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Original Research Article

Recognition of images of finger skin with application of histogram, image filtration and K-NN classifier

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ABSTRACT

In this paper, non-invasive method of recognition of finger skin was proposed. A plan of study of images of finger skin was proposed. Researches were carried out for three kinds of images: 60 h after injury, 160 h after injury, 450 h after injury. Proposed technique of recognition used methods of signal processing: extraction of magenta color, calculation of histogram, image filtration, calculation of perimeter, and K-NN classifier. A pattern creation process was conducted using 15 training images of finger skin. In the identification process 60 test images were used. The advantage of the presented method is analysis of the finger skin using a smartphone. The proposed approach will help to diagnose pathologies of human skin.

1. Introduction

Recognition of the medical images is a difficult problem in the analysis of digital images. The first problem is image acquisition. There are many devices to take images with various resolution. The second problem is to select proper processing methods to recognize pathology or biological variation. There are many methods of preprocessing, feature extraction and classification. There are also problems with different: age, gender and race of analyzed patients.

In the literature scientists develop many techniques of recognition of medical images [1–12]. Many of them are related to perfusion images [7–10]. Techniques based on thermal images are presented in recent years [11,12]. Some of them are also related to recognition of pathology of human skins [13–18]. Human skin can vary in color and appearance. Often this makes the task of recognition very difficult. Pathology

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Fig. 1 – Analyzed image of injured human finger. Time elapsed since injury – 60 h.

of the human skin may lead to malignant melanoma. It is the most dangerous type of skin cancer [19–21]. In this paper Authors developed method of recognition of injured (Fig. 1) and healthy human finger (Fig. 2). The advantage of the presented method is analysis of the finger skin using a smartphone.

Most of previous approaches were related to finger vein [22–24]. Injured human fingers were common skin injury. It was a reason to analyze this kind of injury.

Section 1 describes general information about problems of recognition of human skin and short survey of literature. Section 2 presents the method of recognition of finger skin. Analysis of images of finger skin is discussed in Section 3. Conclusions of the article are presented in the last Section.

2. Proposed method of recognition of image of finger skin

Authors used smartphone (Colorovo CityTone) for acquisition of images. There is possibility to use other digital camera or smartphone. Next obtained images were copied to the computer (Intel Core i7-4702MQ, 16GB RAM, Windows 8, Matlab 2014b). Images were used as training and test images for process of recognition (proposed technique of recognition). The process of recognition of images of finger skin had 2 steps: pattern creation process and identification process (Fig. 3).

Fig. 2 – Analyzed image of healthy human finger. Time elapsed since injury – 450 h.

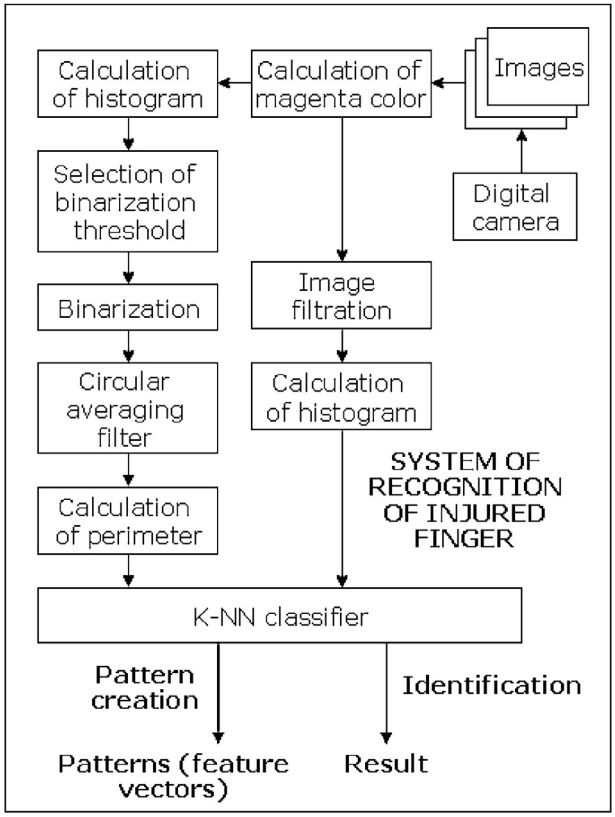

Fig. 3 – The process of recognition of images of finger skin.

Both of them had similar steps of processing such as: calculation of magenta color and calculation of histogram, binarization, circular averaging filter, calculation of perimeter. Selection of binarization threshold was calculated only for pattern creation process. Pattern creation process used training images. Identification process used test images. Feature vectors were calculated (1 value of perimeter and 254 values of histogram). Final step was classification of feature vectors. In identification process K-NN classifier was used to classify obtained feature vectors.

2.1. *Acquisition of image of finger skin*

The patient was 32 years old. The patient's skin color was white. There were 3 kinds of images of injured finger: 60 h after injury, 160 h after injury, 450 h after injury (healthy). Finger skin was filmed by smartphone. Obtained movie was split by a program in a Perl language. This program used *mplayer library* and extracted a single image from the movie. The resolution of obtained images was 1920 × 1080 pixels.

2.2. *Extraction of magenta color*

Magenta color from the image of finger skin was extracted by Matlab2014b [25]. In CMYK color space image consisted of 4 colors: cyan, magenta, yellow and black. Blood has red color, so magenta color was very essential for finger skin. Authors also analyzed RGB color space. RGB color space was not good for recognition of images of finger skin. Magenta color of image of injured human finger was presented in Fig. 4.