Improvement of imaging system for hand-waving finger vein authentication

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Abstract In our previous study, we proposed a hand waving finger vein authentication system. In this system, the captured finger vein images were somewhat blurred when a finger moved quickly, because the frame rate of the imaging system was not high. In this study, we improve the imaging system so as to be able to take more clear finger vein images without using a high frame rate camera, by using a pulse irradiation LED as an illumination light.

Keywords: biometric authentication, pattern recognition, infrared imaging

1. Introduction

Recently, a walkthrough type vein authentication system has been attracting extensive attention, which is effective for wide-scale events such as big event venue, theme park, and so on. In our previous study, we developed a prototype system for hand-waving finger vein authentication [1], in which we used movie pictures of hand-waving finger and synthesized finger vein pattern from multiple frames were used for verification. One of problems in the proposed system is motion blur of captured finger vein pattern when a hand waves quickly. This problem causes a low verification accuracy. If we used a high speed camera, we could overcome this problem easily, but it costs much more than standard cameras with 30fps. In this study, we propose an improved imaging system for capturing a finger vein pattern in order to suppress blurring without a high speed camera. The proposed imaging system uses a short pulse irradiation LED as an illumination light and a common camera with 30 fps. We expect that it can take less blurred finger vein pattern while it has less adverse influence on a human body by high-power LED irradiation.

2. Improved imaging system

In order to capture an unblurred finger vein image when a hand waves quickly, a short exposure time is required. On the contrary, it causes a low Signal-to-Noise (S/N) ratio in general. To achieve both of unblurring and high S/N ratio, a high-power LED irradiation or capturing with high frame rate is effective. However, it is concerned that high-power LED irradiation has an adverse influence on a human body and high frame rate camera is so expensive. To avoid these issues, we use a short pulse irradiation LED as an illumination light as shown in Fig.1. It can be expected that the proposed imaging system can take an unblured finger vein pattern with a low frame rate camera such as 30 fps when a hand waves quickly.

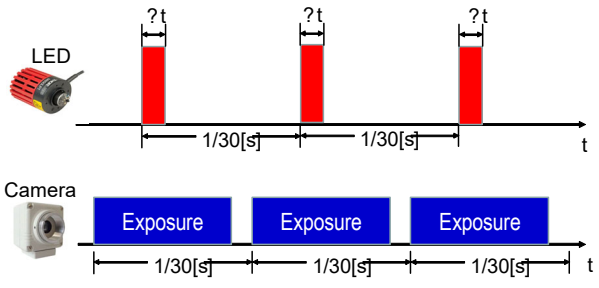


Fig. 1. CI system for capturing finger vein images.

3. Experiments

A schematic of the experimental setup is shown in Fig.2, and its appearance is shown in Fig.3. It consists of a LED (THORLABS: M850LP1) with the wavelength of 850nm, a CMOS camera (xiQ: MQ013RG-E2) with 30 fps, a function generator (Keysight Tecnologies: Function Generator 33522B), and two polarizers. Pulse irradiation of LED is controlled by inputting a trigger signal from the function generator.

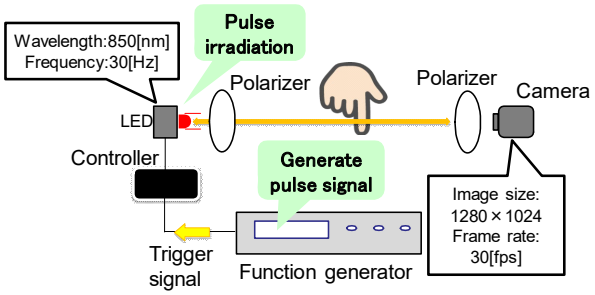


Fig. 2. Schematic of finger vein capturing system.

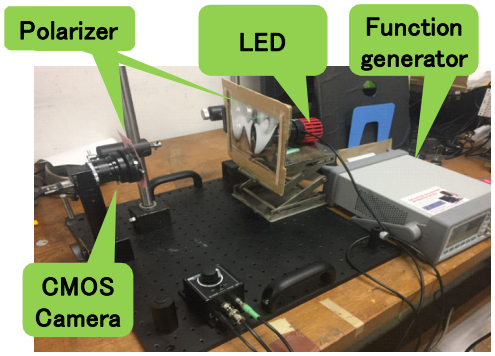
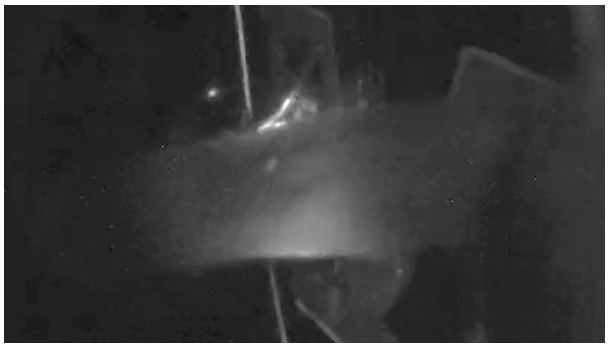


Fig. 3. Appearance of finger vein capturing system.

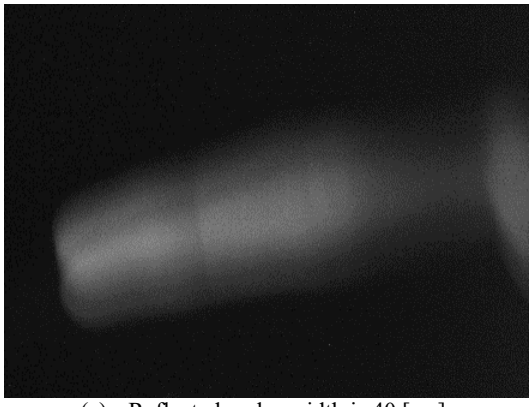
Examples of captured images are shown in Fig. 4. These pictures were captured on the assumption that a typical person waves her/his hand naturally. We can see that captured image on a short pulse irradiation have less motion blur than ones on a

long pulse irradiation. In comparison of transparent and reflected finger vein image, there is an inconsistency in brightness in case of transparent finger vein images due to an erosion of LED light into a finger inside, while a relatively consistent finger appears in reflected finger vein images.

(a) Transparent, pulse width is 17 [ms].



(b) Transparent, pulse width is 3.3 [ms].



(c) Reflected, pulse width is 40 [ms].

(d) Reflected, pulse width is 10 [ms]

Fig. 4. Examples of captured finger vein images.

4. Conclusion

We proposed an improved capturing imaging system for finger vein patterns, which can take an unblurred finger vein image without a high speed camera by using a short pulse irradiation LED as an illumination light. With experiments, we also showed that the proposed imaging system was effective to suppress motion blur when a hand waved quickly.

Reference

[1] H. Suzuki, et al., “Finger vein authentication system based on capture of moving images”, JSAP-OSA Joint Symposia 2016, 13a-C301-6, 2016.

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