Pathword: A 3D Identity Authentication Interface Based on Connection Trajectory

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Abstract

Existing solutions for unlocking virtual reality (VR) systems have issues related to inefficient character input, a high error rate, and easily observable gesture passwords. For these issues, we propose a globe-based user interface called Pathword to access VR devices. Using gesture interaction, the user can select locations on a three-dimensional virtual globe in order to form a trajectory that serves as a key to unlock the VR system. The user authentication interface provides guidance and visual feedback to assist them in entering a trajectory. This method of input is efficient and can be applied to a wide range of VR scenarios.

Index Terms: Authentication; Virtual Reality; Usable Security; Connection Trajectory Passwords.

1 Introduction

With the development of technology and the evolution of the social milieu, consumer-grade virtual reality (VR) devices are becoming more prevalent. The conversion of a 2D plane to a 3D space opens up new landscapes. Despite this, virtual reality devices are insecure and inefficient as significant information storage devices for individuals or organizations because there is a lack of robust security authentication when VR devices are launched, which makes it possible for other users to easily access the apps and data stored on them. Traditionally, handheld devices have been used to enter a password consisting of numbers and letters. This, however, leads to long entry times and a high rate of input errors [1].

Due to the preceding issues, it is essential to create an authentication mechanism for the unlocking procedure. We present here a method of authentication referred to as Pathword, which incorporates the globe as its widget, as illustrated in Figure 1. Passwords are the connection trajectories formed by a sequence of selected locations on a globe. Gesture interactions are used to pick locations. The unpredictability of the sphere's angle, the uncertainty of the location, and the switching of the country and city all contribute to a more secure, effective, and user-friendly verification technique for virtual reality (VR). Although graphic passwords are complex, they are relatively easy to view and record [3].

2 Related Work

Fawaz A. Alsulaiman and El Saddik [2] have presented an authentication system that allows users to navigate and interact with three-dimensional virtual objects. The user's 3D password consists of all interactions, activities, and inputs with regard to objects and the virtual 3D environment. Although the idea is interesting, the environment imposes strict restrictions.

Dr. Mcchester Odoh [4] concludes that 3D passwords are easy to remember because users can visualize them as "small stories." Moreover, diverse 3D objects and a vast number of conceivable interactions with them may result in a large theoretical cipher space, which makes cracking more difficult.

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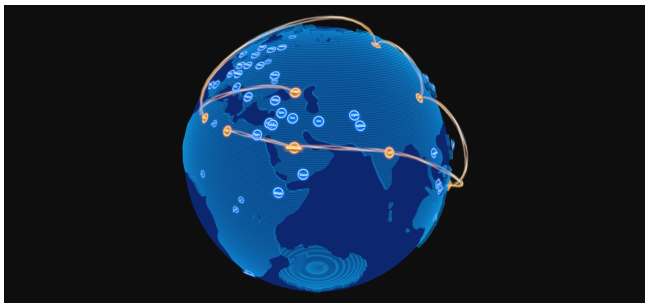

Figure 1: The interface of Pathword

3 Pathword

Pathword was developed on the Unity platform with the official Oculus SDK. When setting up or logging in, passwords are entered using specific gestures. These gestures are recognized by detecting information about the hand bones. By watching the animation, the user can learn how to enter the password for the first time after entering the device, as depicted in Figure 2.

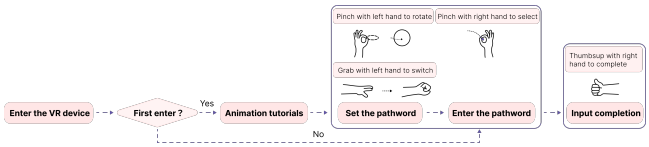

Figure 2: The flow chart of Pathword

3.1 User Interface

As shown in Figure 3(a), the Pathword system places the globe in a fixed position in space, with 50 countries and 50 cities represented. Country and city levels can be interchanged, and the different levels are colored to distinguish them. By rotating the sphere, the user can freely select locations, which will then be connected sequentially into a trajectory. This trajectory serves as the key for unlocking the VR device. Globes, countries, and cities may reduce the need for users to relearn and memorize information, thereby increasing their performance.

3.2 The Path Design

Pathword's goals for the unlocking of the VR device are as follows. (1) The procedure should be easy to learn and quick to execute, which indicates a high level of efficiency. (2) There should be a balance between security and usability. To achieve these goals, we propose the following rules for setting of Pathword:

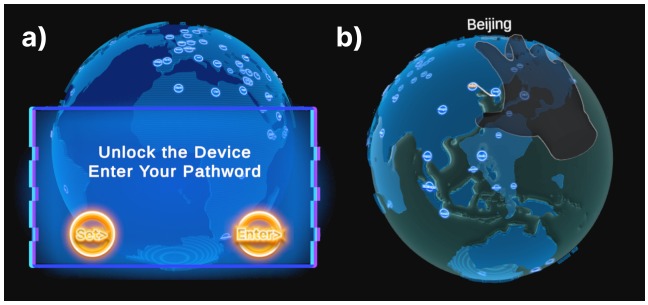

Figure 3: a)The page when the user first enters b)"Beijing" is displayed above the sphere

- Rule 1: Each location has three states: the selected state (Figure 4(a)), the default state (Figure 4(b)), and the hover state (Figure 4(c)), which assist users in comprehending the setup process and reduce learning costs.
- Rule 2: Each selected location is displayed above the sphere as a reminder to prevent confusion and enhance efficiency, as shown in Figure 3(b). Users can deselect a location by picking it twice, confirming their cognitive preferences.
- Rule 3: During the input process, the level of the location can be freely changed, which increases the complexity of the trajectory password. Even if the input process is observed, the risk of being cracked can be reduced.
- Rule 4: The system authenticates users based only on location and selection order rather than the traditional way of matching user ID and password. Users do not need to enter a user name, which is more convenient.

Figure 4: Three different states of location

3.3 Interaction

Pathword's interface is gesture-based since the system mimics a globe, making the input process more natural. There are three primary types of gestures:

- **Pinch:** As depicted in Figure 5(a), users can make a pinch gesture with their left hand anywhere in the space to activate the globe widget at the fingertip to rotate the globe, thereby avoiding occlusion when operating with both hands, expanding the operating space rather than concentrating on the sphere, and facilitating operation as a result. A pinch movement may allow for more precise control of the sphere's rotation based on the user's usage habits.

  By making a pinching gesture with the right hand toward the sphere, the user can select a location. Pathword visualizes the selection process by indicating the direction with the pointer between the thumb and forefinger of the right hand. As depicted in Figure 5(b), the fishing line shot by the finger will automatically point to the closest location, thereby enhancing input precision and making selection easier.

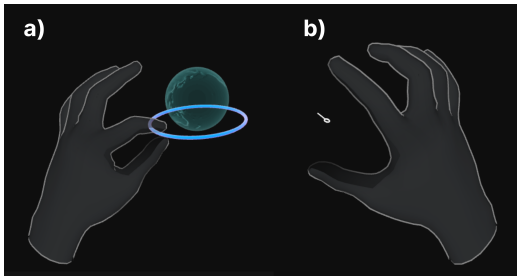

Figure 5: a)The globe agent b)The pointer

- **Grab:** Pathword provides two levels of selection, country and city, in order to enhance the complexity of the password. A user can switch between different levels during the input process by grasping the sphere with their left hand, and the selected track from the other level is always available when switching levels. Grasping the sphere is a straightforward and easy method of changing the state that is consistent with user cognition.
- **Thumbsup:** Once a selection has been completed, the user may confirm its completion by making a thumbs-up gesture with their right hand. The semantics of this gesture are clear, with the meaning of "satisfied," which makes the process of entering a password more interesting.

4 Innovation

For unlocking VR devices, a simple and efficient authentication method has been presented that differs from the common method that utilizes the combination of user ID and password. It uses the trajectory formed by the sequence of selected locations as a code for unlocking the device, which meets the requirements of the target scene and is more convenient to operate.

By introducing a common sense of the earth, country, and city to the identity authentication system, as well as the expression of the earth based on pattern connection verification, a private and unique meaning is imparted to the password that is inseparable from the user's own experience, easy to remember, and more diverse. Additionally, common sense provides reasonable limits and guidelines for password settings. A new type of password content and presentation increases the system's usability and interest.

References

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