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Tissue Analysis by Virtual Instrumentation

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Abstract: This paper introduces the possibilities of diagnostics and analysis of tissue via virtual instrumentation - LabVIEW. The two dimensional images shot by the camera provide information about the surface properties and degradation of a real skin. The main idea is based on the human skin parameters measured for healthy and ill skin. The aforementioned access provides parameters evaluation by creating a structure model. The anomalies are recognized by this model.

Keywords: Virtual Instrumentation, image processing, human tissue

1. Introduction

The human tissue parameters measurement is most helpful for doctors. They can diagnose most of illness with these parameters. They can analyze specimens of human tissue by virtual instrumentation – LabVIEW. The analyses help doctors at better diagnosis given. They can perform statistical analysis of human tissue too. Doctors can measure the ratio between vessels and the other tissues. This measurement is important for doctors. Doctors measure the ratio vessels to tissue by manual methods up to now. The results were influenced by subjective valuation and by human factor. Virtual instrumentation makes possible the objective valuation of specimens.

2. Virtual Instrumentation - LabVIEW

The LabVIEW is a graphical programming environment, which can be used to built data acquisition and instrument control application. The LabVIEW graphical dataflow language and block diagram approach naturally represent the flow of our data and intuitively map user interface controls to his data, so we can easily view and modify our data or control inputs. The LabVIEW programs are called

virtual instruments, or VIs, because their appearance and operation imitate physical instruments, such as oscilloscopes and multimeters. The LabVIEW contains a comprehensive set of tools for acquiring, analyzing, displaying, and storing data, as well as tools to help us troubleshoot our code.

In LabVIEW, we built a user interface, or front panel (Fig. 1), with controls and indicators. Controls are knobs, push buttons, dials, and other input devices. Indicator are graphs, LEDs, ant other displays. After we built user interface, we add code using VIs and structures to control the front panel objects. The block diagram contains this code (Fig. 2).

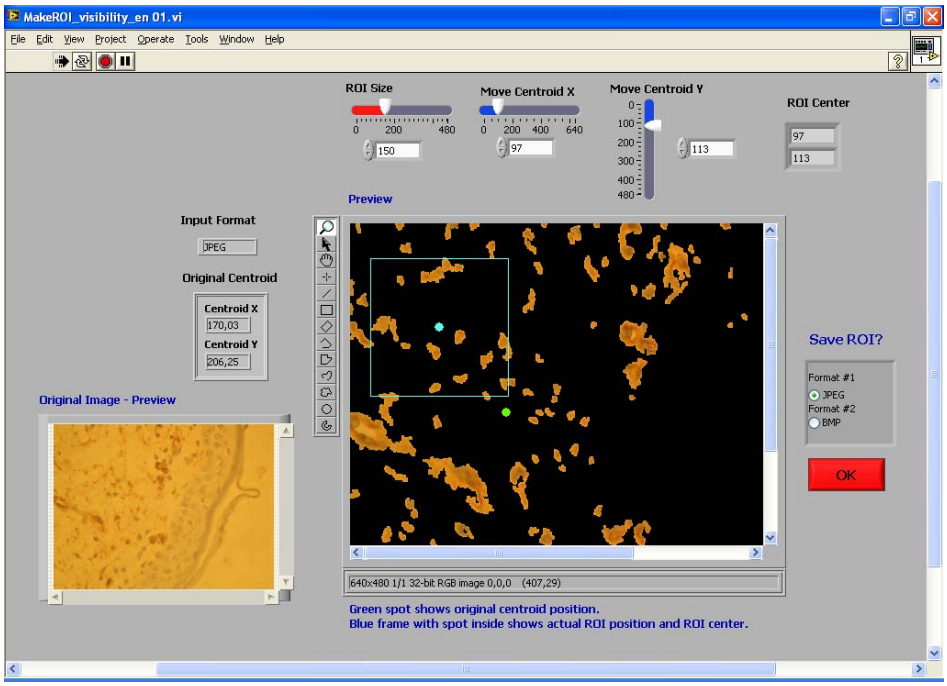

Fig. 1 Application front panel.

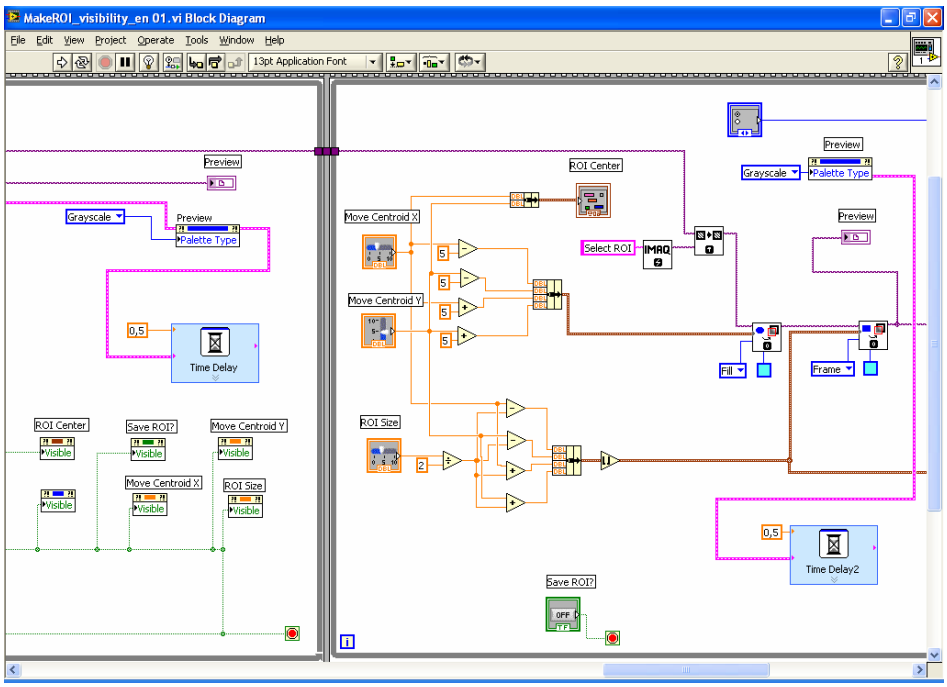

Fig. 2. Application block diagram.

LabVIEW Express technology transforms common measurement and automation tasks into much higher-level, intuitive VIs. With Express technology, thousands of nonprogrammers have taken advantage of the LabVIEW platform to build automated systems quickly and easily. LabVIEW delivers the performance, flexibility, and compatibility of a traditional programming language such as C, C++ or BASIC. In fact, the full-featured LabVIEW programming language has the same constructs that traditional languages have - variables, data types, looping, and sequencing structures as well as error handling. And, with LabVIEW, we can reuse legacy code packaged as DLLs or shared libraries and integrate with other software using ActiveX, TCP, and other standard technologies.

2.1 NI Vision Development Module

National Instruments imaging software is ideal for imaging application. NI-IMAQ image acquisition driver software, included with image acquisition devices, makes image acquisition easy.

The National Instruments Vision Development Module (Fig. 3) is for engineers and scientists who develop machine vision and scientific imaging applications. The module includes NI Vision Assistant, an interactive environment for developers who need to quickly prototype vision applications without programming, and IMAQ Vision, a library of powerful image processing functions.

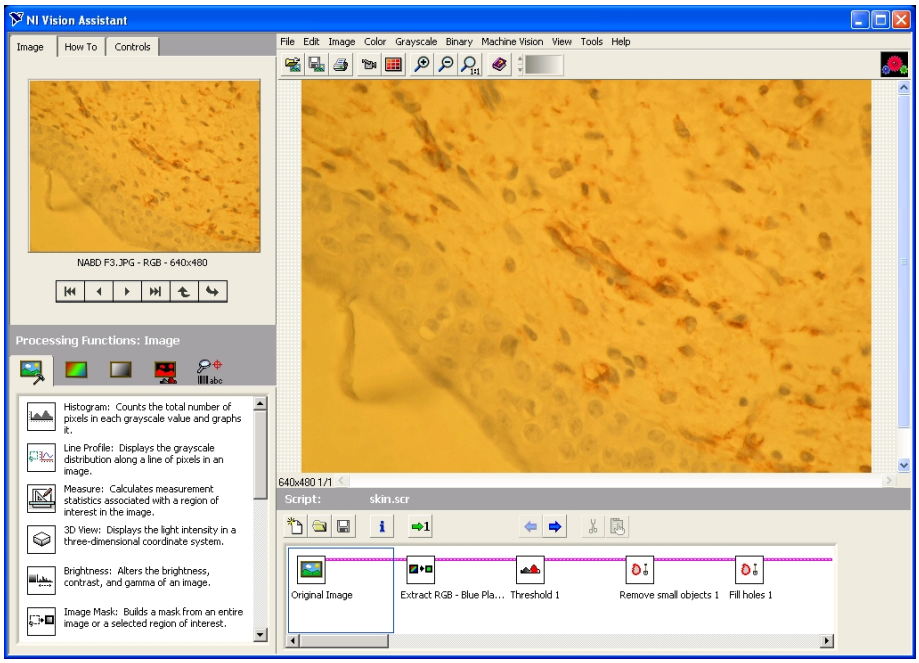

Fig. 3. NI Vision Assistant.

NI Vision Assistant and IMAQ Vision work together to simplify vision software development. NI Vision Assistant can automatically generate a LabVIEW block diagram, LabWindows/CVI code, and Visual Basic builder files. We can run the code generated by itself, or integrate it into your automation or production test application, which may include motion control, instrument control, or data acquisition. We can also take advantage of embedded capabilities with LabVIEW Real-Time, resulting in greater reliability, determinism, and ease of use.

3. Human Tissue Measurement

This application was build in collaboration with Jesenius Faculty of Medicine in Martin. We can measure various tissue parameters for normal tissue. We also can measure parameters for ill tissue for example psoriasis vulgaris or lichen planus.

A derma blood supply parameters evaluation is good diagnostic index. The goal of this application is to find areas containing vessels. We can find the vessels at healthy or pathological changed tissue. Also we can select required region of interest (ROI) and then the region can be processed statistically. We perform statistical analysis of the vessels. It means that we recognize a percentage of ROI vessels coverage.

The basic image analysis was performed in NI Vision Assistant 7.1. Then the script was converted to the LabVIEW. The images of abdominal tissue were used as the base statistical samples.

The script was preprocessed in NI Vision Assistant after image analysis. Important color space was extracted and its thresholding was done in this step of processing. Than we create a binary mask together with morphological operators (dilatation, erosion, closing, opening). Because these operations are basic for ROI creation we convert script to LabVIEW. The results of images preprocessing are at Fig. 4.

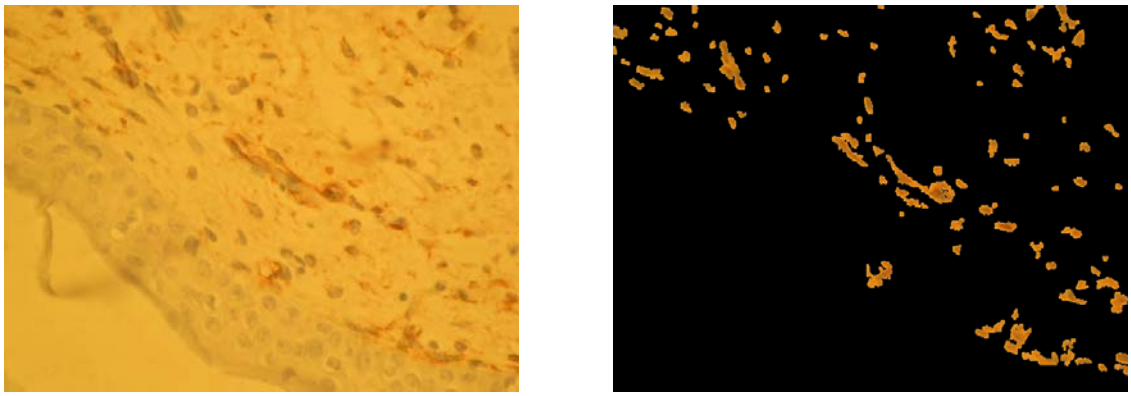

Fig. 4. a) Original image b) result of preprocessing in NI Vision Assistant

If we want sharpen vessels in this tissue, we have to use a special colorized solution. We can perceive the sharpened vessels as dark red or rusty objects. The specimen background is created from epithelium cells, which are not interested for our analysis. This fact is shown at Fig. 5.

The tissue specimens are 24 bit RGB color image with the JPEG compression. Histogram distribution of specimen and also the measurement with IMAQ tools illustrate, that 8 bit color space R and G are approximately identically. Color space B has different gray levels distribution as previous color spaces. Additionally the color space B of vessel is different that color space B of background and cell. Therefore the color space B is selected for threshold. Because color space B levels are in close range, we must perform histogram stretching for refinement of threshold step.

Because LabVIEW is DataFlow oriented, we must define time sequence of the script. We can do it with Flat Sequence Structure. Frames of sequences define the functions which are performed in time succession. The actual script consists of three subsequences (Fig. 6).

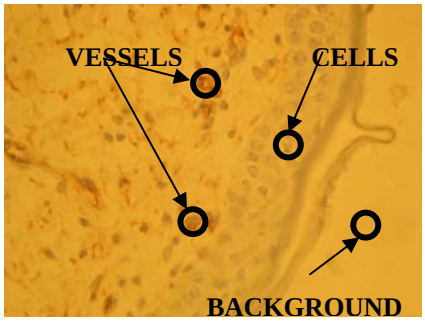

Fig. 5. Abdomen specimen.

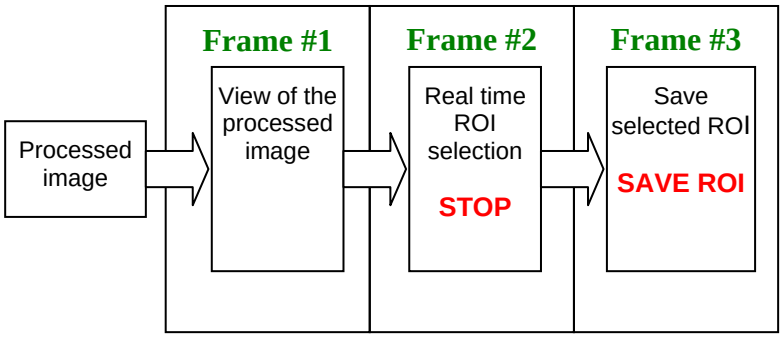

Fig.6. Time sequence of the script.

The view of processed image is created in the first frame. The next frame performs thresholding, mask creating by morphological operators and ROI selection. Selected ROI is saved in third frame.

We can select ROI manually or automatically. The image centroid is computed in automatic mode and ROI size is computed from original image size. Customer can change centre and dimensions of ROI in manual mode. Threshold value, morphological operator, and count of iterations can be change by customer.

4. Conclusions

The derma blood supply parameters evaluation is good diagnostic index. We can find the vessels at healthy or pathological changed tissue with this application. The analyses help doctors at better diagnosis given. They can perform statistical analysis of human tissue too (Fig. 7). Doctors can measure the ratio between vessels and the other tissues. It means that they recognize a percentage of ROI vessels coverage. We can say – "Virtual instrumentation makes possible the objective valuation of specimens".

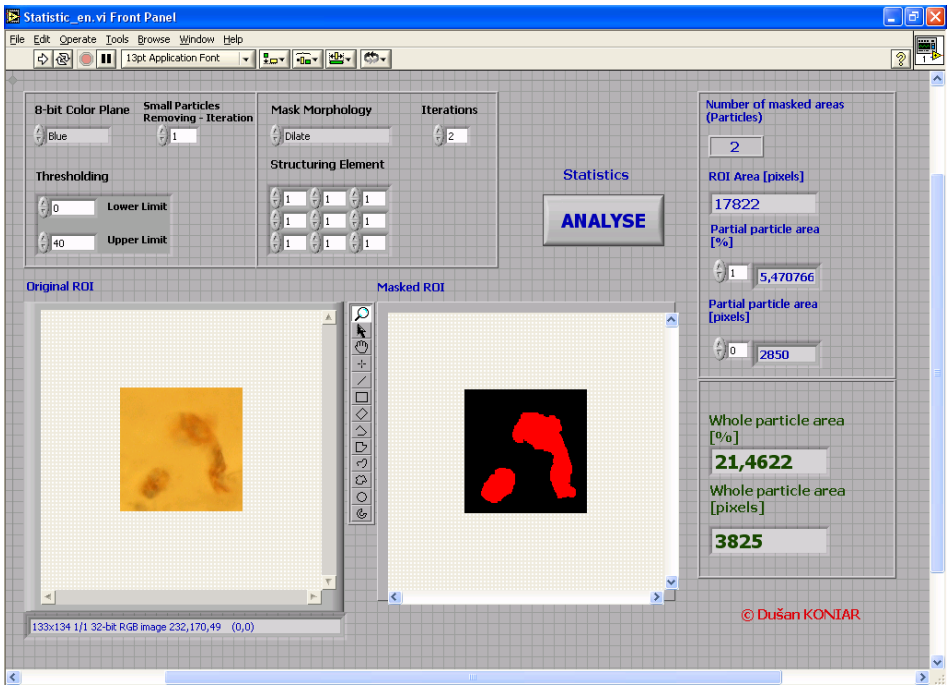

Fig. 7. Statistical analysis of human tissue.

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Guide for Contributors

Aims and Scope

Sensors & Transducers Journal (ISSN 1726- 5479) provides an advanced forum for the science and technology of physical, chemical sensors and biosensors. It publishes state-of-the-art reviews, regular research and application specific papers, short notes, letters to Editor and sensors related books reviews as well as academic, practical and commercial information of interest to its readership. Because it is an open access, peer review international journal, papers rapidly published in *Sensors & Transducers Journal* will receive a very high publicity. The journal is published monthly as twelve issues per annual by International Frequency Association (IFSA). In additional, some special sponsored and conference issues published annually.

Topics Covered

Contributions are invited on all aspects of research, development and application of the science and technology of sensors, transducers and sensor instrumentations. Topics include, but are not restricted to:

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- Theory, principles, effects, design, standardization and modeling;
- Smart sensors and systems;
- Sensor instrumentation;
- Virtual instruments;
- Sensors interfaces, buses and networks;
- Signal processing;
- Frequency (period, duty-cycle)-to-digital converters, ADC;
- Technologies and materials;
- Nanosensors;
- Microsystems;
- Applications.

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