversion is as show in figure 4. here we use luminosity method for this conversion



Fig. 4 colour to gray conversion

The result of adaptive thershoding is shown in figure 5 it can be clearly seen that veins appear in dark black colour.

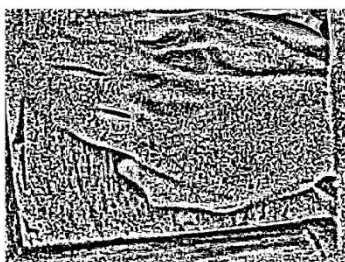


Fig. 5 result of adaptive threshold

After adaptive thresholding we apply image negative operation to turn white lines to black that lines are veins.



Fig. 6 result of an image negative

After image negative operation we apply morphological opening with disk type structuring element to remove the noise from an image.



Fig. 7 result of morphological opening operation

Then we select connected component having large area that is large area component in an image. That is longest area component in an image. The resultant image is shown in fig 8. In that image veins appear in white colour and other part are black

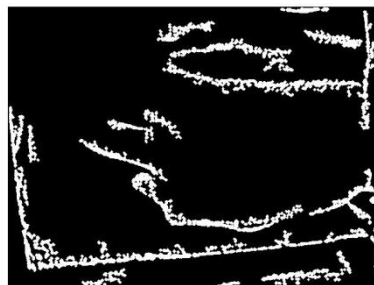


Fig. 8 select connected component

#### V. CONCLUSION:-

To realize the vein detection system, we have developed a Simultaneous observation system for a body surface image and a transillumination image of blood vessels. The system Basically consists of a light source, a camera, a personal Computer. As a light source, many LED's were arranged on a printed circuit board. It made the high-intensity and small-leak illumination possible.

Using the developed system, the blood veins in palm hands were visualized. We could obtain the transillumination images of the palm hand and using image processing algorithm we extract veins from palm.

#### VI. REFERENCE

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