

# Control System of Pain by Expanding Pupil Patient

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**Abstract** - Control system of pain by expanding pupil patient has been developed. The system works by recording the eye of the patient. Image is transmitted to program of processing and analysis on personal computer. In case of pain signal is sent to the audio speakers.

**Keywords** - System of pain control by the patient pupil, Computer vision system.

## I. INTRODUCTION

Often in medicine requires rapid objective determination of the degree of patient's pain. There are various traditional methods for determination of pain, including the most common find digital scale, visual analogue scale, verbal rating scale, and similar methods. All these methods are based on interviews with the patient and his subjective feelings. In addition, there are situations when interrogate is impossible, particularly in dental interventions, shock conditions and other. Thus, there is need for development of new objective methods of assessment of pain.

It is known that when a person feels pain, it expands the pupil reflex; with shock pain such expansion reaches a maximum (7-9 mm in diameter). Using this phenomenon allow to create an objective method for optical control of pain by expanding pupil patient.

The current situation allows design observations systems for various purposes on the basis of publicly available and commonly used devices and software. Existing computer vision algorithms that were used in developing this system provide high performance and accuracy of parameters defining the objects in question [1-4].

## II. SYSTEM DESCRIPTION

The system for automatic control of pain by expanding pupil patient has been designed using the phenomenon of reflex pupil expansion in feeling throe. The system includes a receiver image, a device for processing and analyzing images and sensor output signal. The electronic infrared camera, personal computer and audio speakers are used as system components.

Using a standard web camera, personal computer and free computer vision library for image processing and analysis of pupil makes the system of universal and available for use in medicine.

The following algorithms have been used for creating a program of the processing and analysis image of pupil:

- *Putting the image in color space grayscale.*
- *Gaussian distribution.* The matrix size had chosen equal to 7. This is enough to significantly reduce noise in the image. Standard deviation is calculated automatically.
- *Kenny algorithm* for edge detection in the image.
- *Hough algorithm* to find circles in an image.

The results of the program are: appointed circle on the

image for visual confirmation of correct detection of the pupil; calculates the average radius of the pupil during the last and previous seconds after the application of these algorithms (see fig. 1).

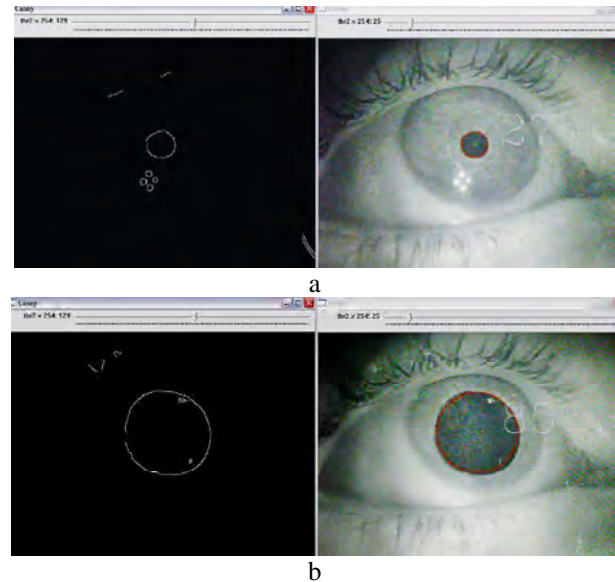


Fig.1 Determination of the size pupil: a – pupil radius 27 pixels; b – pupil radius 85 pixels

If the radius of the pupil during this time has changed more than the limit then the program notifies the audio signal and the inscription on the screen.

## III. CONCLUSION

The developed system was tested on Windows 7 and Windows XP SP3. Thanks to infrared illumination system can operate in complete darkness. Testing of the system showed that as a result of eye movements and light reflections in the image occurs error of radius of the pupil, not exceeding 10 points. Thus, for accuracy and stable determination of changes in pupil size webcam must be installed so that the initial radius of the pupil exceeds at least 20 points.

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