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Research on Image Processing Algorithm to Implement Vein Viewer System

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***Abstract*—This research is developing an imaging processing algorithm to apply vein viewer system. This paper dealing with three categories. First, implementing algorithm, second, developing algorithm software, and the third one is software embedded. The objective of this research is to build a software development environment based on Visual Studio C / C ++ Community 2013, to speed up image processing time using NVDIA company CUDA (Compute Unified Device Architecture) technology, and implementation of the program to be compatible C / C ++ language to prepare embedded system.**

***Keywords*—Image Processing Algorithm, Vein Viewer, Software Embedded, Algorithm Optimization**

I. Introduction

Developing an algorithm to implementing vein viewer consist of three processes. First, optimize the algorithm. In consideration of the thickness and direction of recorded original blood vessel, detect the blood vessel edge and then precise the location information. After defining an image region, based on the average value of pixels in the image area setting the threshold value. The algorithm calculation processing to remove the noise image.

Second, developing an algorithm software. To develop a software, display the blood flow, and specific information. Using FDK algorithm and rotation based algorithm, display the image efficiently. For user friendly, development of UI which is emphasizes the ergonomic usability.

Third, Software embedded has to be done, to control of vein viewer and system. To optimize the software to install in hardware and usable, low-end software implementation is needed for portable devices. Have to minimize power consumption and execution speed improvement. Updating software include continuous improvement and debugging process.

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II. ALGORITHM DEVELOPMENT PROCESS

A. Building Software Development Environment

The initial algorithm development is to build programming environment using Matlab and Image Acquisition Tool Box. And then construct C / C++ programming environment using Visual Studio for the image processing speeds up and embedded development. Windows application program development and UI system implemented using C++ MFC (Microsoft Foundation Class). Visual studio development shown on Fig.1. and program application screen on windows shown on Fig.2.

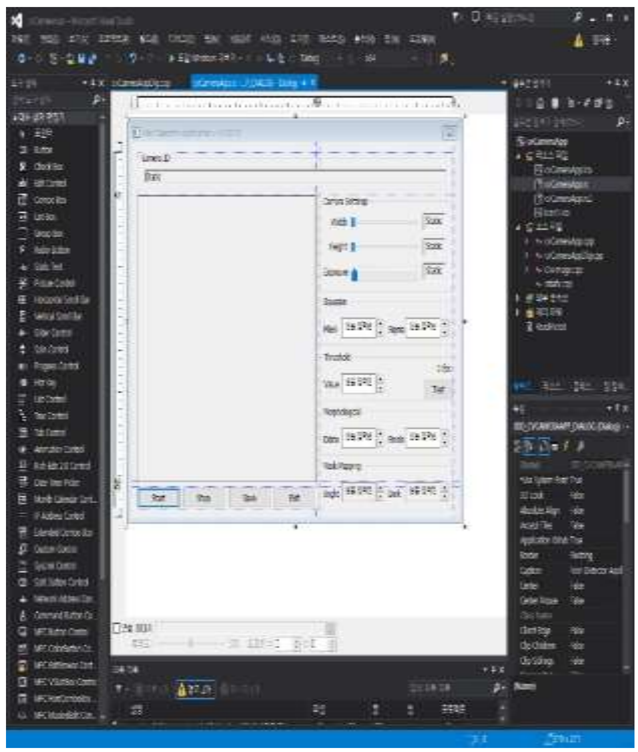

Fig. 1. Visual Studio Development Environment.

A parameter adjustment could be done and could be applied to the blood vessel pattern, which is extracted by the mask image and the size threshold value can be adjusted in real-time image transformation.

The exposure time of the camera sensor could be adjusted. Since the close relationship between the degree of blurring of the image unit and the exposure time in the LSC output from the LSC in real time, it is possible to derive the optimum exposure time

It indicate the operation time required for image processing time of one frame in real time. By deriving a calculated time, showed an ever-changing Frame rate.

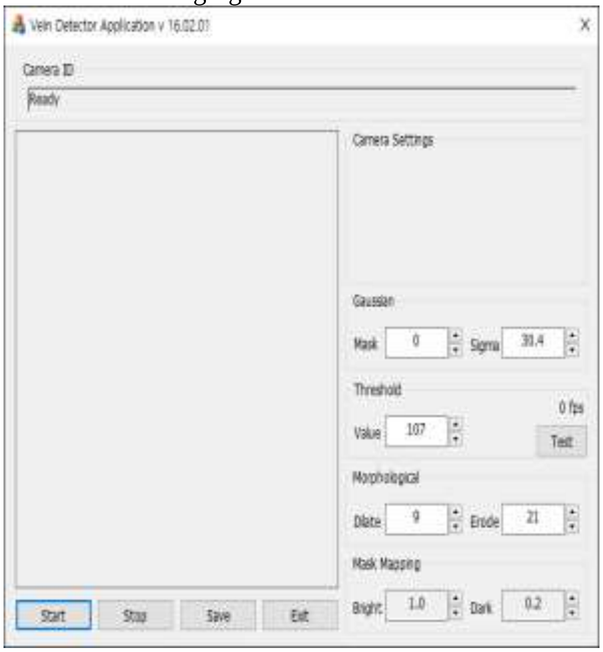

Fig. 2. Program Application Screen on Windows

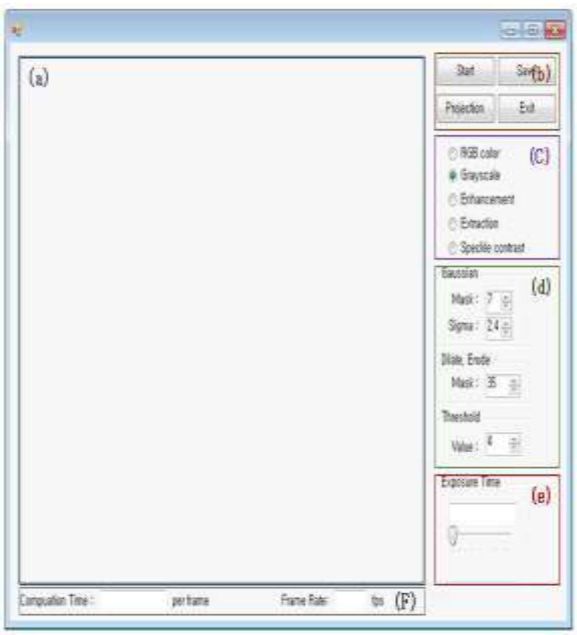

Fig. 3. Program Application Screen on Windows.

B. *Vascular Imaging Algorithm Implementation*

Developing the image processing process for emphasizing only the blood vessel pattern in a blood vessel image having a low contrast obtained using the near-infrared optical system.

One of the disclosed open-source using the OpenCV (Open Computer Vision) develop image handling process.

C. *Implementation of Image Quality Enhancement Algorithm*

After extracting blood vessel pattern, generating Mask image to reduce the distortion of the original image.

At the same time, designing an algorithm to derive a better result by the user Mapping process in the process of Mask Mapping process.

Image processing method Liukui Chen was used for extracting a blood vessel pattern.

The blood vessel image, which was acquired by the camera reset to the size and scope fit in the desired area. And then

And then in order to remove the speckle noise by the light source 5 × 5 size, a Gaussian low pass filter applied Sikkim has a sigma value of 0.8

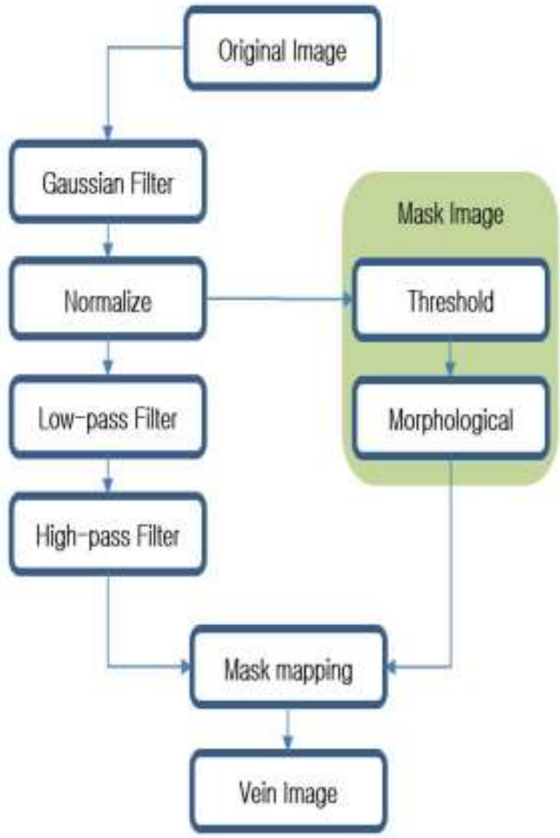

Fig. 4. Flowchart of Image Process

D. *Vascular Imaging Algorithm Implementation*

Through NVIDIA CUDA platform, building a parallel image processing environment accelerate the algorithm performing time about 20 times faster.

Continuously develop and apply CUDA based user friendly algorithm to replace the Open CV image processing algorithm.

Improve the readability of blood vessel images and expected to increase the image processing speed.

E. *Software Embedded*

Currently Window based application program was developed by C ++, however part of image processing algorithm was designed to be compatible with the C language. Especially, image processing algorithm part is considering embedded for the future. For the embedded, only C language is possible to develop.

Embedded process must prepare in case of cannot use a graphics card of NVIDIA Company.

In such cases, all graphic card supported parallel handling process, OpenCL (Open Computing Language) based algorithm developed separately.

F. Laser Speckle Contrast Index (LSCI)

The image obtained through the laser light source was reconstructed 600 by 480 pixel size image of LSC images.

Since the larger the speckle pattern by the blood smear degree, the lesser the ratio of standard deviation due to the mean brightness of the unit area, reconstructed image of LSC has a low brightness.

Skin tissue, with no movement has a high brightness in the image LSC because of the small degree of blurring.

The reconstructed image by the LSC was configured Laser speckle contrast index (LSCI) image by applying a color map in accordance with the brightness.

III. Results and Discussion

Through a preliminary experiment, applying a variety of known algorithms to the existing blood vessel detection and compare the performance. In consideration of the possibility of real-time image processing algorithm select the most suitable Liukui algorithm for the present system and the research environment. Some parameters were controlled and optimized to meet the research goal.

Finally, since the vascular pattern extraction express thicker than the actual vessel, microscopic blood vessels are not detected, or recognize a shadow as a blood vessel. It is believed that vascular pattern detection capability improvement is needed through the pattern extraction algorithm and optical improvement system.

By analyzing the changes of scattered laser speckle pattern according to the movement of the blood flow using laser speckle imaging technology, it was able to obtain the relative movement of the blood flow information quantitatively and visually.

It was difficult to interpret the specific biological information of the speckle signal due to the optical uncertainty of biological tissue. It was difficult to detect the exact shape of the blood vessel within speckle image according to the blood flow image of microvascular. With all difficulties by reconfiguration of LSCI blood vessel image, it was obtain the functional information as well as structural characteristics of the blood vessel through the phantom study

For real time processing of data, high performance computing environments with Intel i7 CPU and 16GB of memory prepared. Comparing the results of required processing time for the operation of a frame calculation by an image processing process, it showed a low frame rate in the blood vessel pattern detection and LSCI frame reconstruction.

Despite the low speed image processing, there were no difficulties to identify the blood vessels and the blood flow information. But for completeness in future systems it is necessary to improve the data processing speed through the parallel computing, such as GPU.

Detecting vascular information of the interest region and extraction-projection system was made in the operating distance 240㎜ at the same time. It was confirmed that projected in the same area of camera images without the size or the phase difference through the preliminary test and evaluation system.

Since the laser projector and camera-lens viewing angle varies, it is difficult to match the optical axis of the camera and the projector completely. But, matching the viewing angle through lens replacement and modification of projector could develop no limit operating distance applicable system using the straight distance of the laser projector.

Further research required method to improve the distortion caused by the curvature, the projection angle of the projected area for more accurate projection technique.

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