

INFRARED HAND PHOTOGRAPHS AS A METHOD OF DETECTING HIDDEN PATHOLOGICAL SIGNS ON THE PALM

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Abstract: As a result of the study of the line of infrared filters from 720 nm to 950 nm, it was found that the most detailed images of the palms are obtained when using an infrared filter with a transmission wavelength of 760 nm. Photography of the palms in infrared light, through a 760 nm light filter, allowed the discovery of the "black phalanges" effect, which is associated with a stronger absorption of infrared radiation by the phalanges of the fingers than by the palms. A hypothesis is put forward about the connection of the discovered effect with human pathology. Infrared images revealed dark spots measuring 1 to 1.5 mm in size, located near the border of the lower and middle phalanges of the fingers in individuals aged 50 to 75. It is suggested that these dark spots are the result of age-related changes or abnormalities in the finger veins. The study hypothesizes a correlation between the lack of visibility of finger veins in infrared light and the tendency towards prolonged physical exertion.

Keywords: Infrared light, palm, fingers, pathology, finger veins.

I. INTRODUCTION

Relevance. Shooting of palms in infrared light will allow to obtain additional information about the palm, which cannot be seen in the visible light spectrum. On this basis, a new biometric method of identification of the person by the pattern of finger veins is based [3]. This direction is currently devoted to the work of the largest firms around the world. For this reason, the photo shooting of hands in infrared light is relevant.

The practical significance of the work lies in the technical simplicity of infrared shooting. All digital cameras have light-sensitive matrices that capture not only the visible spectrum of light, but also the infrared and ultraviolet ranges. Therefore, in practice, it is not necessary to purchase expensive infrared photography equipment; instead, any digital camera can be used with an appropriate light filter, which significantly reduces the cost of obtaining new information.

Review and analysis of literature sources. The first infrared photographs were taken in the United States by Robert Wood in 1910, but infrared photography became popular among amateur photographers after 1935, when infrared film became available. In the second half of the last century, infrared film photography was widely used in aerial photography, geodesy, forensics, medicine, archival work, archaeology, and museums [1]. With the advent of digital photography, infrared photography became accessible to everyone due to the ease of taking pictures and the lack of a very complicated film development process.

The sensitivity of the human eye to visible light is limited to wavelengths between 400 nm and 700 nm. Anything outside this range is invisible to the human eye. Wavelengths below 400 nm are known as ultraviolet light, while wavelengths above 700 nm are known as infrared light.

II. MAJOR FORMAT GUIDELINES

Lines and signs on the palm of the hand have been known since ancient times, but the question of whether there are signs on the hand that are invisible to the human eye, and if so, what they mean, is not a trivial one and requires serious research. To answer this question, a special digital infrared camera is needed, which can cost anywhere from a hundred thousand rubles to several million, so modifications to regular digital cameras for infrared and/or ultraviolet photography are currently being widely used. To improve image quality, digital camera manufacturers place infrared and ultraviolet filters on the light-sensitive matrix. For this reason, it is impossible to obtain high-quality infrared photos using conventional digital cameras with an infrared filter attached to the lens.

Research objectives and tasks. The aim of the research is to develop a method of shooting palms in infrared light to reveal hidden signs and their patterns.

To achieve this goal, the following tasks are solved.

1. To determine the wavelength of the infrared light filter that allows for detailed images of hidden signs.
2. To decipher the meanings of the revealed hidden elements and their patterns.

Research methods. As a working tool for infrared photography, a Canon EOS 30D camera with an EF-S 18-55mm lens was chosen. In this camera, the cut-off filters were removed, and a yellow-orange filter with a wavelength of 570 nm was installed in their place. Fig. 1. As a result, the camera became capable of capturing images in the wavelength range from 570 to 1000 nm and beyond, covering the orange to near-infrared spectrum.



Fig. 1. Cameras for shooting in visible and infrared light.

Infrared shooting of the palms with the specified camera was carried out as follows. The palm was illuminated by a 75-watt incandescent lamp, where most of its radiation falls in the infrared range. The camera is set to "M" mode (shutter speed 30) and manual focus is set. The lens is focused through the viewfinder, then the appropriate infrared filter is attached to the lens, and the shutter button is pressed.

The following filters were used to identify the transmission wavelengths of the infrared filter that produce clearly visible hidden signs: 720 nm, 760 nm, 850 nm, and 950 nm on the electromagnetic wave scale.

Fig.2 shows the photographs of the right hand taken under the illumination of a 75-watt incandescent lamp in manual focus mode. From the figures it is seen that the hidden signs on the phalanges of the fingers are most clearly visible when using 760 and 850 nm filters. In further studies it was decided to use these filters.

Processing of infrared images is carried out on a stationary computer using specialized software.

To decipher the identified hidden elements, the method of collecting statistical information by representative sampling was used. Research results. First, a series of photographs were taken: in visible light (400 nm – 700 nm), orange 570 nm, infrared 720 nm, infrared 760 nm, infrared 850 nm, and infrared 950 nm.

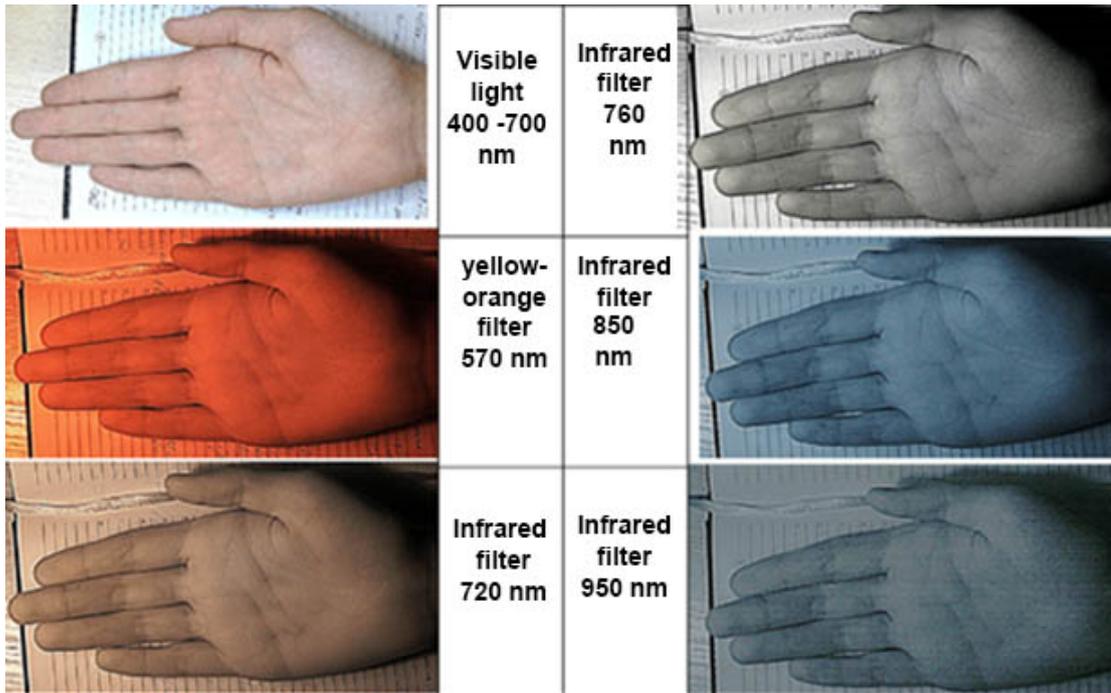


Fig. 2. Photos of the right hand taken with different filters

In the photos of the palms taken in infrared light (760 nm), branched superficial finger veins were found, which are invisible in visible light, but clearly visible in infrared (Fig.3).



Fig.3. Comparison of photos of the right hand taken in visible and infrared light.

As is known, the finger superficial veins are located in the subcutaneous fat layer and provide blood flow from the fingers. Scientists at the University of New York in Buffalo have proposed using infrared images of finger veins to gain access to classified facilities. The blood vessels in the fingers have a unique individual feature and have been used by US scientists for personal identification purposes. The visibility of the finger vein pattern is based on the ability of blood hemoglobin to

absorb infrared radiation [2]. In total, a representative sample of 118 people was analyzed, including 24 men and 90 women aged 18 to 75 years, as well as 4 schoolchildren. By profession, from housewives and drivers to the CEO of a large company. As a result of the analysis of infrared images of the palms, it was found that palm illumination in the wavelength range of infrared radiation (720-950 nm), the visibility of the finger veins differs sharply from each other in contrast, and in some images it is completely absent. It is clear that the visibility of finger veins is affected by the thickness of the subcutaneous fat layer and the wavelength of the infrared light. If the subcutaneous fat layer is thick and the infrared wavelength is short, the blood vessels in the fingers may not be visible. All 118 infrared images were divided into four groups based on their level of visibility: highly visible, moderately visible, slightly visible, and invisible. The statistical distribution of the number of infrared images by the degree of visibility is shown in Fig. 4.

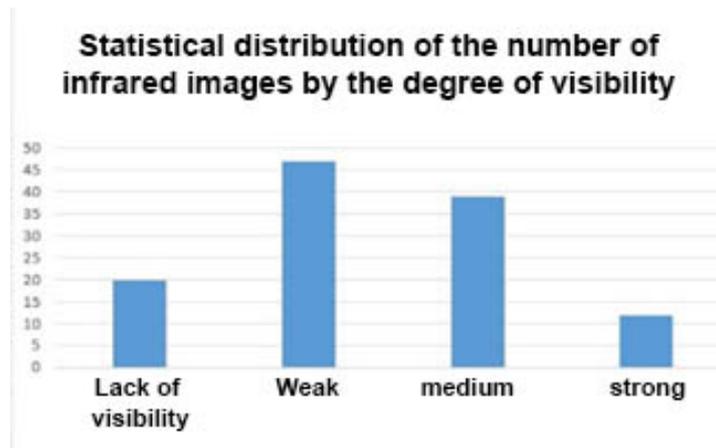


Fig. 4. Statistical distribution of the number of infrared images by the degree of visibility

The vast majority of images belong to the weak and medium degree of visibility – 86, while the absence of visibility was observed in 20 images, and strong visibility only in 12 photographs. Fig. 5 shows four gradations of visibility of finger veins.

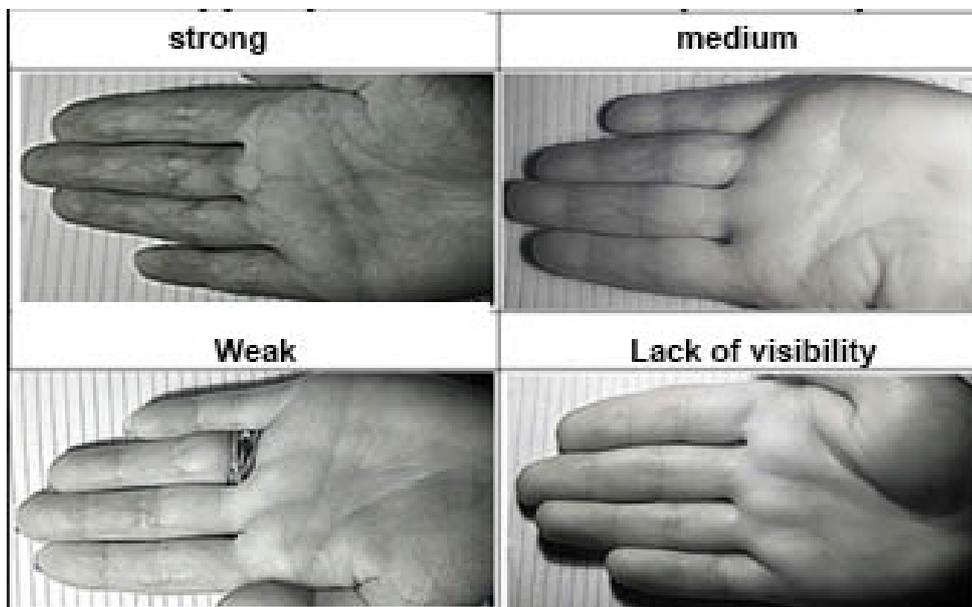


Fig.5. Four gradations of finger vein visibility: strong, medium, weak, and invisible.

The figure clearly shows the effect of the thickness of the subcutaneous fat layer, especially if you compare the left top image (strong degree of visibility) and the right bottom (no visibility), where the finger veins are not visible, while they are clearly visible on the left top. From medicine it is known that infrared radiation penetrates deeper than visible light into the subcutaneous fat layer, on which the treatment with infrared light is based. Therefore, it can be assumed that the thickness of the subcutaneous fat layer is individual for each person and affects the visibility of the finger veins in infrared light, with a thicker layer resulting in less visibility.

However, the metaphysical significance of the subcutaneous fat layer on a person's psyche and character is important to us. For this purpose, we analyzed the hands of individuals with prominent finger veins on one hand and those with no visible veins on the other. The results of the analysis showed that the psychological susceptibility and sensitivity of people in the first group, with a strong degree of visible finger veins, is significantly higher than in the second group with no visible finger veins. Thus, in the first group of "thin-skinned" the majority of women were 80%, and in the second "thick-skinned" the majority of men were 60%, of which half were engaged in physical labor, and this despite the fact that the number of men out of 118 was only 20% - 24 people. From this, it can be concluded that people whose fingers do not show finger vein branches in infrared light have stronger nerves, lower sensitivity, and the ability to perform heavy physical labor. Conversely, people with a clearly visible finger vein pattern have weaker nerves, are more sensitive, and are not prone to prolonged physical exertion. Another feature of capturing the palms in infrared light was the detection of the "black fingers" effect, which is shown in Fig. 6, where the same palm is captured in visible (300-700 nm), orange (570 nm), and infrared spectra with wavelengths from 720 to 950 nm.

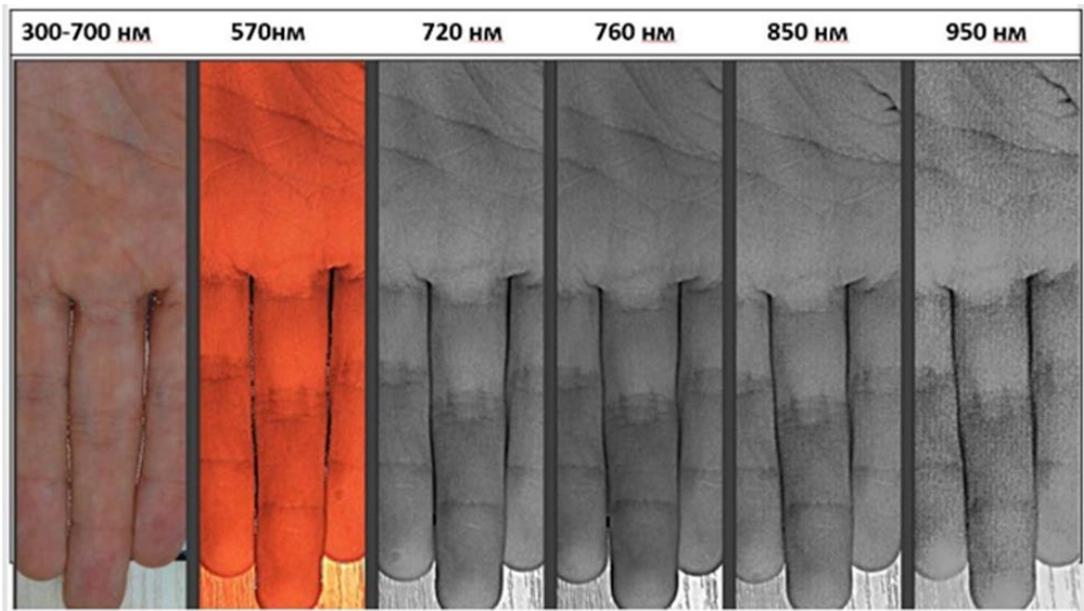


Fig. 6. Comparison of finger photos captured with different light filters

The photos show that the darkening effect of the first two phalanges of the fingers becomes noticeable when the photos are taken through an orange filter and reaches its maximum visibility when the photos are taken through a 760 nm infrared filter. The darker color compared to the palm is a result of the first phalanges absorbing more infrared rays than the third phalanges and the palm, which reflects more of these rays and appears lighter. This effect is clearly demonstrated in Figure 7, which shows images of the right and left hands in visible light (left) and infrared light through a 760 nm filter (right).

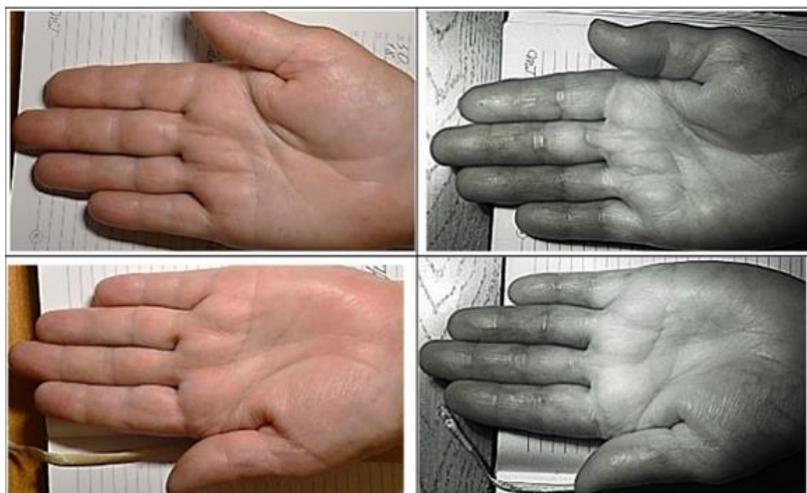


Fig.7. Comparison of images of the right hand in visible and infrared light through a 760 nm filter

In the photograph of the right hand (on the right), the first two black phalanges of the little finger and the ring finger are clearly visible, although in the visible light (on the left), the border between the first two and the third phalanges of the little finger is not visible.

The effect of black fingers in infrared photographs was found only in 6 people, which was 5% of the total number. Given the representativeness of the sample, it can be assumed that the observed effect of black phalanges is a deviation from the norm or a violation of the average statistical pattern. In this case, it is possible that there are some initial pathological processes occurring in the human body, but this is already a medical issue that can be addressed by identifying a simple diagnostic marker in the form of "black phalanges" that can detect the disease at an early stage. The third feature of the infrared photography of the palms was the detection of dark spots in the vicinity of the lower and middle phalanges of the fingers. Dark spots were found on infrared pictures of 5 people aged from 50 to 75 years. Fig.8 shows the photographs of the right and left hands in visible and infrared light.

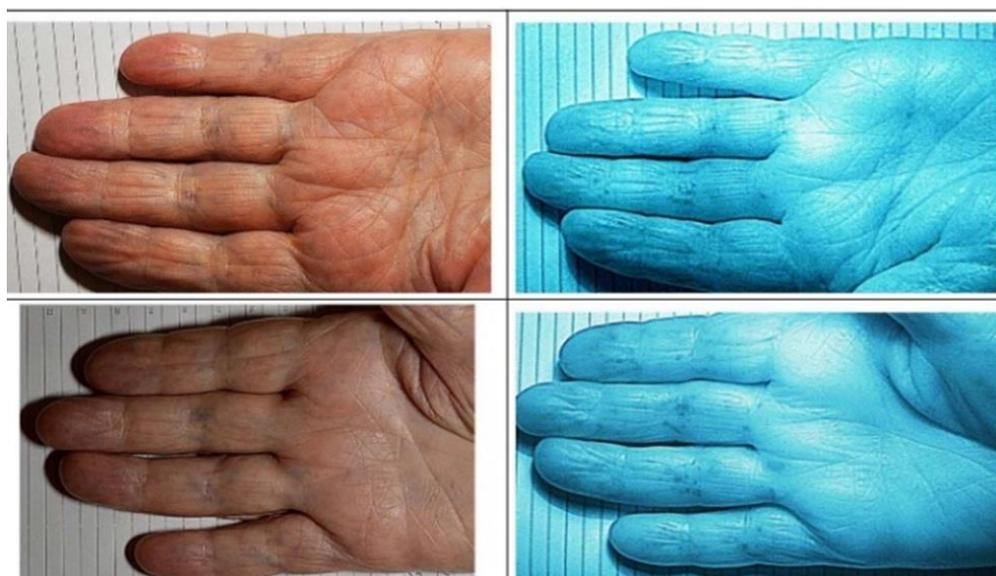


Fig.8. Photographs of the right and left hands in visible and infrared light. On infrared photographs, dark spots of 1 to 1.5 mm in size are clearly visible. Given that these photos belong to people of retirement age, it is logical to assume that the dark spots are age-related changes or pathologies of the finger veins [4].

III. CONCLUSION

1. As a result of the study of a line of infrared filters from 720 nm to 950 nm, it was found that the most detailed images of finger veins are obtained when using an infrared filter with a transmission wavelength of 760 nm.
2. People whose fingers do not show finger vein branches in infrared light have stronger nerves, lower sensitivity, and the ability to perform heavy physical labor. Conversely, people with a well-visible pattern of finger veins do not have strong nerves, are susceptible, sensitive, and are not prone to prolonged physical exertion. The "black phalanges" effect has been observed, which is visible in infrared images but not in visible light. This effect is associated with a higher absorption of infrared radiation by the finger phalanges compared to the palm. The effect was observed in 6 individuals out of a representative sample of 118 respondents.

A recommendation has been formulated to use "black phalanges" to develop a diagnostic marker that can identify a possible disease at an early stage. Dark spots measuring 1 to 1.5 mm were detected on infrared images in the vicinity of the lower and middle phalanges of the fingers in five individuals aged between 50 and 75. It is suggested that these dark spots are the result of age-related changes or abnormalities in the finger veins.

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