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A New Authentication Method by Using Sequence of User Interactions

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ABSTRACT: In this technical world, authentication is very important to provide security to various applications. Nowadays major password stereotypes are used such as textual passwords, biometric scanning, tokens and cards .Textual passwords are commonly used by all. Encryption algorithms should follow to provide security. In biometric scanning, natural signature and cards or tokens are scanned. But some people are irritated about this type. Most of textual passwords are easily identified by person's interest like pet names, first school name. In this internet world, there is lot of tools available on online to hack easily. 3d password provides more secure than the common methods. It fully based on the virtual environment to generate a password. Some of the attacks may break trial and error method. Therefore, we embedded 3d password and encryption. This idea is more customizable and very interesting way of authentication. And also, this paper provides the overall view of all types of passwords.

I. INTRODUCTION

Types of password

There are three Basic Identification Methods of password that are possession, biometrics, knowledge .

Password is basically an encryption algorithm. Usually it is 8-15 character or slightly more than that. Mostly textual passwords now a day are kept very simple say a word from the dictionary or their pet names, friends etc. Passphrase is nothing but the enhance version of password. Usually it is a combination of words or simply collection of password in proper sequence is Passphrase. It contains any well known thought also.Length of Passphrase is about 30-50 character or more than that also. But it has also some limitations because 30-50 character is creates ambiguity to remember if there is no any proper sequence. Biometricsrefers to a broad range of technologies. It automates the identification or verification of an individual. It fully based on human characteristics or body organs. Types of biometrics are physiological (face, fingerprint, iris) and behavioral.(Hand-written signature, voice).But biometrics has also some drawbacks. Suppose you select your fingerprint as a biometrics. But what to do when you have crack or wound in your finger. In this situation you might be in trouble. And now days some hackers even implement exact copy of your biometrics also.

II. 3-D PASSWORD OVERVIEW

The 3-D password is a multifactor authentication scheme. The 3-D password presents a 3-D virtual environment containing various virtual objects. The user navigates through this environment and interacts with the objects. The 3-D password is simply the combination and the sequence of user interactions that occur in the 3-D virtual environment. The 3-D password can combine recognition-, recall-, token-, and biometrics-based systems into one authentication scheme. This can be done by designing a 3-D virtual environment that contains objects that request information to be recalled, information to be recognized, tokens to be presented, and biometrical data to be verified. For example, the user can enter the virtual environment and type something on a computer that exists in (x1, y1, z1) position, then enter a room that has a fingerprint recognition device that exists in a position (x2, y2, z2) and provide his/her fingerprint. Then, the user can go to the virtual garage, open the car door, and turn on the radio to a specific channel. The combination and the sequence of the previous actions toward the specific objects construct the user's 3-D password.

Virtual objects can be any object that we encounter in real life. Any obvious actions and interactions toward the real-life objects can be done in the virtual 3-D environment toward the virtual objects. Moreover, any user input (such as

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speaking in a specific location) in the virtual 3-D environment can be considered as a part of the 3-D password. We can have the following objects:
1) A computer with which the user can type;
2) A fingerprint reader that requires the user's fingerprint;
3) A biometrical recognition device;
4) A paper or a white board that a user can write, sign, or Draw on;
5) An automated teller machine (ATM) that requests a token;
6) A light that can be switched on/off;
7) A television or radio where channels can be selected;
8) A staple that can be punched;
9) A car that can be driven;
10) A book that can be moved from one place to another;
11) Any graphical password scheme;
12) Any real-life object;
13) Any upcoming authentication scheme.
The action toward an object (assume a fingerprint recognition device) that exists in location (x1, y1, z1) is different from the actions toward a similar object (another fingerprint recognition device) that exists in location (x2, y2, z2), where x1!= x2, y1!= y2, and z1!= z2. Therefore, to perform the legitimate 3-D password, the user must follow the same scenario performed by the legitimate user. This means interacting with the same objects that reside at the exact locations and perform the exact actions in the proper sequence.

III. 3-D PASSWORD SELECTION AND INPUTS

Let us consider a 3-D virtual environment space of size G x G x G. The 3-D environment space is represented by the coordinates (x, y, z) **Є**[1, . . . , G] x [1, . . . , G] x [1, . . . , G]. The objects are distributed in the 3-D virtual environment with unique (x, y, z) coordinates. We assume that the user can navigate into the 3-D virtual environment and interact with the objects using any input device such as a mouse, keyboard, fingerprint scanner, iris scanner, stylus, card reader, and microphone. We consider the sequence of those actions and interactions using the previous input devices as the user's 3-D password. For example, consider a user who navigates through the 3-D virtual environment that consists of an office and a meeting room. Let us assume that the user is in the virtual office and the user turns around to the door located in (10, 24, 91) and opens it. Then, the user closes the door. The user then finds a computer to the left, which exists in the position (4, 34, 18),And the user types "FALCON." Then, the user walks to the meeting room and picks up a pen located at (10, 24, 80) and draws only one dot in a paper located in (1, 18, 30), which is the dot (x, y) coordinate relative to the paper space is (330, 130). The user then presses the login button. The initial representation of user actions in the 3-D virtual environment can be recorded as follows:

(10, 24, 91) Action = Open the office door;
(10, 24, 91) Action = Close the office door;
(4, 34, 18) Action = Typing, "F";
(4, 34, 18) Action = Typing, "A";
(4, 34, 18) Action = Typing, "L";
(4, 34, 18) Action = Typing, "C";
(4, 34, 18) Action = Typing, "O";
(4, 34, 18) Action = Typing, "N";
(10, 24, 80) Action = Pick up the pen;

(1, 18, 80) Action = Drawing, point = (330, 130). This representation is only an example. In order for a legitimate user to be authenticated, the user has to follow the same sequence and type of actions and interactions toward the objects for the user's original 3-D password. Fig. 1 shows a virtual computer that accepts textual passwords as a part of a user's 3-D password. Three-dimensional virtual environments can be designed to include any virtual objects. Therefore, the first building block of the 3-D password system is to design the 3-D virtual environment and to determine what objects the environment will contain. In addition, specifying the object's properties is part of the system design. The design of the

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3-D virtual environment influences the overall password space, usability, and performance of the 3-D password system. Fig. 2 shows a snapshot of an experimental 3-D virtual environment.

Fig.1. Snapshot of a proof-of-concept 3-D virtual environment, where the user is typing a textual password on a virtual computer as a part of the user's 3-D password.

Fig.2. Snapshot of a proof-of-concept virtual art gallery, which contains 36 pictures and six computers

To simplify the idea of how a 3-D password works, Fig. 3 shows a state diagram of a possible 3-D password authentication system.

IV. 3-D VIRTUAL ENVIRONMENT DESIGN GUIDELINES

Designing a well-studied 3-D virtual environment affects the usability, effectiveness, and acceptability of a 3-D password system. Therefore, the first step in building a 3-D password system is to design a 3-D environment that reflects the administration needs and the security requirements. The design of 3-D virtual environments should follow these guidelines.

1) Real-life similarity: The prospective 3-D virtual environment should reflect what people are used to seeing in real life. Objects used in virtual environments should be relatively similar in size to real objects (sized to scale). Possible actions and interactions toward virtual objects should reflect real-life situations. Object responses should be realistic. The target should have a 3-D virtual environment that users can interact with, by using common sense.
2) Object uniqueness and distinction: Every virtual object or item in the 3-D virtual environment is different from any other virtual object. The uniqueness comes from the fact that every virtual object has its own attributes such as position. Thus, the prospective interaction with object 1 is not equal to the interaction with object 2. However, having similar objects such as 20 computers in one place might confuse the user. Therefore, the design of the 3-D virtual environment should consider that every object should be distinguishable from other objects. A simple real-life example is home numbering. Assume that there are 20 or more homes that look like each other and the homes are not numbered. It

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would be difficult to distinguish which house was visited a month ago. Similarly, in designing a 3-D virtual environment, it should be easy for users to navigate through and to distinguish between objects. The distinguishing factor increases the user's recognition of objects. Therefore, it improves the system usability.

3) Three-dimensional virtual environment size: A 3-D virtual environment can depict a city or even the world. On the other hand, it can depict a space as focused as a single room or office. The size of a 3-D environment should be carefully studied. A large 3-D virtual environment will increase the time required by the user to perform a 3-D password. Moreover, a large 3-D virtual environment can contain a large number of virtual objects. Therefore, the probable 3-D password space broadens. However, a small 3-D virtual environment usually contains only a few objects, and thus, performing a 3-D password will take less time.

4) Number of objects (items) and their types: Part of designing a 3-D virtual environment is determining the types of objects and how many objects should be placed in the environment. The types of objects reflect what kind of responses the object will have. For simplicity, we can consider requesting a textual password or a fingerprint as an object response type. Selecting the right object response types and the number of objects affects the probable password space of a 3-D password.

5) System importance: The 3-D virtual environment should consider what systems will be protected by a 3-D password. The number of objects and the types of objects that have been used in the 3-D virtual environment should reflect the importance of the protected system.

It may be applicable for critical servers, Nuclear and military facilities, Airplanes and jetfighters. A small 3-D virtual environment can be used in many systems, including ATMs, personal digital assistants, desktop computers and laptop logins, web authentication.

V. SECURITY ANALYSIS

To analyze and study how secure a system is, we have to consider how hard it is for the attacker to break such a system. A possible measurement is based on the information content of a password space, which is defined in [13] as "the entropy of the probability distribution over that space given by the relative frequencies of the passwords that users actually choose." We have seen that textual password space may be relatively large; however, an attacker might only need a small subset of the full password space as Klein [2] observed to successfully break such an authentication system. As a result, it is important to have a scheme that has a very large possible password space as one factor for increasing the work required by the attacker to break the authentication system. Another factor is to find a scheme that has no previous or existing knowledge of the most probable user password selection, which can also resist the attack on such an authentication scheme.

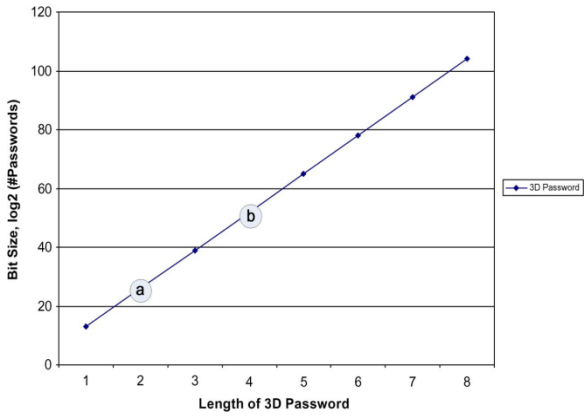

fig shows the points where the 3-D password exceeds two important textual password points. Point "a" shows that by having only two actions and interactions as a 3-D password, the 3-D password exceeds the number of textual passwords used by Klein [2] to break 25% of textual passwords of eight characters. Point "b" represents the full textual password space of eight characters or less. It shows that by performing only four interactions, actions, and inputs as a 3-D password, the 3-D password space exceeds the full textual passwords of eight characters or less.[1]

VI. 3-D PASSWORD DISTRIBUTION KNOWLEDGE

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Studying the user's behavior of password selection and knowing the most probable textual passwords are the key behind dictionary attacks. Klein [2] used such knowledge to collect a small set of 3 x 10^6 words that have a high probability of usage among users. The question is how has such information (highly probable passwords) been found and why. Users tend to choose words that have meaning, such as places, names, famous people's names, sports terms, and biological terminologies. Therefore, finding these different words from the dictionary is a relatively simple task. Using such knowledge yields a high success rate for breaking textual passwords. Any authentication scheme is affected by the knowledge distribution of the user's secrets. According to Davis et al. [9], Passfaces [8] users tend to choose faces that reflect their own taste on facial attractiveness, race, and gender. Moreover, 10% of male passwords have been guessed in only two guesses. Another study [14] about user selection of DAS [13] concluded that for their secret passwords, users tend to draw things that have Meaning, which simplifies the attacker's task.

Currently, knowledge about user behaviors on selecting their 3-D password does not exist. Every user has different requirements and preferences when selecting the appropriate 3-D password. This fact will increase the effort required to find a pattern of user's highly selected 3-D password. In addition, since the 3-D password combines several authentication schemes into a single authentication environment, the attacker has to study every single authentication scheme and has to discover what the most probable selected secrets are. For textual password, the highly probable selected textual password might be determined by the use of dictionaries. However, there are many authentication schemes with undiscovered probable password space. Since every 3-D password system can be designed according to the protected system requirements, the attacker has to separately study every 3-D password system. This is because objects that exist in one 3-D password system might not exist on other 3-D password systems. Therefore, more effort is required to build the knowledge of most probable 3-D passwords.[3]

VII.ATTACKS AND COUNTERMEASURES

To realize and understand how far an authentication scheme is secure, we have to consider all possible attack methods. We have to study whether the authentication scheme proposed is immune against such attacks or not. Moreover, if the proposed authentication scheme is not immune, we then have to find the countermeasures that prevent such attacks. In this section, we try to cover most possible attacks and whether the attack is valid or not. Moreover, we try to propose countermeasures for such attacks.[4]

Brute Force Attack: The attacker has to try all possible 3-D passwords. This kind of attack is very difficult for the following reasons.
1) Time required to login: The total time needed for a legitimate user to login may vary from 20 s to 2 min or more, depending on the number of interactions and actions, the size of the 3-D virtual environment, and the type of actions and interactions done by the user as a 3-D password. Therefore, a brute force attack on a 3-D password is very difficult and time consuming.
2) Cost of attacks: In a 3-D virtual environment that contains biometric recognition objects and token-based objects, the attacker has to forge all possible biometric information and forge all the required tokens. The cost of forging such information is very high; therefore, cracking the 3-D password is more challenging. Moreover, the high number of possible 3-D password spaces (as shown in Table I) leaves the attacker with almost no chance of breaking the 3-D password[5].
3)Well-Studied Attack*:* The attacker tries to find the highest probable distribution of 3-D passwords. However, to launch such an attack, the attacker has to acquire knowledge of the most probable 3-D password distributions. Acquiring such knowledge is very difficult because the attacker has to study all the existing authentication schemes that are used in the 3-D environment. Moreover, acquiring such knowledge may require forging all existing biometrical data and may require forging token-based data. In addition, it requires a study of the user's selection of objects, or a combination of objects, that the user will use as a 3-D password.[6] Moreover, a well-studied attack is very hard to accomplish since the attacker has to perform a customized attack for every different 3-D virtual environment design.[7] Every system can be protected by a 3-D password that is based on a unique 3-D virtual environment. This environment has a number of objects and types of object responses that differ from any other 3-D virtual environment. Therefore, a carefully customized study is required to initialize an effective attack[8].

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4) Timing Attack: In this attack, the attacker observes how long it takes the legitimate user to perform a correct sign-in using the 3-D password. This observation gives the attacker an indication of the legitimate user's 3-D password length. However, this kind of attack alone cannot be very successful since it gives the attacker mere hints. Therefore, it would probably be launched as part of a well-studied or brute force attack. Timing attacks can be very effective if the 3-D virtual environment is poorly designed.[9]
5) Shoulder Surfing Attack: An attacker uses a camera to record the user's 3-D password or tries to watch the legitimate user while the 3-D password is being performed.[10] This attack is the most successful type of attack against 3-D passwords and some other graphical passwords. However, the user's 3-D password may contain biometrical data or textual passwords that cannot be seen from behind. The attacker may be required to take additional measures to break the legitimate user's 3-D password. Therefore, we assume that the 3-D password should be performed in a secure place where a shoulder surfing attack cannot be performed[11].

VIII. COMBINING 3D PASSWORD AND ENCRYPTION

The 3-D password is a multifactor authentication scheme that combines these various authentication schemes into a single 3-D virtual environment. The virtual environment can contain any existing authentication scheme or even any upcoming authentication schemes by adding it as a response to actions performed on an object. Therefore, the resulted password space becomes very large compared to any existing authentication schemes. It is the user's choice and decision to construct the desired and preferred 3-D password.[12] The 3-D password is still in its early stages. Designing various kinds of 3-D virtual environments, deciding on password spaces, and interpreting user feedback and experiences from such environments will result in enhancing and improving the user experience of the 3-D password.[13]
Shoulder surfing attacks are still possible and effective against 3-D passwords.[14]
The more effective encryption scheme can be added with this 3d password. The 3d password from the visual environment can be encrypted again. Encryption scheme may be any type depends upon the area of application. If combinations of different algorithms are used to encrypt 3d password, it provides high level of security.[15]

Probability of Breaking Multi-dimensional Authentication
There are 'n' input images for authentication system and each image has got
multiple- options. In order to authenticate the password, it is required to send input option in a particular sequence while the following gives a probabilistic model of such an authentication system. Let 'n' be the number of inputs where the ith input has Ni option.[16] It is assumed that the option in any input selected for the authentication is one at a time. Considering this aspect, we have n*N1*N2…*Nn possible options. Therefore, the probability of hacking correct password is
1/n*N1*N2*N3…*Nn =>1/n*Nn .Assuming all images that we have the same number of option N1=N2=N3=N. Given N=100 and number of input n=3, 4, 5 the probability of hacking decreases as number of input increases which is very obvious . Y axis values are logarithmic.[17]

No of inputs	Probability of hacking
3	3.33333E-07
4	2.5E-09
5	2E-11

Table 1: Repesents the MDP with 100 attempts for 3 to 5 input

Below figure represents the results while we taken a multidimensional password generation
system with number of input is 3 and number of attempts for hacking increases from 100 to 500.

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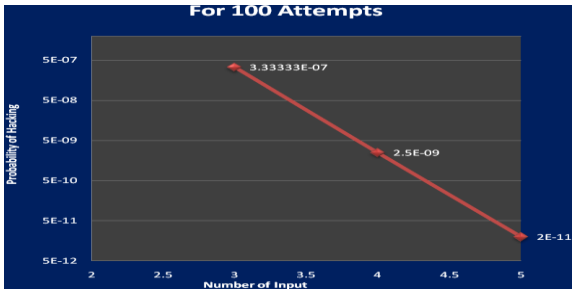

n= Number of attempts , H= Probability of Hacking

100 3.33333E-07
200 4.16667E-08
300 1.23457E-08
400 5.20833E-09
500 2.66667E-09

Fig shown the probability of hacking for given number of attempts

From the above graphs, it is very clear that security level i.e. reduction of probability of hacking, improves drastically with increase in number of dimension of input. So it is advised to go multidimensional password authentication scheme. However, based on the level of security requirements one can decide the number of dimension for the input.[18] Therefore, we conclude that by using multi-dimensional password generation technique, we can improve the security of folder

IX. CONCLUSION AND FUTURE WORK

Moreover, gathering attackers from different backgrounds to break the system is one of the future works that will lead to system improvement and prove the complexity of breaking a 3-D password. Moreover, it will demonstrate how the attackers will acquire the knowledge of the most probable 3-D passwords to launch their attacks. Therefore, a proper solution is a field of research
Working. It depends upon the three different planes and the positions of each and every activity. The user only knows how to behave in the virtual environment

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