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Reliability of palms security under difficult conditions

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Abstract. Reliability of biometric identification systems is a much discussed topic and nowadays security of premises is very important. The work is focused on palms security research and reliability of the system under adverse conditions, the aim of the measurement was to determine the reliability of readers under adverse conditions that may occur in an industrial environment. Difficult conditions include dirty surface of hand by water, dust, oil and writing accessories. First, a sample measurement was carried out, where the hands of the subjects were washed and thoroughly dried. This measurement was used to compare with measurements under adverse conditions. The results show that the more viscous the fluid the lower the reliability and also dusty hands caused considerably distorted results. The reliability of biometric systems still needs to be improved, as it often happens that the real values do not match the parameters that are declared by the manufacturers. Certain conditions must be met for the proper functioning of palms security, so that identifying persons are allowed access to the protected areas and have not been repeatedly denied.

Key words: palms security, reliability, biometrics, difficult conditions.

INTRODUCTION

Nowadays, more and more emphasis is placed on the safety and security of buildings and personal documents. There are many I&Has systems (Intrusion and Hold-up Alarm System) that deal with this problem, and these also include biometric identification systems. Fingerprint systems are the most widely used, which are used not only as access systems but also as attendance systems (Rak et al., 2012). These systems have been tested by a number of scientists and it was concluded that their reliability is sufficient for common modes of use, in particular as an increase in security of access to a building (Lee, 2012). At the same time, it is also pointed out that their reliability is limited by the environment and the difficult conditions under which these readers evaluate (Athalea et al., 2015). Other most frequently used devices include biometric readers using facial scans for identification. This method has been, and still is, problematic in terms of the length of identifying a person, as well as reliability, where the surrounding circumstances play a major role, as well as the covering of identification points of the face - hair, beard, etc (Abudarham et al., 2019).

The issue addressed in this paper is based on a scan of the bloodstream of the hand. This system is used not only to authorize a user to enter a protected area, but also as a payment confirmation or as a control element for working on a laptop or computer. At present, all of the documents are being worked with and are stored in electronic form. Communication between people is also getting limited to electronic form, and it is therefore necessary to address the problem of protecting these documents and communication. Today, passwords and codes are used for these purposes, but these are very unstable from a security perspective and their security is very low. Therefore, biometric methods have begun to be introduced into this issue, and the question is to what extent they are reliable. In recent years, the biometric method palms security has started to develop, which is quite reliable under standard conditions (Wang et al., 2008; Zhou & Kumar, 2011). It is used not only for building entrances but also as a card payment password. These are still touch devices that have their pitfalls under difficult conditions. Laptops and computers are used in all industries and environments, so their reliability under difficult conditions needed to be determined. As the reader is integrated into the notebook, there is a presumption that it will be exposed to difficult conditions as the notebook is nowadays used for both office work and industry where it is possible to meet very dusty environments and people who want to authorize they may have very dirty hands. It is important to solve the problem of whether the device using the bloodstream scan of the hand is reliable and can be used even in difficult conditions of normal operation.

MATERIALS AND METHODS

The research was carried out in the laboratory and buildings of the Faculty of Engineering of the Czech University of Life Sciences Prague. Measurements were carried out in two environments. The first environment was a standard office. The ambient average office conditions were: temperature 23 °C, air humidity 49% and light intensity 313 lx. The second environment was an outdoor tent located in the school field, and here the average values of the environment were as follows: temperature -1 °C, air humidity 42% and light intensity 7,224 lx. A set of 30 measurements were carried out for each user under individual difficult and standard conditions, from which a standard sample was created on each device in both measuring environments. There were a total of 50 users, 25 of whom were women aged 22–64 and 25 men aged 21–73.

The measuring device used was an external reader for scanning the bloodstream: Fujitsu Accessory PalmSecure ID Match Security Access Protection, see Fig. 1, which was connected via a USB interface to a Dell Inspiron notebook, into which the appropriate evaluation software was uploaded. The other device was a Fujitsu Lifebook U757 with an integrated hand bloodstream scanner.

Figure 1. Fujitsu Accessory PalmSecure ID Match Security Access Protection.

It was firstly necessary to determined suitable difficult conditions. The conditions were determined according to the environment in which a laptop can be used. The following difficult conditions were determined: wet hands, undercooled, smeared, soiled and contaminated with oil. Prior to each measurement of each difficult condition, it was necessary to measure each person's standard template, which was measured on clean and warm hands. This benchmark was used to evaluate the reliability level. The measurements were made with each user first performing a set of standard measurements, with difficult conditions then gradually being fulfilled and other sets of measurements were carried out. After measuring each difficult condition, the hands were washed, and an hour break was set in order to normalize the condition of the skin.

The first set of measurements that were carried out in the office space was more reliable than the set of measurements outdoors at -1 °C. This increased error rate is attributed to the fact that the biometric identification system did not operate well at a temperature below 0 °C. The measured values from the two devices were very similar and it was therefore not necessary to process them separately; however, an average value was created from these values. This solution was also relevant because both the reader in the laptop and the external reader work on the same technology principle and with the same recognition software.

The following formula (1) was used to calculate reliability:

$$FRR = \frac{N_{FR}}{N_{EIA}} \cdot 100(\%) \tag{1}$$

FRR – False Rejection Rate; N_{FR} – Number of False Rejection; N_{EIA} – Number of Enrolle Identification Attemps.

During the measurements, it was first necessary to set a time limit after which it would be assumed that the person was denied by the biometric identification device. This time period was 2.4 seconds.

RESULTS AND DISCUSSION

In Figs 2 and 3, it can be seen that this period depends not only on the ambient temperature, but also on the state of the hands, i.e. on the relevant difficult conditions. Fig. 2 shows the time limit being exceeded in the office space, and Fig. 3 in outdoor areas. It is evident from both graphs that the highest time exceeded was for hands soiled with dirt of clay, as the contamination layer prevented the reader from functioning correctly. On average, the value of the time overlap was 66%. The results were better for hands soiled with oil, where the overlap was 54% on average, as this was due to the reflection of the oil and thus the read surface of the hand was devalued, and the reader could no longer be as accurate as for the standard measurement. For hands dirty with hot silicone, the reliability changed in climatic environments. In outdoor areas the readers showed a lower time overlap than in the indoor areas due to the high ambient temperature difference and the difficult conditions tested. On the other hand, in the case of undercooled hands, the values of the time overlap in the outdoor areas were lower; it can be said that they were zero compared to the interior spaces, which was again caused by the ambient temperature and the biometric features examined.

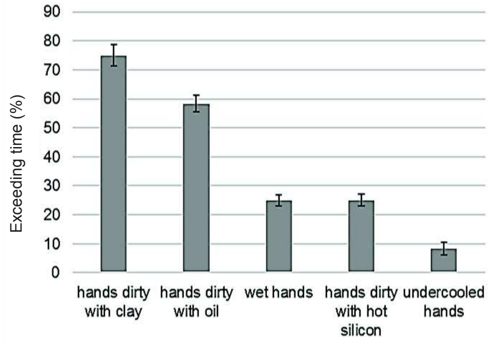

Figure 2. Time limit being exceeded in the office space.

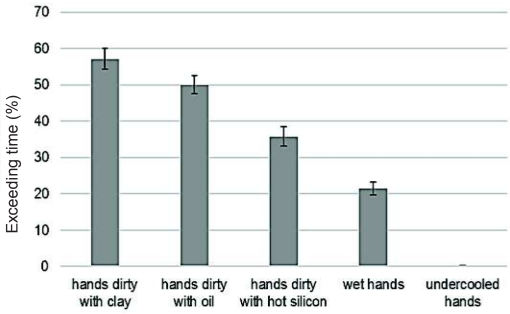

Figure 3. Time limit being exceeded in the outdoor areas.

Another monitored value was the time difference compared to the measured values under normal conditions (benchmark). The average of the measured values in the office space was 1.2 s and the average value of the benchmark was 1.4 seconds for the external areas. The graphs in Figs 4 and 5 show that in the inside areas, the biggest difference compared to the benchmark of 0.9 seconds under difficult conditions was for hands dirty with clay, followed by hands dirty with oil with a difference of 0.7 seconds. The situation was similar in the outdoor areas where, in addition to the two aforementioned difficult conditions, hands dirty with hot silicone with a difference of 0.5 seconds from the benchmark also played a role. As summarized in Table 1 statistically significant differences were achieved in all cases except undercooled hands in the outdoor areas.

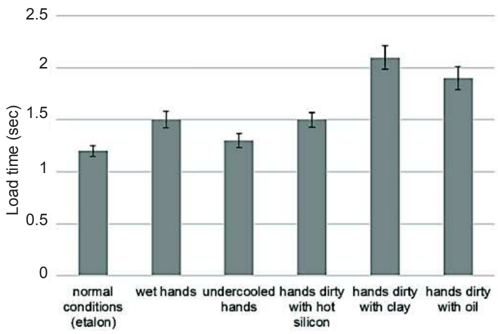

Figure 4. Load time difference compared to the benchmark in the office space.

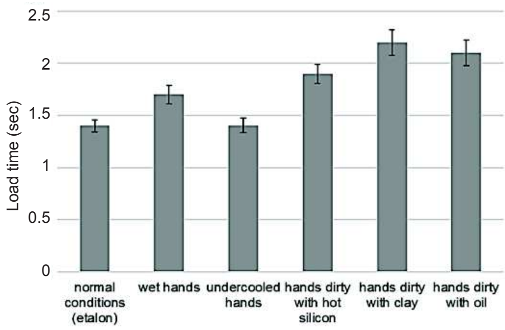

Figure 5. Load time difference compared to the benchmark in the outdoor areas.

Table 1. T-test statistical analysis of load time

T criteria	Wet hands	Undercooled hands	Hands dirty with hot silicon	Hands dirty with clay	Hands dirty with oil
T (indoor)	146	60	161	302	242
T (outdoor)	129	1.66	42	256	219
$t_{0,05}(1,499)$	1.96	1.96	1.96	1.96	1.96

For the final assessment of the reliability of biometric systems identifying the bloodstream of the hand based on a scan, a formula (1) used to calculate invalid user rejection was used. The time limit for determining when a user could not log in to the system was set to 2.4 seconds. The graph in Fig. 6 shows the percentage of reliability,i.e. the percentage of invalid user rejection in both indoor and outdoor conditions. The least reliable proved to be hands dirty with clay with nearly 30%, followed by hands with oil, where reliability was reduced by about 26%. Other difficult conditions were much better, i.e. by up to 10% reduced reliability. As is summarized in Table 2 all values reached significant statistical difference compared to normal condition.

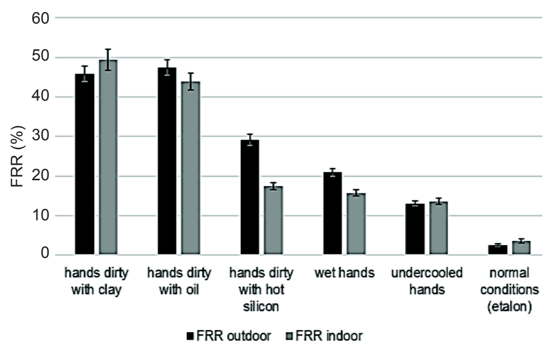

Figure 6. Percentage of invalid user rejection in both areas.

Table 2. T-test statistical analysis of FRR parameter

T criteria	Wet hands	Undercooled hands	Hands dirty with hot silicon	Hands dirty with clay	Hands dirty with oil
T (indoor)	678	712	643	546	486
T (outdoor)	831	896	709	715	576
$t_{0,05}(1{,}499)$	1.96	1.96	1.96	1.96	1.96

The research of biometric systems recognizing users on the basis of the bloodstream of the hand was also addressed by the authors of the publication (Athalea et al., 2015). In their research, they came to the conclusion that the system they were examining identified users with 92% reliability under normal conditions. Also, in (Lee, 2012) the reliability of this identification method is shown, and the reliability values range from 94% to 98%. According to the used method, this research was also performed under standard conditions and in the beginnings of this technology. We have also reached these values under standard conditions and it is clear from the results that readers no longer have an acceptable level of error in difficult conditions. Authors (Thakuria et al., 2017) in their article A Comparative Study of Vein Pattern Recognition for Biometric Authentication discuss the overall use of this biometric technology to identify people. In article Development and evaluation of the authentication systems by using phase-only correlation palm print identification methods by authors (Ucan et al., 2017) is investigate palm prints used in biometric authentication and matching systems. The aim was to match two images of one hand of the person taken from the different perspectives and damaged because of the action. The image took from the palm print reader was softened through the Gauss filter. In addition to the reliability of the device itself, it is very important that this device is protected against external attacks, and the authors (Bhilare & Kanhangad, 2018) of the article Securing palm-vein sensors against presentation attacks using image noise residuals deal with it. Their method is based on analysis of noise residual computed from the acquired image. The palm-vein image acquired by the sensor was denoised through median filtering, a well-known nonlinear technique for noise reduction. Subsequently, a noise residual image was obtained by subtracting the denoised image from the acquired image. The local texture features extracted from the noise residual image were then used to detect the presentation attack by means of a trained binary support vector machine classifier. They have performed evaluations on a publicly available palm-vein dataset consisting of 4,000 bona fide and fake images collected from 50 subjects in two different sessions. Their approach consistently achieves a perfect average classification error rate of 0.0%.

Palms print identification is a relatively new method of identification, and so there are very few scientific studies on the subject.

CONCLUSIONS

Research on biometric identification systems is still a current topic. Emphasis on security is on the rise and it is necessary to continually improve these systems. Based on the results of the measurements, it is evident that identification based on the bloodstream scanning in the relevant systems is sufficient under normal conditions, as reliability in outdoor areas is reduced by 1.52% and in internal area by 2.12%, which is very acceptable for users. The question, however, was how these systems work in difficult conditions that can occur during normal operation. Reliability under difficult conditions dropped between 29.64% and 7.84%. The lowest reliability was found in hands with clay. The best difficult condition was undercooled hands. In addition to difficult conditions, the environment has also had an impact on identification. Under such difficult conditions, it would be preferable to use a biometric identification device that identifies on the basis of a face scan or a fingerprint where skin care is better. However, in subsequent research, it would be suitable to focus on the improvement of systems for biometric identification of persons under difficult conditions, as there is a relatively large gap and important work is not limited to office activities in the interior, but it is also necessary to have high quality and secure access under non-standard conditions and in exteriors.

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REFERENCES

Abudarham, N., Shkiller, L. & Yovel, G. 2019. Critical features for face recognition. *Cognition* **182**, 73–83.

Athalea, S., Patilb, D., Deshpandec, P. & Dandawated, Y. 2015. Hardware Implementation of Palm Vein Biometric Modality for Access Control in Multilayered Security System, *Procedia Computer Science* **58**, pp 492–498.

Bhilare, S. & Kanhangad, V. 2018, Securing palm-vein sensors against presentation attacks using image noise residuals. *Journal of electronic imaging* **27**, 126–134.

Lee, J.-Ch. 2012. A novel biometric system based on palm vein image. *Pattern Recognition Letteers* **33**, pp 1520–1528.

Morales, A., Kumar, A. & Ferrerc, M. 2016. Interdigital palm region for biometric identification. *Computer Vision and Image Understanding* **142**, pp 125–133.
Rak, R., Matyáš, V. & Říha, Z. 2012. Biometrics and identity of man in forensic and commercial applications. Praha: Grada Publishing, a.s., pp. 281–285 (in Czech).
Thakuria, H., Dutta, A., Sarkar, A., Ghosal, A., Saha, R., Pramanik, S., Mitra, S., Mukherjee, C., Thakur, U.N. & Mukherjee, D. 2017, A Comparative Study of Vein Pattern Recognition for Biometric Authentication. In: *2017 8TH IEEE Annual information technology, electronics and mobile communication conference*, IEMCON, Vancouver, Canada, pp. 689–694.
Ucan, O.N., Bayat, O. & Coskun, M.B. 2017. Development and evaluation of the authentication systems by using phase-only correlation palm print identificaton methods. In: *2017 International conference on engineering and technology*, ICET. Antalya, Turkey, pp. 1–4.
Wang, J.G., Yau, W.Y., Suwandy, A. & Sung, E. 2008. Person recognition by fusing palmprint and palm vein images based on 'Laplacianpalm', *Pattern Recognition* **41**, pp 1514–1527.
Zhou, Y. & Kumar, A. 2011. Human Identification using Palm-Vein Images, *IEEE Transactions on Information Forensics and Security* **6**, pp. 1259–1274.