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# Shoulder-Surfing Resistant Graphical Password System

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## Abstract

Graphical passwords consist of selecting images or drawing symbols rather than entering textual characters. They can be considered as an alternative to overcome the problems that arise from the text-based passwords system. It has been suggested that graphical passwords are harder to guess or to be broken by brute force attack. Also, the dictionary attacks are difficult. After a comprehensive study on various graphical password schemes, we propose a design to minimize the search time to find the pass-images on a login screen. The scheme proposed is currently under implementation and will be tested for usability and security verification.

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*Keywords:* passwords;graphical; authentication; pass-objects; login

## 1. Introduction

Text based passwords are the most widely used for authentication. But this traditional technique has its own flaws and is vulnerable to attacks. One of them is the shoulder surfing attack that can be performed by an antagonist to obtain the user's password by watching over the user's shoulder as he enters his password. Traditionally, shoulder surfing attacks also called "peeping attacks" concerns moved from telephone calling card fraud to automated teller machine (ATM) fraud, and more recently to mobile computer users.

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Most graphical authentication systems are based on either recognition or recall [14]. In recognition-based systems a user must recognize images chosen during registration phase from a bulkier group of decoy images. There can be only 2 possibilities that the image is recognized or unknown [13]. In recall-based password systems users must click on several areas chosen at the time of registration in an image, cued by viewing the image. It is known that recognition memory is better than unaided recall [7].

Furthermore, psychological studies show that images are recognized with very high accuracy (up to 98 per cent) after a two hour delay, which is much higher than accuracy for words and sentences [8]. Hence, we propose a scheme to improve some recognition based systems which not only reduce the threat of shoulder-surfing but also has an added benefit of expeditious recognition and usability, thus reducing some flaws of recognition based systems.

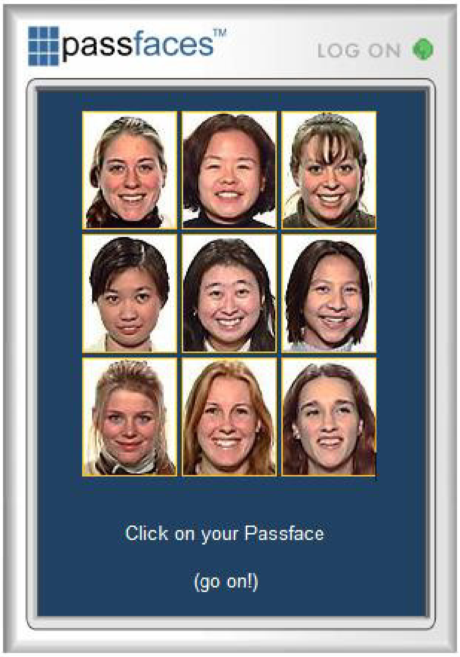
The paper discusses related work in the field of password authentication followed by the description of the proposed scheme. The future work and development in the proposed system concludes the paper.

## 2. Related Work

Some of the graphical password systems are given below:

### 2.1 Passfaces$^{TM}$[2]:

It is a commercial product by Passfaces Corporation. It requires user to select previously seen human faces picture as password. During the login process, the user is required to choose the correct face out of other faces to login. However, such systems are easily anticipated as they are affected by race, gender and attractiveness.



Click on your Passface

Fig. 1.Passfaces$^{TM}$ (passfaces$^{TM}$, 2006)

### 2.2 Pattern Lock[3]:

Nine points are presented to the user. He is supposed to form a pattern by selecting all or some of these points. This pattern is registered and every time the user wants to log in he should enter the same password by joining to points. If the pattern formed is correct the user is granted further access. This scheme is commonly used in smartphones.

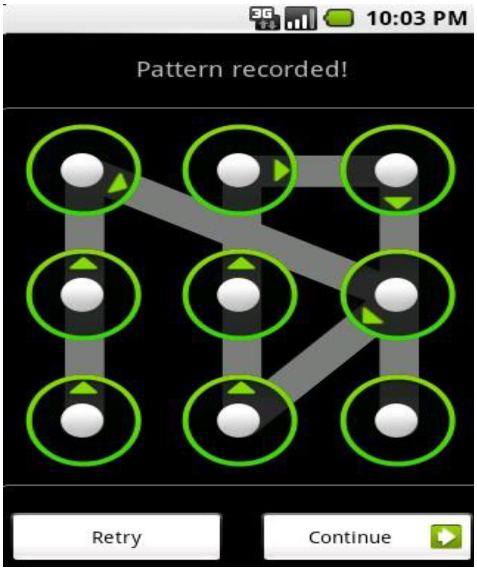


Fig. 2.Pattern Lock (free animation hub, 2012)

## 2.3 Jensen et al. Method[4]:

Based on image selection, a numerical sequence is registered to form a password. At login time user has to recognize same images in same sequence at login time. Main flaw was that password space was small since, the no of images were limited to 30.

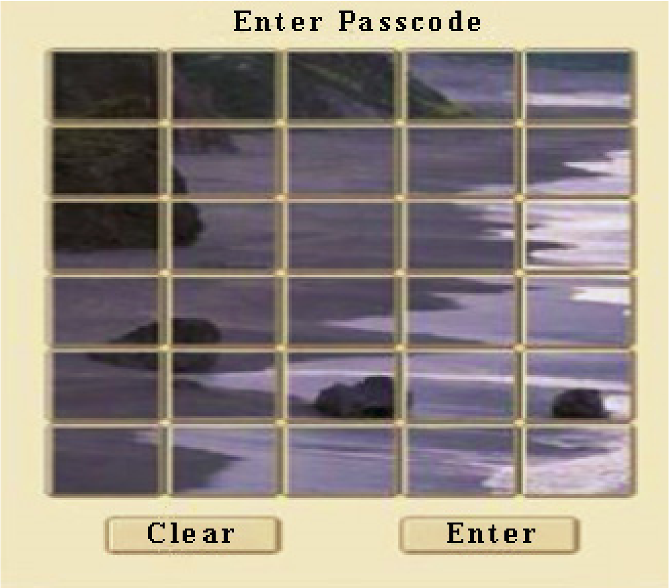


Fig. 3. Cats and dogs theme

## 2.4 Dhamiga and Perrig Method[5]:

Dhamiga and Perrig proposed a scheme called “Déjà vu”. It is based on human ability to remember previously seen pictures. User has to select few pictures from a set of previously. User has to perform same at login time. All abstract images were generated using Andrej Bauer’s random Art. They showed 90 % success rate using “Déjà vu” while only 70% using text-based password and pins. Perhaps shoulder surfing problem is one of the biggest problem for existing graphical authentication. If a person observes a few login rounds can deduce the password. The method stated leaks the pass-images to anybody watching the login screen. Due to susceptibility to such attacks, graphical passwords could never be used in situations where the login is to be done in the presence of people other than the users. However, it is feasible to develop schemes to impede the shoulder surfing problems.

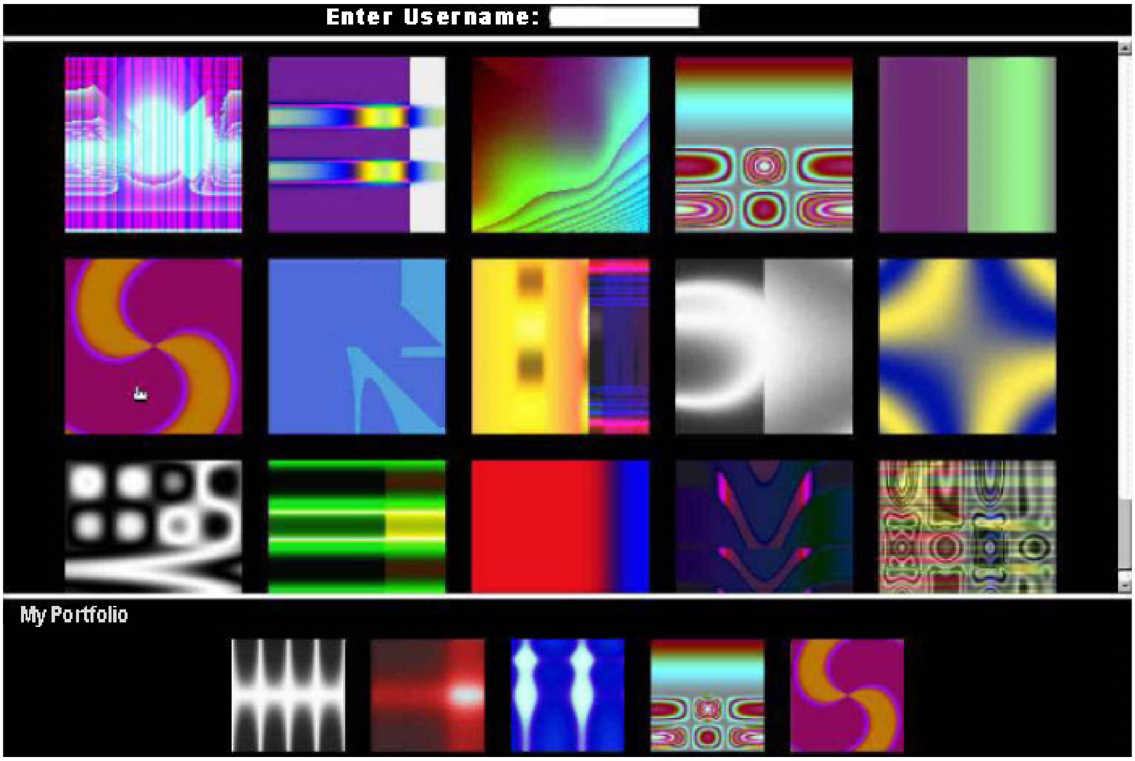


Fig. 4. Dhamiga and Perig Method

## 2.5 Pict-O-Lock[9]:

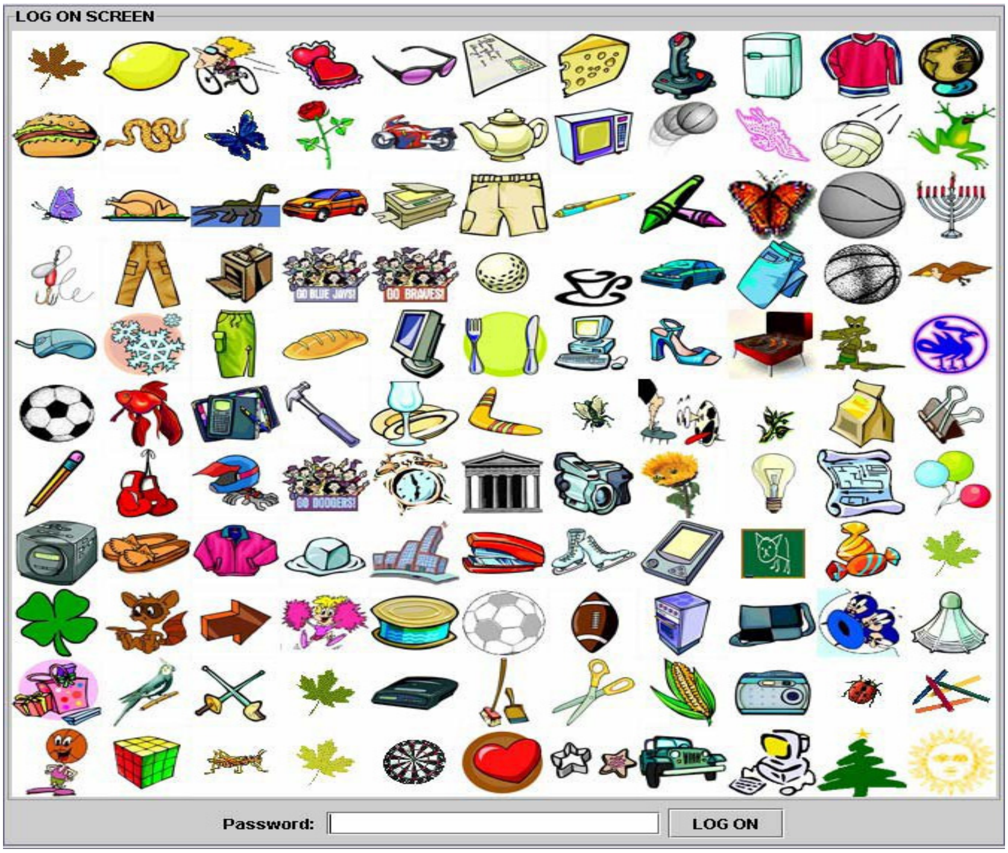


Fig.5.Pict O Lock

In this scheme, each word or character of a password was associated with a pass-image object. For example, if the password has a "0" then it could be associated with any symbol or object appearing as a "0". However, the registration process of this scheme is quite long. The login also becomes very exhausting and sluggish.

## 2.6 Sobrado and Birget (Movable Frame Scheme)[1]

User has to locate 3 pass-objects out of K pass-objects. Out of 3 pass-objects, 1 pass-object is placed in movable frame. The user needs to move the frame like a tape and line it up as per registered alignment with the other pass-object as shown below.

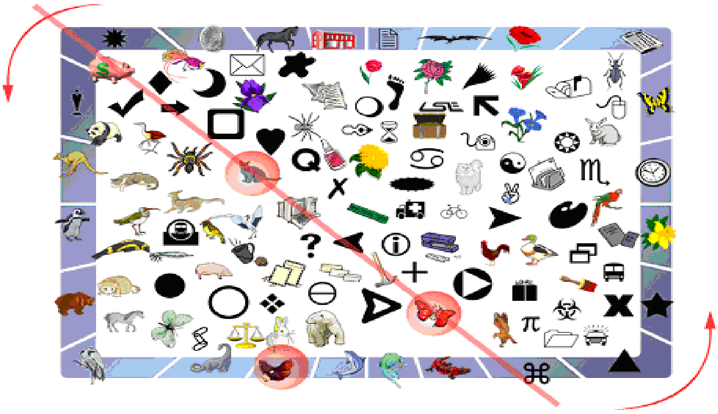
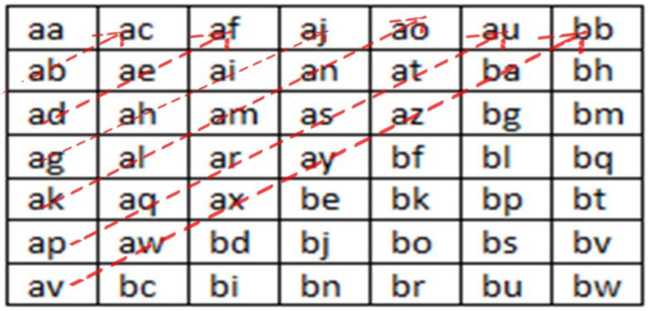


Fig.6. Movable frame scheme

The system recommends using about 1000 objects on the screen. However, detecting 3 objects from 1000 is tedious and time-consuming [1].

### 3. Our Proposed Scheme:

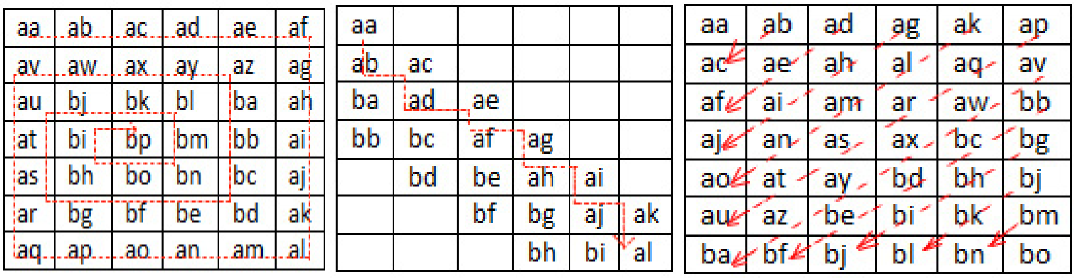
In this section, we will consider a shoulder surfing resistant graphical password scheme based on Sobrado and Birget scheme (Mobile frames scheme).The movable frame scheme by Sobrado and Birget[1] is a recognition-based graphical password authentication scheme. To allow the user to quickly recognize the password symbols on the screen, we propose that instead of using objects in images use texts in images which will lead to quicker recognition and hence we can make use of more images that will in turn lead to higher password space [17]. A simple login screen can be shown below:



| | | | | | | |
|---|---|---|---|---|---|---|
| aa | ac | af | aj | ao | au | bb |
| ab | ae | ai | an | at | ba | bh |
| ad | ah | am | as | az | bg | bm |
| ag | al | ar | ay | bf | bl | bq |
| ak | aq | ax | be | bk | bp | bt |
| ap | aw | bd | bj | bo | bs | bv |
| av | bc | bi | bn | br | bu | bw |

Fig.7. Simple login screen example

The user can select an alphanumeric passphrase at the time of registration. For simplicity, we assume that the user will choose a password containing only alphabets with length of six. Also, we consider that each image on the login page contain two characters in it. Suppose if the password is "abbcbz". The user will have move the frames with characters "ab", "bc" and "bz" and arrange them as per the alignment chosen during registration. The user can move each frame (a row or a column) in the grid which would increase usability and reduce random login. To enhance recognisability, we can arrange the alphanumeric characters in specific patterns for every new login session. Some examples of the patterns are displayed below.



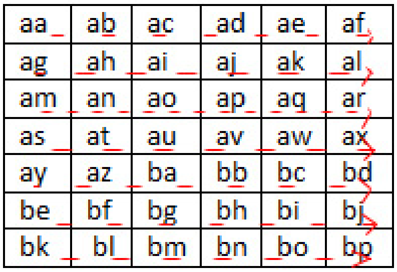
|  |  |  |  |  |  |
|---|---|---|---|---|---|
| aa | ab | ac | ad | ae | af |
| av | aw | ax | ay | az | ag |
| au | bj | bk | bl | ba | ah |
| at | bi | bp | bm | bb | ai |
| as | bh | bo | bn | bc | aj |
| ar | bg | bf | be | bd | ak |
| aq | ap | ao | an | am | al |

|  |  |  |  |  |  |
|---|---|---|---|---|---|
| aa |  |  |  |  |  |
| ab | ac |  |  |  |  |
| ba | ad | ae |  |  |  |
| bb | bc | af | ag |  |  |
|  | bd | be | ah | ai |  |
|  |  | bf | bg | aj | ak |
|  |  |  | bh | bi | al |

|  |  |  |  |  |  |
|---|---|---|---|---|---|
| aa | ab | ad | ag | ak | ap |
| ac | ae | ah | al | aq | av |
| af | ai | am | ar | aw | bb |
| aj | an | as | ax | bc | bg |
| ao | at | ay | bd | bh | bj |
| au | az | be | bi | bk | bm |
| ba | bf | bj | bl | bn | bo |

Fig. 8.(a) Spiral Inward pattern (b) Downward Zig-Zag pattern (c) -45 degree pattern

We can have many such patterns. However, we cannot include patterns with all characters arranged horizontally or vertically as shown below because it will give a hint about the password depending upon the frames being moved in left-right or top-down directions.



|  |  |  |  |  |  |
|---|---|---|---|---|---|
| aa | ab | ac | ad | ae | af |
| ag | ah | ai | aj | ak | al |
| am | an | ao | ap | aq | ar |
| as | at | au | av | aw | ax |
| ay | az | ba | bb | bc | bd |
| be | bf | bg | bh | bi | bj |
| bk | bl | bm | bn | bo | bp |

Fig. 9.Horizontal Arrangement

## 4. Future Work and Conclusion:

In this paper, we presented a graphical shoulder surfing resistant scheme in which the user can efficiently and effortlessly complete the login process without being concerned about shoulder surfing attacks. From a security perspective, this exploration is anticipated to bolster the development of graphical passwords especially recognition-based. Our research shows that the future developments in the field of recognition-based should concentrate on enriching the login time, usability and cognizability. So, a method for contracting the time gap in the authentication process and balancing usability will lead to better graphical password systems. Also, making these schemes available on all platforms is another area for future research.

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