Analysis of Captcha Security Methods in Web Applications

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Abstract

Captcha is the abbreviation for completely automated public turing test to tell computers and humans apart. Captcha is a security mechanism which determines whether the online user is human or automated programs known as bots. Captcha ask the user to perform some task to prove him as human. It is easy for humans to complete the task but difficult for bots. Thus Captcha become a standard protective arrangement in all the websites and web applications to prevent the entry of bots which perform malicious activities such as spamming, scalping. This paper analyzes the various types of Captcha methods engaged in different websites as a security arrangement and their merits and demerits.

Keywords — *Text Captcha, Image Captcha, security, attacks, web applications.*

I. INTRODUCTION

Captcha is a human interactive proof, which ensures the presence of humans in web based applications and the primary duty is to eliminate the computer bots which perform malicious activities. Various types of Captcha methods have been deployed in various websites as a security arrangement. Captcha can be classified as,

- Text based Captcha.
- Image based Captcha.
- Audio based Captcha.
- Video based Captcha

An efficient Captcha [1] should have the following properties.

- Easy for Humans to solve
- Difficult for automated bots to solve
- Easy to generate and evaluate

Captcha has been employed in the following applications [2] as a security arrangement.

- E-mail spam protection
- Web scrappers
- Online polls
- Prevent spam in blogs
- Search engine bots protection

II. TEXT-BASED CAPTCHA

Text-based Captcha is one of the most accepted and widely used forms of Captcha. The text based Captcha consists of a set of characters and numbers generated randomly and then distorted in noisy background to prevent any bot attacks. The user is asked to type the characters in the text box to prove him as human. If a match occurs then authentication will be granted. Andrei broder [3] developed the first Captcha for AltaVista website to prevent automatic adding of URLs to the website for indexing .The Captcha image is shown in figure.1.

Fig.1. Alta Vista Captcha

Gimpy is one of the eminent text based Captcha developed by CMU in association with Yahoo. Gimpy design is based on the human ability to read the extremely distorted text. The bots were unable to recognize this for a long period. Gimpy randomly selects seven words from a dictionary [4], and displaying them with different orientation, distortion and overlapping. The user is asked to enter a subset of the words in the image. A human user can only identify the words correctly, whereas the automated bot programs cannot. During 2000 Henry Baird [5] developed EzGimpy Captcha. It is the simplified version of Gimpy Captcha and adopted by Yahoo in their Signup page. EzGimpy randomly selects a single word from a dictionary and presented with distortion and noise. The user is then asked to identify and enter the text correctly.

Baffle-Text is another text based Captcha designed at California University, Berkeley by Henry Baird [6]. It is a modified version of Gimpy. It selects random alphabets or characters to form a pronounceable text. These words are nonsense words not available in any dictionary. Pessimal print [7] Captcha was developed by coats et al during 2001, in which a degraded image consisting of characters was

displayed to the user as Captcha test. The Gimpy, EzGimpy, Baffle Text and Pessimal print Captcha images are shown in figure 2.

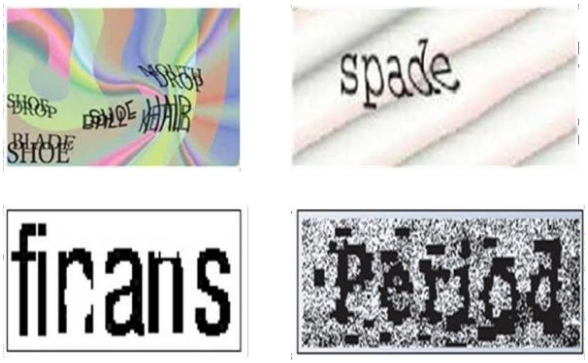

Fig.2. Gimpy, EzGimpy, Baffle Text and Pessimal print Captcha images

MSN Captcha [10] is another popular text based Captcha designed exclusively by Microsoft for their services. They are also known as MSN Passport Captcha. In this eight characters and digits are used to form a Captcha. The characters are presented in the dark blue foreground and in a grey background. Warping is used to distort the characters, to produce a ripple effect, which makes very difficult for recognition by bots. ReCaptcha is another popular text Captcha devised by Von Ahn et al. In addition, to prevent spam the ReCaptcha is also used to identify the deciphered words which are not recognized by the scanners. Out of the two words, one will be taken from an old book need to be digitized.

Lupkowski et al [8] introduced text based semantic Captcha approach. This method presents three words, mostly the names of animals or birds in different rotations. The user needs to identify the semantic relationship between the words and should click the word that does not belong to the group. Amalia rasu et al [9] introduced a handwritten Captcha as HIP which challenges the bots with a handwritten image. In this method an image of handwritten word in a noisy background is presented to the user for identifying the characters. This will be a tough task for the bots, whereas the humans are familiar in recognizing the handwritten words. Fig.3. shows the MSN Captcha, Google ReCaptcha, Semantic and Handwritten Captcha images.

The text based Captcha is most popular among the different type of Captcha security methods. Because,

- It is user friendly for all sections of users
- It is easy for generation and validation

The limitations are,

- More distortion, noise and misrepresentationmake it difficult for humans also.
- By using the OCR method almost every text based Captcha may be cracked easily.
- The text based Captcha methods also suffered by relay, pixel count, and random guess and dictionary attacks.

Fig.3. MSN Captcha, Google ReCaptcha, Semantic and Handwritten Captcha images

III. IMAGE BASED CAPTCHA

An image-based Captcha has been designed based on the image recognition concept of the user. Humans have the ability to recognize different types of images and ability to identify different patterns also. In an image based Captcha the user need to recognize the image and to perform different kind of actions such as solving a quiz, matching symbols, recognizing human faces etc.

Von ahn et al [11] introduced the concept of ESP game and later extended as ESP PIX Captcha. ESP-PIX Captcha needs a large database of labeled images. The program picks multiple images of the same object at random, and presents them to the user. The user has to look the set of pictures and then select the word that best describes all the images. Bongo Captcha [12] asks the user to solve a visual pattern recognition problem. It displays two series of blocks, the left and the right. The blocks in the left series differ from those on the right, and the user is required to find the characteristic that sets them apart. The user is presented a block and asked to identify the block belongs to which group.

Kittenauth is an image based Captcha [13] designed to replace the traditional text based Captcha. It uses the pictures of animals, birds and other living things as Captcha image. Identifying animal images are easy for human and it will be very difficult for the bot programs until neural networks will become powerful to solve such images.

Assira means Animal Species Image Recognition for Restricting Access [14] is another human interactive proof devised by Microsoft, which utilizes www.petfinder.com to design the Captcha.The user is presented with images of cats and dogs and asked to identify all images of cats out of the twelve

pets. This needs image recognition, knowledgeand the user has to go through all the twelve images and click all the answer images. Picatcha [15] is another image based Captcha designed by a group of research people in University of California, Berkeley. It displays a set of images and asks the user to click one or more images of a particular object to prove as human. Figure.4. shows the different Image based Captcha methods.

Fig.4. ESP PIX, Bongo, kittenauth, Assira and Picatcha images

The image based Captcha has the following merits.

- The Captcha design is based on the image recognition concept.
- Users need the ability to recognize different types of images and ability to identify different patterns.
- The users need to perform some actions; solve a quiz, match symbols, recognize human faces.
- It is a best alternate for the text based Captcha
- Images Creates interest to solve, for the humans
- Become a challenge for OCR software

The limitations are,

- Difficult for the users having low vision and color blindness.
- Suffers by machine learning and edge detection attacks.
- Also suffered by relay, pixel count and random guess attacks.

IV. AUDIO BASED CAPTCHA

The Audio-Based Captcha uses downloadable audio clippings [16]. In this the programs picks a word or a sequence of numbers at random and turn into sound clip and distorts the sound clip; it then presents the distorted sound clip asCaptcha to the users. Now the users need to enter the correct word for authentication. This Captcha test is based on the understanding capacity of human to the language and the accent which is impossible for bots. It is designed to help the visually disabled users. But the audio based Captcha is difficult to solve by the non English speaking peoples. Figure.5 shows the Audio based Captcha images.

Fig.5. Audio based Captcha images.

Audio based Captcha image has the following advantages.

- Captcha in the form of audio is played to user for typing
- Designed mainly for visually impaired users

The limitations are,

- Difficult for users with hearing impairments
- User need sound knowledge in English.

V. VIDEO BASED CAPTCHA

In a Video based Captcha [17] a video clipping which have three key words are presented to the user or a video from a public domain like YouTube is used as Captcha. The user need to watch the video, identify the words and submit for authentication. This approach provides greater security and better usability. It poses a great challenge to the computer bots. Figure.6. Shows the Video based Captcha images.

The merits of video based Captcha methods are,

- Video makes human to watch interestingly and to solve the Captcha test.
- Unable to break by OCR

The limitations are,

- Large file size needs extra download time or require high bandwidth.
- Users need more concentration to identify the words.

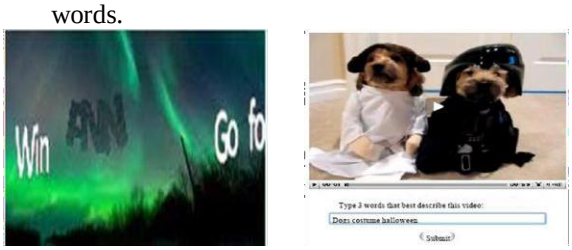

Fig.6. Video based Captcha images

VI. CONCLUSION

Captcha is one of the most powerful and simple security mechanism almost employed in almost every web based applications. The primary purpose of Captcha is to prevent the entry of bots into the website or web applications. But the security method Captcha itself faces different types of attacks such as OCR attacks, laundry, brute force and dictionary attacks. All the traditional text, image, audio and video based Captcha images on different websites are suffering with these attacks. Hence cognition based Captcha security methods are deployed presently in most of the websites. Cognitive activities are the combination of mental processes and physical actions. It includes thinking, knowing, remembering, judging, problem solving and motor skill activities. Cognition activity increases the security of web applications and become a great challenge for the bot programs. Thus security is improved.

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