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A Study on Game-Based Cartoon CAPTCHA

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ABSTRACT: A CAPTCHA is a type of challenge-response test used in computing as an attempt to ensure that the response is generated by a person. However, as many researchers have already reported, conventional CAPTCHAs could be overcome by state-of-the-art malwares since the capabilities of computers are approaching those of humans. Therefore, CAPTCHAs should be developed on the basis of human-cognitive processing as well as user friendly. As researchers have already proposed Turing test with cartoon CAPTCHA [1], which is fun and enjoyable. So in this paper, I proposed Drag and Drop (DnD) of image CAPTCHA.

KEYWORDS: CAPTCHA, Malwares, Human-cognitive, Turing test

I. INTRODUCTION

CAPTCHAs [2] are used in attempts to prevent automated software from performing actions which degrade the quality of service of a given system, whether due to abuse or resource expenditure. CAPTCHAs can be deployed to protect systems vulnerable to e-mail spam, such as web mail services of Gmail, Hotmail, and Yahoo! Mail.

However, many researchers have recently pointed out security problems with conventional text recognition based-CAPTCHAs [3]. Malicious automated programs that install a sophisticated Optical Character Reader (OCR) have been spreading and these have cracked conventional text recognition based-CAPTCHAs [4,5].

It has become difficult for automated programs to pass tests (read texts) by increasing distortion or noise. However, it has also become difficult for humans to read texts. We therefore need to adopt even more advanced human cognitive processing abilities to enhance CAPTCHA to overcome this problem.

An image recognition-based CAPTCHA such as Asirra [6] is known as one of the effective solutions to enhance CAPTCHAs, because image recognition is much harder problem for a machine than character recognition [1, 6-8]. In Asirra, several photos of animals are presented to a user, and the user is then asked to select a specific animal in a test. For example, when the user is asked to “select all the cats,” if the cat pictures are selected correctly, then the user is identified as a human.

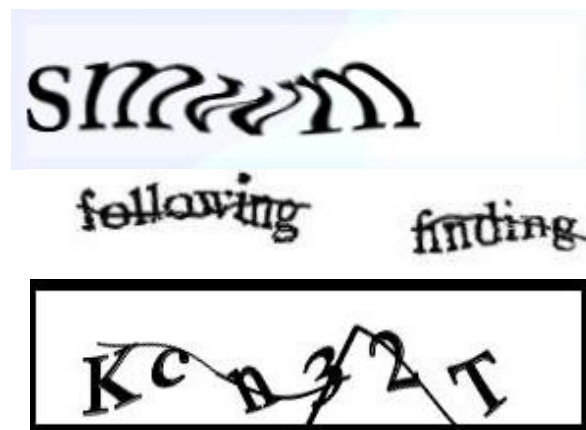


Fig 1 Example text recognition based-CAPTCHAs [3]

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However, a technique that has effectively been used to breach image recognition-based CAPTCHAs has been reported and shocked many researchers [9]. Advancements made to cracking capabilities (CAPTCHA cracking algorithms and CPU processing speeds) will never end. No matter how advanced malicious automated programs are, a CAPTCHA that will not pass automated programs is required. Hence, we have to find another more advanced human cognitive processing ability to tackle this challenge.

Moreover, it is also important to keep in mind that answering CAPTCHAs is an added annoyance for users, who feel troublesome to prove that they are humans. CAPTCHAs must therefore be either (a) tests that create as small as possible the extra trouble that users must go through, or (b) tests that do not make users bored.

On considering these in mind, we have focussed on CAPTCHA of this type to be fun and enjoyable, as it is Drag and Drop of image CAPTCHA. Also CAPTCHA of this type, having 8-panels is extremely high resistance to malwares attacks.

The next section introduces related works of an image recognition-based CAPTCHA, and the concept behind the 8-panel Drag and Drop CAPTCHA and simulation results are described in Section III. In Section IV, conclusion and future work are described.

II. RELATED WORK

As a specific example, I have proposed a CAPTCHA using a four-panel cartoon [1] (Fig 2). In this four-panel cartoon CAPTCHA, a four-panel cartoon is presented with the four panels rearranged randomly, and a user that is able to respond with the correct order is identified as a human. Even if the panels of a four-panel cartoon are rearranged randomly, the human can understand the meaning of the pictures and utterances in each panel, and deduce the order in which the panels must be arranged in order to create a funny story. We therefore believe that it will be relatively easy for a human to arrange the four panels in the correct order.



Fig 2 Example of authentication screen in the proposed method

(Source: From left: 1st image: 1st panel of four-panel cartoon on p.25 of Bibliography [9]; 2nd image: 4th panel; 3rd image: 3rd panel; 4th image: 2nd panel)

Warner proposed Kitten Auth in which several photos of animals are presented to a user (Figure 3). The user has to select images of a specific animal among them [8].



Fig 3 Example authentication windows for the Kitten Auth [8]

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Microsoft's Asirra [6] is similar to Kitten Auth in outline. A User has to select images of a specific animal among several Images (Figure 4). The notable feature of Asirra is that it works together with the world's largest site for homeless pets. The site provides extremely large number of labelled photos of animals. Thus the image database of Asirra is large enough to prevent attackers from reconstructing the database manually.



Fig 4 Example authentication window for Assira [6]

ESP-PIX, so called "naming images CAPTCHA", have been proposed in CMU [2]. In ESP-PIX, a user is presented with several distinct images of same subject. Then the user has to correctly type the common term associated with the images ("elephant" in Fig.5).

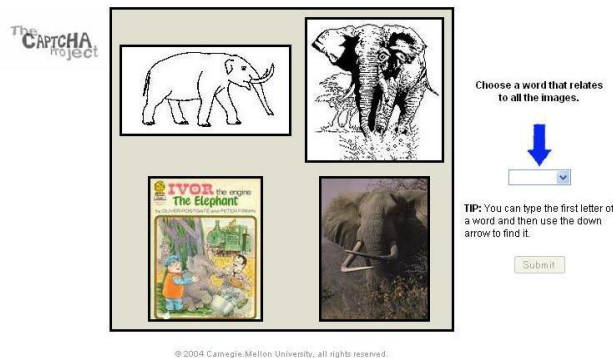


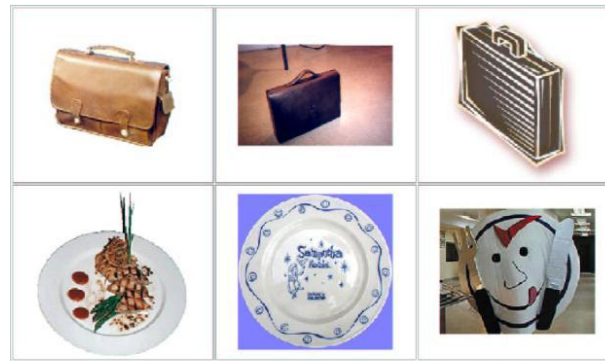
Fig 5. Example authentication window for ESP-PIX [2]

Chew and Tygar proposed two variations on the naming images CAPTCHA [7]; distinguishing images CAPTCHA and anomaly images CAPTCHA. The distinguishing images CAPTCHA presents two sets of images to a user (Figure 6). Each set has three images of the same subject. With equal probability, both sets either have the same subject or not. The user has to answer whether or not the sets have the same subject to pass the test.

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Are the top row of images of the same sort of thing as the bottom row?
 Yes No

Fig 6 Example authentication windows for the distinguishing images CAPTCHA [7]

The anomaly images CAPTCHA presents five images of the same subject and one anomalous image to a user (Fig.7). The subject of the anomalous image is different from that of the other five images. The user has to identify the anomalous image to pass the test.

Find the image that doesn't belong.

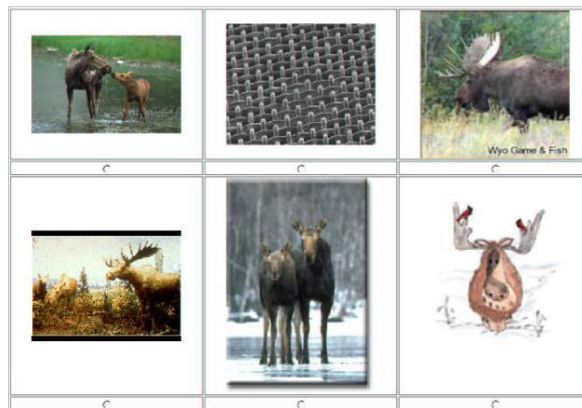


Fig 7 Example authentication window for the anomaly images CAPTCHA [7]

III. PROPOSED CAPTCHA AND RESULT

A. Concept

We have explored a new type of CAPTCHA, based on arranging an image into correct order by the process of Drag and Drop. In this paper, an image is sliced into 8-pieces and shown to the user to rearrange it into a correct image, by dragging the piece-by-piece of image and dropping it another window.

For example, in fig 8, an image of an elephant has been sliced into 8-panels, which is given to the user to arrange. By dragging and dropping those pieces in another window, the user has to arrange in it into correct elephant. After arranging into correct image, it is compared with the original image of elephant (fig 9). If the arranged image is correct, the user is authenticated as human and not a malware.

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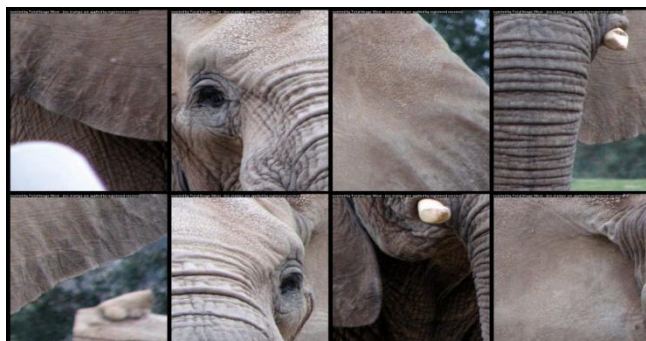


Fig 8. Rearranged 8-panel image of an elephant

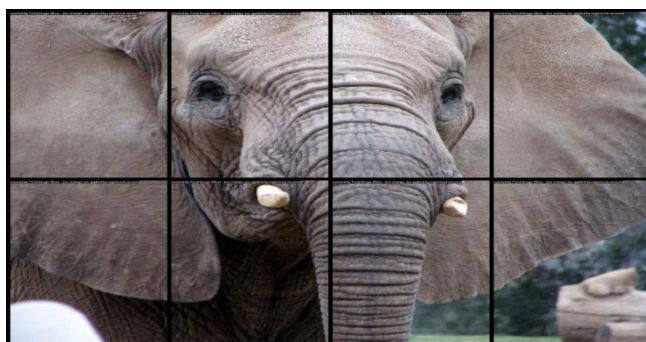


Fig 9 Arranged 8-panel image of an elephant

For a computer, however, it would be difficult to recognize the meaning of the pictures in each panel, to arrange it into a correct image. Moreover, even if image processing and natural language processing capabilities developed, it would be still impossible for the computer to arrange the eight panels in the right order unless it understood what the sliced picture is actually. We believe that it would be nearly impossible for malwares to reach a level where they can understand this type of implicit meaning (what the picture is?), regardless of how advanced the technology might be.

Furthermore, because arranging image is fun and entertaining for humans, an eight-panel DnD CAPTCHA will most likely be seen as an agreeable and enjoyable Turing Test that does not adversely affect convenience for users.

B. Authentication process

The authentication process used in an eight-panel DnD CAPTCHA is as follows:

1. An eight-panel image is selected at random from a database of images
2. The order of the panels in the selected image is sliced into 8-panels and rearranged randomly (shuffled).
3. The shuffled eight-panel image is presented to a webpage visitor.
4. The visitor rearranges the shuffled eight-panel image into what appears to be the correct order by Dragging and dropping piece-by-piece of images in another window (The webpage could be equipped with a form allowing the visitor to input the correct order of panels.)
5. If the order of the panels entered is correct, the visitor is identified as a human, and if the order is incorrect, the visitor identified as malware.



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IV. CONCLUSION AND FUTURE WORK

In this study, I focused on the user's ability to arrange an image, which represents the ultimate in human cognitive processing abilities, and proposed a CAPTCHA that uses eight-panel image. The proposed method is expected to offer a new form of CAPTCHA that features both security and usability, being difficult for advanced malwares to decipher, and at the same time offering entertainment value for users, who will enjoy Drag and Drop of a rearranged image into a correct image.

At present, there is still room for improvement in terms of both security and usability, and make improvements to the proposed method based on the knowledge obtained through the experimental results in this paper. And also can conduct studies to determine whether the eight-panel DnD CAPTCHA is truly resistant to malware attacks. Furthermore, we have to evaluate how much the correct response rate for the eight-panel DnD CAPTCHA, which depends on the intelligence of each human.

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BIOGRAPHY

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