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Testing the familiarity and the ease of using Fingerprint devices and how the current design affecting the accuracy

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Abstract

There are remarkable reliance on fingerprint devices in many secure places such as boarder points, airports, and test centers. These devices help to authenticate people by making sure this person is what he/she claimed to be. It is important for this technology to be easy to use, and more accurate in their decisions. In addition, level of people awareness is high towards this technology because of its publicity. Nevertheless, they have low level of experience with it. It is crucial for any technology to be adopted to have level of awareness, and familiarity increased. This study investigate group of high school students in Saudi Arabia in order to test three factors of dealing with this technology during the enrollment process. First, it tests the familiarity of the device by questioning them in what places have they used the device. Second, it checks the easiness of using the device and if they ever needed any helps to place their fingers on the device in order to get approved image. Third, it investigates the accuracy by checking how many times needed to scan their fingers in order to get the right image. The main finding in terms of the familiarity is that: although many of them have never tried the device or they have used it for one single time only, they are aware of the technology. Concerning the easiness of the device and the accuracy, there is an apparent problem dealing with this device because most of them needed help to place their fingers. Furthermore, half of the participants did not get the accepted image from the first try. So, this study strongly believes that there is a link between the accuracy and the physical design of the device. It must be improved by thinking of a different shape easier to grasp.

Keywords: fingerprint device, fingerprint design, biometric authentication.

Background

System security is not a piece of device or software implemented and does all the jobs. It is a holistic issue and it can be considered as a chain of joined parts. Protecting this chain can only be reached by protecting every part of the chain. A weakness at any part of the chain will consequently lead weakness to the chain as a whole. The highest possible protection is the target of every system. Therefore, companies spent millions of their annual budget in security. The spending can be distributed between hardware, software, establishing awareness programs, and management procedures. It is not enough to implement a system without introduce people to it, make them familiar with it and explain to them the necessity of adapting it. Otherwise, implementing this system might face many obstacles. In addition, this system should be easy to use and adapt by all people of the premise. Organizations spend money for giving training and raise awareness to their employee in order to understand the use of the hardware or software implemented. This is the case in organizational structured premises. However, some devices implemented to be used by people out of the organization. For instance, fingerprint device implemented in immigration offices or airports or in citizen's affairs in some countries are used by all kind of people pass by. Levels of familiarity with the device are varied between people. Some are very familiar because they have seen and used it in many occasions in different places. On the other extreme, some of them are totally unfamiliar and they never heard of it. Some other people might have tried it in few occasions because the technology is considered to be new in terms of its deployment.

This paper tends to investigate familiarity of the device among people with low level of experience bearing in mind their age and sex. It was expected and has been found that large portion of them have never tried the device before. Nonetheless, some of them have been found with higher experience than the others but cannot be certain to which extent. The research classified those who have tried the device in different places as experienced people comparing to the others. Before moving forward, fingerprint technology should be identified. It is a type of biometric authentication methods which test some of the unique physiological characteristics of the human body. The human body has some features which considered to be unique and cannot be found similar in any other human being such as fingerprint, vein pattern, vessel pattern in the retina and the iris dimensions. In the past, images used to be taken offline by scanning the fingerprint which was printed previously on a paper. This method does not involve real time reading of the finger and it is called offline method. However, technology nowadays is more sophisticated and the image is taken directly from the finger and saved in a data base inside a local computer or in a remote centralized computer.

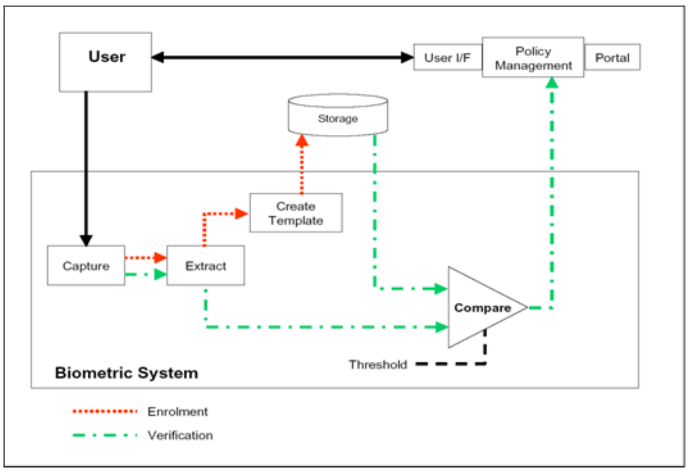

Figure 1: Biometric system process

Figure 1 illustrates the process of enrolling new person to any biometric system and also the process of verifying user. In the enrollment process, images of the users' fingers should be extracted and then saved in storage area. This storage should hold all images of all users. The verification step is required when users request access to a specific secured area. For example, people before visiting a country, they need to enroll themselves in the embassy or the consulate of this country before the travel. Then, after they are granted the visa and when they reach the border they will be verified again. As such, the verification process will match the image extracted from them at that moment by the images stored in the storage of the system. Then the decision should be made if the images taken are matched or not.

There are two unwanted scenarios and both of them happened as a consequence of the level of accuracy of the device. The first is when an illegitimate person is given false acceptance. This scenario could happen in very rare occasions because fingers extracted the time of the verification should match images in the storage. Nonetheless, the storage could be breached by an intruder and injected by a fake image to authorize an illegitimate person. The second scenario is considered to be happening more often which is called the false rejection. This happens when a legitimate person is refused to access while he/she should be permitted. This circumstance can happen due to two reasons. First, the finger image might not have taken correctly at the enrollment phase. In this situation, the operator in the must make sure of the quality of the image and the image must cover all dimensions of the finger. Additionally, fingerprint designer must design a stable and accurate system in order to reduce this type of fault. Second, the image extracted at the verification level might not be good enough to be matched. This situation mostly happens as a result of not firming fingers on the surface of the device due to the lack of the familiarity of the device among people. Moreover, people might have kind of fear of being rejected by the device or fear of hazardous of getting infected by touching the device. H1N1 is one of the diseases that could be transferred by hundreds of people who touched the device. Also, the laser light that transmitted from the scanner might bring some worries. To overcome this problem the operator usually helps people to firm their fingers on the surface. This might not be a problem for a premise with small number of people. However, it could be a vital issue when this happen in a busy crowded area such as airports where the time is crucial. Number of

operators could be reduced by improving the design of the fingerprint device and make it easier for fingers.

Methodology:

Fortunately, the idea of the research came before the enrollment process of schools for the comprehensive exam in May. This exam is requested by all last-year students before entering colleges or universities. The enrollment process will extract all the fingerprint images of all students and store them in the administration of the ministry of education. At the day of the exam, every student is verified and his/her fingerprint image will be extracted at that day then it will be compared against all images that have been collected in the day of the enrollment. Eventually, the decision should be made weather to accept (if it is legitimate) or reject (if it is illegitimate) the student. It was useful to investigate their feedback concerning their thoughts of using the device in the enrollment process. The group of people was chosen to be investigated is a group of high school students in the industrial city of Yanbu (Saudi Arabia).

This research was conducted immediately after the step of the enrollment. A questionnaire was designed to investigate three major factors of dealing with fingerprint devices: the first factor is the familiarity, the second factor is the easiness of use and the third factor is the accuracy. The familiarity of the device can be noticed by questioning them a direct question how they classify themselves in terms of the familiarity. This question is having five answers starting from very unfamiliar and ending at very familiar. Familiarity is also tested in a second question by asking them if they have ever tried this device before and state where they have seen it in airports, immigration offices, embassies, or any other places. As same as the familiarity factor, easiness of use factor has been tested in two places. Firstly, the survey directly asked students how easy they think it is to stick their fingers on the plate of the device. The scale here is five points starting from very easy and up to very difficult. Secondly, the survey questioned them if they have every needed help in every time they have tried the device. The last factor is the accuracy which is difficult to demonstrate the real reasons if the image is not clear enough for the reader. However, the main reason this research investigate is that the easiness of the hardware which could remarkably affect the quality of the image. This is why it is often operator help people in placing their finger at the right position. The accuracy here is simply tested by how many times a person needs to have his/her fingerprint image accepted by the device. As long as the image is not accepted by the device, the accuracy of the image was not clear enough. Thus, the operator need to clear the surface glass of the device, ask the person to stick the finger a second, third or maybe more time. The next section will produce the results have been collected and then it should discussed in the following section.

Results and Discussion

Familiarity with the device

Familiarity of the device has been tested in two questions as mentioned. The second question asked them about the places where they have tried similar device. One of the options was if they have never tried this kind of devices. The answers can be clearly noticed in figure2 where 46% of the respondents have never dealt with the device. Figure 3 shows the places where people have tried the technology before. Sixty five percent of people whom tried the technology have seen it in citizen affairs of Saudi Arabia. All adult citizens of Saudi Arabia are requested to have their fingerprint enrolled if they want to have a national ID. Having national ID is considered to be optional for females. This is the reason why the percentage is not 100%.

Immigration offices, airports, embassies, and other places have almost similar percentage with no remarkable differences. This also indicates the level of awareness that people possess towards such devices. In addition, many boarders rely on this device and other devices to authenticate users. Hence, fingerprint device must be more familiar in design in order to help people to rapidly adapt the technology.

It is also important to investigate level of familiarity that people think about themselves towards fingerprint device. Figure 4 illustrates their familiarity of the device according to their feelings. In this figure, around half of the respondents consider themselves to be familiar or very familiar with the device. In contrast, few numbers of respondents consider themselves as unfamiliar with the technology. It was thought at first that all unfamiliar people are of those whom never tried it. Table1 shows the responses of people with first experience with the machine. Almost half of them prefer the natural choice. However, quite large portion of them (42%) think they are familiar or very familiar with the device. This can be referred to the popularity of the technology which makes people familiar with the technology even if they have never experienced it.

Very familiar	Familiar	Neutral	Unfamiliar	Very unfamiliar
15%	27%	46%	9%	3%

Table1: People whom never experienced the fingerprint device.

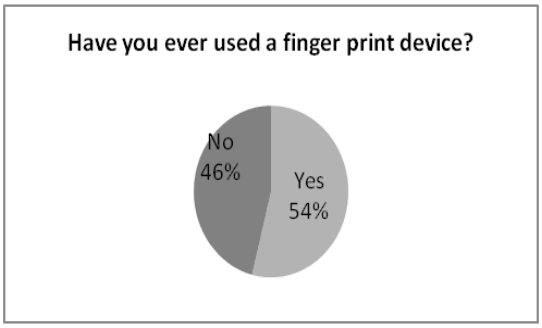

Figure2: Familiarity of the device

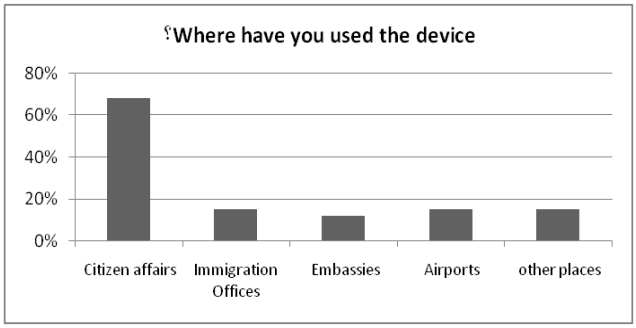

Figure3: Familiarity of the device

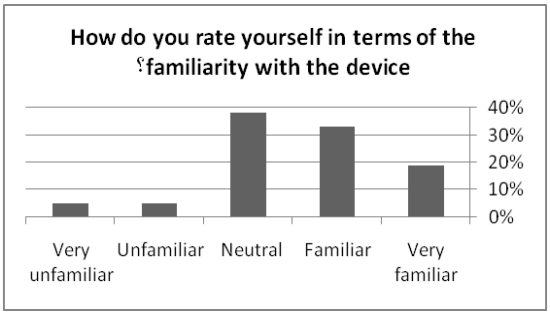

Figure4: Familiarity of the device

Easiness of the device

The easiness of the device factor was examined by asking their thought of the easiness of the use of the device. Usually, in the design of the fingerprint device the glass surface come in the top of the device in a horizontal direction. Therefore, users need to stick the finger against the surface

which could be unpleasant especially for thumbs. The results were unexpected because 70% of the respondents think it is easy or very easy sticking fingers on the device as shown in figure 5. It is important to bear in mind that 46% of the respondents have never used the device. In other words, the enrollment process is considered to be the first try for 46% of them. Thus, their judgments based on the first try which might not be enough. The study divided the answers into two groups based on their experience as shown in table2. Experienced people are those who have tried the device at least more than one time. The answers for both groups are almost similar concerning the easiness of the device.

	Very easy	Easy	Neutral	Difficult	Very difficult
Experienced people	41%	37%	19%	3%	0%
Inexperienced people	29%	45%	26%	0%	0%

Table 2: How easy sticking your fingers on the plate of the device?

The previous question might not be enough to judge whether the device is easy to use or not due to the low level of experience with the users. In addition, some of the respondents might not understand the meaning of the question correctly. Furthermore, bearing in mind the respondents were students and the survey conducted inside the school. The device also is brought by the regional administration and this could intentionally affect the answers. Therefore, it was important to involve the second factor which examines if they ever needed help to firm the finger in the surface. Figure 6 shows that 75% of the respondents needed help more than one time. Also, 15% of the respondents claim that they needed help in every time.

By focusing on familiar and unfamiliar respondents, this study finds unfamiliar people need help more than familiar people in sticking fingers on the device and this result was anticipated as shown in table 3. In addition, the experience with the device is taking into account and people are classified in this context by the number of time that they have experienced the device. Overall, the respondents experienced the device between 1 to 3 times or more. It is noticed (table 4) that the percentage of people who never needed help is growing as number of experience goes up. Table 4 also shows that 62% of experienced people (tried the device in 3 places or more) needed help at least for few occasions.

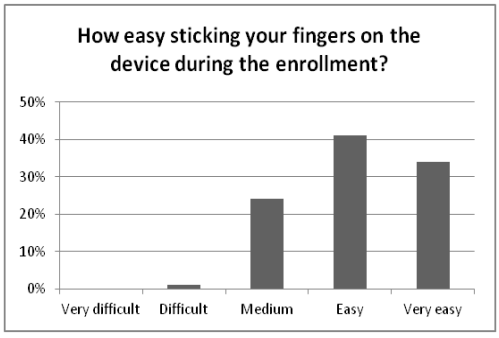

Figure 5: Easiness of the device

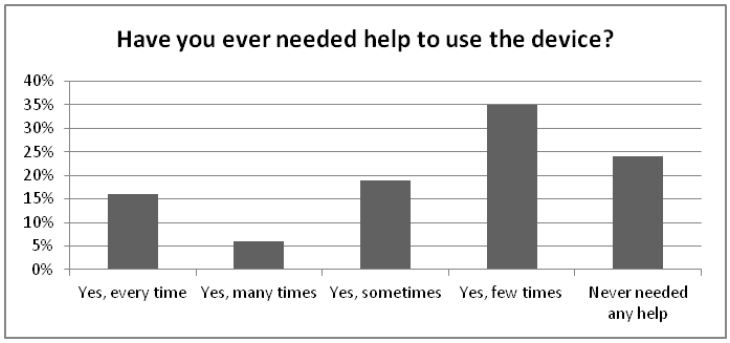

Figure 6: Easiness of the device

	Every time help is needed	Many times help is needed	Sometimes help is needed	Few times help is	Never help is needed

				needed	
Very Familiar and familiar	18%	0%	9%	40%	33%
Neutral	18%	13%	22%	26%	22%
Unfamiliar and very unfamiliar	16%	17%	67%	0%	0%

Table 3: familiarity Vs help needed in using fingerprint device

	% of the whole respondents	Every time help is needed	Many times help is needed	Sometimes help is needed	Few times help is needed	Never help is needed
Experienced fingerprint in 1 place	56%	23%	6%	20%	37%	14%
Experienced fingerprint in 2 places	31%	5%	11%	26%	26%	32%
Experienced fingerprint in 3 places or more	13%	12%	0%	0%	50%	38%

Table 4: experience Vs help needed in using fingerprint device

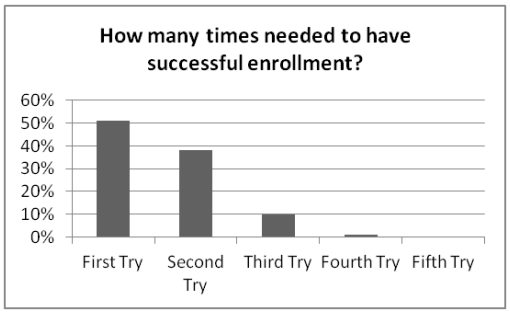

Figure 7: Accuracy

Accuracy

Accuracy in this study will be determined by testing number of time required to get the right picture. It has been very common that the picture quality do not match the requirement at the enrollment phase. Therefore, participants needed to stick the hand a second or third time to get the image approved by the system. Operators of the device are usually involved by helping participants sticking their fingers on the plate of the device. This circumstance happens again at the stage of the verification. This process can be done in airports, or test centers like in our case. It is emphasized that in the verification stage the fault happen more often because it rely more to the users capabilities of sticking his/her fingers at the right position. Otherwise, they will need some help to stick their hands. It is strongly believed by this study that the current physical design of the device cannot help to make this improved. The current design does not help get the best image for enrollment or verification from the first shot. The results of this study show that around 50% of the respondents needed more than one time to have the right image. This percentage could be crises if hundreds of people are waiting in an immigration boarder.

Conclusion

This study was conducted in a female high school at Yanbu Industrial City in the registration process for the comprehensive exam. The number of females participated in this study was 62 girls from the last year in the high school. The study finds many points concerning the familiarity of the device among the participants, the easiness of use and the accuracy. In spite of that the majority of the participants have experienced the machine for single time or never, they have classified themselves as familiar with the device. Moreover, the majority of the respondents have experienced the device in the National Affairs of Saudi Arabia in order to issue National Identity. Few of them tried it in other places such as international airports, and immigration offices. In general, people are aware of the technology but have short of experience with it. This make the decision of adopting such technology harder. Nowadays, the technology is adopted in many boarders and offices dealing with people with unknown level of experience. Next survey and future work can conduct to investigate operators of such devices in boarders. The easiness of the device is exposed when this study has realized that 75% of the respondents needed help in placing their fingers on the surface of the device. Large portion of this percentage are from experienced people.

To sum up, this study believes that current design of fingerprint scanner will not help in either enrollment or verification processes. it will not help the accuracy factor in the sense of that the quality of the image will not reach its best. Definitely, algorithm of the device will only approve a specific range of quality. Most of the image will come at the least level of this range. Furthermore, this design will cause delay for because the scanner needs to read more times. This can be critical if when it is applied for busy and crowded areas that serve huge number of people. This design must be changed for another one easier to grasp and place fingers without requiring any help.

Acknowledgment
Our thanks are due to Mrs Aziza Falatah and her daughter Miss Safaa Falatah for helping us in this research by distributing the questionnaire and collecting data back to us.

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Appendix 1: The Survey

Yanbu University College intends to do a research in the use of fingerprint devices in order to demonstrate any obstacles could be existed in its deployment. Your contribution in this research is highly appreciated and all your answers will be kept confidential and it will only be used for the research purposes.

Research team

1. How did you see the enrollment of your fingerprint process?
    - The enrollment was successful from the first try.
    - The enrollment was successful from the second try.
    - The enrollment was successful from the third try.
    - The enrollment was successful from the fourth try.
    - The enrollment was successful from the fifth try.

2. How do you rate yourself in terms of the familiarity of the fingerprint device?

Very unfamiliar	Unfamiliar	Medium	Familiar	Very familiar
○	○	○	○	○

3. List all places where you have tried this device before? (Choose all appropriate answers)
    - Citizen affairs
    - Immigration offices
    - Embassies and consulates
    - Airports
    - Other places …….
    - I have never dealt with such device

4. How easy sticking your fingers on the plate of the device?

Very easy	Easy	Medium	Difficult	Very difficult
○	○	○	○	○

5. From your experience in dealing with this device, have you ever needed any help in sticking your fingers in the surface?
    - Yes, every time
    - Yes, many times
    - Yes, sometimes
    - Yes, few times
    - Never needed any help