Review Article

Comprehensive Study on Performance Analysis of Various Captcha Systems

Pranal C. Tayade†* and Mahip M. Bartere†

†G.H.R.C.E.M Department of Computer Science & Amravati University, India

Abstract

With growing use of internet and its services, a large number of organizations are making use of password to provide security. A password is a secret word or combination of alphabet used for user authentication. Authentication to user account to access internet services on-line is achieved victimization password. The password is most convenient means of authentication. But now a day's password becomes hacked by the attacker. To provide more security, we are using Kerberos and the video CAPTCHA as authentication technique. Kerberos is an authentication protocol and CAPTCHA is a (Completely Automated Public Turing Test to tell Computer and Human Apart) test which provide a way to differentiate user into a human and malicious program. CAPTCHA become the most widely used standard security technique to prevent automated computer program attack. Our aim is to proposed a system which can be a better than existing CAPTCHA and provide higher level of authentication.

Keywords: CAPTCHA, Video CAPTCHA.

Introduction

The early days of Internet and web usage, people, business and companies are facing a disastrous threat that comes out of leakage of sensitive data and information. Also, blocking of the network is one of the possible ways to harm a server, storage or service. The progress of Internet, Web Security has become an important issue. To deal with such problems, John Langford, Nicholas J. Hooper and Luis Von Ahn proposed techniques known as CAPTCHA. CAPTCHA is an acronym for "Completely Automated Public Turning Test to tell Computers and Humans Apart". Typically, a Turing test is performed by a human on a machine. Whilst in CAPTCHA schemes, the test is performed by computers to identify the users of the system, particularly, to test whether the user is a Human or not.

The test is for the humans, that is, it is solvable only by humans and not by machine, system or program. The user is required to provide a correct response to the test and then the user is permitted to access the work. When a correct response is received; it is presumed that the response arrived because of a Human user. The three main aspects or features of a good CAPTCHA technique are: humans to solve, Easy to generate automatically, Almost impossible or difficult for any other computer program, to solve. A good CAPTCHA also has two important aspects: Security and Usability. The security dimension determines its strength for preventing the variant attacks, while usability the necessity of "user friendly" when CAPTCHA is deployed.

A. Type of Captcha

CAPTHCAs means presenting a challenge response test to the users or humans. They are classified based on what is distorted that is whether characters, digits, or images. Some types of CAPTCHAs are given below

1. Text CAPTCHA

CAPTCHA based on text is easy to implement and requires a large question bank. Also contain number of classes of characters and digits so that problem occurs for user to identify the correct character and digit. User identifies the correct character and provides the text in the space provided o the form. There are various forms of text based CAPTCHA.

1.1 Gimpy: It is reliable text-based CAPTCHA, developed by Yahoo and Carnegie, Mellon University.

Fig.1 Example of Gimpy

*Corresponding author **Pranal C. Tayade is a M.E Scholar (CSE)** and **Mahip M. Bartere** is working as Assistant Professor

1.2 Ez-Gimpy:-Simplified version of Gimpy that is developed by Henry Baired, which is used by Yahoo messenger in case of their signup page.

Fig. 1 Example of Ez-Gimpy

1.3 Baffle-Text:-It is developed by Henry Baired at California University at Berkeley. It is modified version of Gimpy.

Fig.3 Example of Baffle-Text

1.4 MSN-CAPTCHA:-This type of CAPTCHA contains 8 characters (Uppercase) and digits are used and background color is gray, foreground is dark blue.
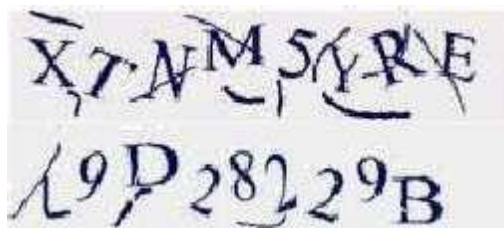

Fig. 4 Example of MSN-CAPTCHA

2. Image CAPTCHA

Image or graphical CAPTCHA is a technique which offers challenge text in which the human user has ability to identify the hidden meaning in the image which is displayed. Various implementation of graphical based Captcha are as follows;

2.1 Bongo:-It is developed by Mikhail M. Bongard who is pattern recognition expert. Visual pattern recognition problem is solved by human. In Bongo, two series of block i.e left and right, and both have different characteristics from each other.
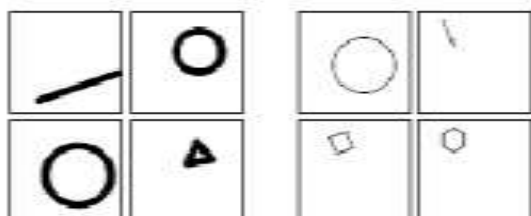

Fig.5 Example of Bongo

2.2 PIX: It include large database of photographic and animated images, which are related to daily needs. There are the images given and user has to recognized the image which is similar to original one. For example - pick the common features among the following 3 pictures =" AEROPLANE"

Fig.6 Example of PIX

3. Audio CAPTCHA

This type of CAPTCHA based on sound-based system. Instead of showing text or image, a sound is played which user must recognized and type the word. It contains downloadable audio-clips. ECO is the first sound based system implemented by Nancy Chan of the City University in Hong Kong.
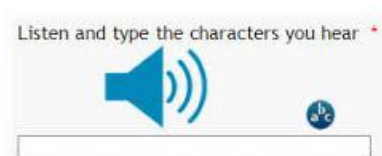

Fig.7 Example of audio Captcha

4. Video CAPTCHA

This type of CAPTCHA is newer technique and more secure than exiting CAPTCHA. A video taken from database that has words that describe video and user has to match word with video and submit even before completing the video.

Fig.8 Example of video captcha

5. Puzzle CAPTCHA

In puzzle based CAPTCHA a picture or image is divided into segment. And user has to arrange this segment to form complete image in correct format.

Fig. 9 Example of puzzle Captcha

Literature Survey

A new security primitive is emerging as an exciting new paradigm, a novel family of graphical password systems built on top of CAPTCHA technology, which we call CAPTCHA as graphical passwords (CaRP). CaRP is both a CAPTCHA and a graphical password scheme. CaRP addresses a number of security problems altogether. Notably, a CaRP password can be found only probabilistically by automatic online guessing attacks even if the password is in the search set. CaRP also offers a novel approach to address the well-known image hotspot problem in popular graphical password systems, such as PassPoints that often leads to weak password choices. CaRP offers reasonable security and usability and appears to fit well with some practical applications for improving online security**.** AnimalGrid and ClickText easier to use than PassPoints and a combination of text password and CAPTCHA. Both AnimalGrid and ClickText had better password memo ability than the conventional text passwords. On the other hand, the usability of CaRP can be further improved by using images of different levels of difficulty based on the login history of the user and the machine used to log in(Bin B. Zhu, Jeff Yan, Guanbo Bao, Maowei Yang, and Ning Xu *et al*,2014).

With the growing use of Internet and its services, a large number of organizations are making use of it to provide and seek information of the people using those services. This has raised the chances of attacks on such services by interrupting them sending multiple requests to the servers providing these services programmatically. So a new technique that utilizes image from custom mouse cursors and outperforms some most popular CAPTCHA techniques such as Text – based CAPTCHAs and previous Image – based CAPTCHAs (Ved Prakash Singh, Preet Pal *et al*,2014).

A CAPTCHA scheme that can be used to distinguish human and robot such as malicious program. Both Google and Microsoft use the text-based CAPTCHA for authenticated process. However, all text-based CAPTCHA has been broken due to the fact that it can't prevent Optical Character Recognition (OCR) attack which can automatically identify the CAPTCHA's words. Consequently, new kinds of CAPTCHA have been proposed to solve this security hole. For example, image-based and audio-based CAPTCHA are new emerging schemes used to replace text-based CAPTCHA. Here, they propose a novel CAPTCHA scheme (GeoCAPTCHA) which utilizes the personalized contents such as geographic information to prevent the 3rd Party Human Attack. Then, we conduct a security analysis of the usability and security of GeoCAPTCHA. GeoCAPTCHA can enhance the performance and security of the Google and Microsoft's CATPCHA system with rotated 3D street-view image (Baljit Singh Saini, Anju Bala *et al*,2013).

As many text-based schema have been broken OCR techniques, a new 3D CAPTCHA have emerged. Here the study of robustness of 3D text-based CAPTCHA adopted by Ku6 which is a leading website providing videos in China and also provide the first analysis of 3D CAPTCHA. The security of this CAPTCHA scheme relies on a novel segmentation resistance mechanism, which combines Crowding Character Together (CCT) strategy and side surfaces which form the 3D visual effect of characters and lead to a promising usability even under strong overlapping between characters (Qi Ye, Youbin Chen, Bin Zhu *et al*, 2014).

The prevailing implementation of CAPTHA is 2D still image verification code however; the developing AI and image recognition technology makes it possible for computer program to pass through CAPTCHA's test. So a new CAPTCHA implementation which is in the form of 3D animation based on the week point of computer vision. New method prevents attacks based on image recognition and moving object recognition (Te-En Wei, Albert B. Jeng *et al*,2012).

Turing test to tell Computers and Humans Apart, it's become a key to prevent malicious programs to access web resources automatically. A new type CAPTCHA system will be proposed. The proposed scheme, named Clickspell, combined the features of text-based and image-based CAPTCHAs. Clickspell asks users to spell a randomly chosen word by clicking distorted letters for passing the test. Users can learn the definition(s) of the chosen word. Clickspell can add an advertisement image which in turn increases Security of your system (Nipun Manohar, Yogesh Kusmude, Chetan Konde *et al*, 2013).

CAPTCHA is a HIP (Human interactive Proof) system. CAPTCHAs are used to improve the security of Internet based applications in order to ensure that a web based application which is intended to be used by a human being is not maliciously used by Artificially Intelligent programs called bots. As the current CAPTCHA methods are striving to turn out to be difficult for bots, they are gradually becoming difficult and annoying for human users as well. Here we review the existing CAPTCHA schemes and the trend of using AI-Complete problems for designing efficient CAPTCHAs (Jing-Song Cui, Jing-Ting Mei, Wu-Zhou Zhang, Xia Wang, Da Zhang *et al*, 2010).

Table Drawback of each types of Captcha

Sn	Type of Captcha	Advantage	Drawback
1	Text based Captcha	1) Text-based Captcha is simple to implement so it's mostly used in websites. 2) Battle Text-based Captcha is used to defeat dictionary attacks. 3) Re-Captcha Text-based Captcha uses new dictionary words that cannot read using optical character recognition	1. In text images, user has some problem to identify the correct text or characters. i. Multiple fonts. ii. Font size. iii. Blurred Letters iv. Wave Motion. 2. It can be easily identified by OCR techniques.
2	Images based Captcha	1) Over the text-based Captcha it increases the security. 2) Simple click based system so no need of typing. 3) Using Image-based Captcha pattern recognition of image is difficult AI program.	1. Some users face problem of image identification who have low vision or due to blurring of Images. 2. It can be easily identified by IR attack.
3	Audio based Captcha	1) It is used for people that have visual impairment. 2) Friendly to peoples.	1. It is available in English therefore end user must have a comprehensive English Vocabulary. 2. Character that have similar Sound.
4	Video based Captcha	1) It cannot break using Optical Character Recognition (OCR). 2) It cannot effect by laundry attacks. 3) In some cases it provides greater security than Text-based Captcha and Image based Captcha.	Due to large size of file, users face problem to download video and find correct Captcha
5	Puzzle based Captcha	1) It seems like a fun. 2) It helps the user to monitor their brain. 3) It's like a game so user can more interact with this Captcha system.	The task is not easy for users because puzzle based Captcha take more time to solve the puzzle and identify actual arrangement of puzzles.

Application of Captcha

CAPTCHA is significantly important to differentiate between human and machine over the internet in the field of AI, Internet Security and human computer interaction. Various application of CAPTCHA is as follows;
1. Protecting Website Registration.
2. Preventing E-mail spam.
3. Preventing Comment Spam in Blogs.
4. Protecting online polls.
5. Preventing Dictionary Attack.
6. Search Engine Bots.
7. Preventing Worm and Spam.
8. E-Ticketing.

Problem Statement and Discussion

The early days of internet and web usage, people, business and companies are facing a disastrous threat comes out of leakage of sensitive data and information. Also blocking of network is one the possible ways to harm a server, storage or services. People have developed techniques, system, program and software system that can replace a normal human being to do a job. In an open network computing environment, a work station cannot be trusted to identify its user correctly to networking services. Internet evolution led to growth of innumerable misuses of the services which lead hacking the user account, has raised the

chances of attack on such services by interrupting them sending multiple request to the servers providing these services programmatically. Many times password may hacked by the hacker. Password act as authentication technique. To deal with such problem, a techniques known as CAPTCHA was proposed.

In a proposed system we are using Kerberos as authentication protocol and a video CAPTCHA as a security mechanism which improves the existing security and also provide better authentication to web services. Finally we are going to provide the multi-level security to web services.

Comparison

In this paper, the current review research is on CAPTCHA. There are many types of CAPTCHA, two methods to implement CAPTCHA mechanism i.e. ORC and non-ORC. But many times CAPTCHA which is implemented by ORC mechanism has been cracked by ORC techniques.

In non ORC mechanism user requires to identify images. It is generally used in research area, commercial sites rarely used.

The above table shows the drawback of each types of Captcha. In proposed method we are trying to provide more security by using video Captcha and also provide authentication by using a standard authentication protocol i.e. Kerberos.

Conclusion

In this paper, we studied the various types of CAPTCHA have developed yet. The applications of Captcha, comparison and drawbacks of each types of CAPTCHA. Though various alternatives of CAPTCHA are continuously emerging and the race will continue. The basic idea of Captcha is to tell human and computer or machine apart. In future the focus is on to developed a CAPTCHA which provide easy access to user and highest level of security.

Reference

Qi Ye, Youbin Chen, Bin Zhu (2014), *The Robustness of a New 3D CAPTHCHA*,11th IAPR International Workshop on Document Analysis Systems, 978-1-4799-3243-6/14

Nikitha Bhasu and Raju. K. Gopal (2014)*, Enhanced Security Solution to Prevent Online Password Guessing Attacks*, SSRG International Journal of Computer Science and Engineering (SSRG-IJCSE) – volume1 issue6.

Bin B. Zhu, Jeff Yan, Guanbo Bao, Maowei Yang, and Ning Xu (2014),*Captcha as Graphical Passwords—A New Security Primitive Based on Hard AI Problems*, IEEE transactions on information forensics and security, vol. 9, NO. 6.

Ved Prakash Singh, Preet Pal (2014),*Survey of Different Types of CAPTCHA*,(IJCSIT) International Journal of Computer Science and Information Technologies, Vol. 5 (2) , 2242-2245.

Varun Ambrse Thomas, Karanvir Kaur (2013),*Cursor CAPTCHA –Implementing CAPTCHA Using Mouse Cursor* ,978-1-4673-5999-3/13/$31.00 © IEEE.

Sushama Kulkarni, Dr. H. S. Fadewar (2013), *CAPTCHA Based Web* Security: An Overview, International Journal of Advanced Research in Computer Science and Software Engineering, Volume 3, Issue 11, ISSN: 2277 128X.

Nipun Manohar, Yogesh Kusmude, Chetan Konde (2013*), A Spelling Based CAPTCHA System Using Click,* International Journal of Computer Science and Management Research, Vol 2 Issue 4.

Baljit Singh Saini, Anju Bala (2013)*, A Review of Bot Protection using CAPTCHA for Web Security*, IOSR Journal of Computer Engineering (IOSR-JCE) e-ISSN: 2278-0661, p-ISSN: 2278-8727Volume 8, Issue 6, PP 36-42

Te-En Wei, Albert B. Jeng (2012), *GeoCAPTCHA - A Novel Personalized CAPTCHA Using Geographic Concept to Defend Against 3rd Party Human Attack*, 978-1-4673-4883-6/12/

Jing-Song Cui, Jing-Ting Mei, Wu-Zhou Zhang, Xia Wang, Da Zhang (2010), *A CAPTCHA Implementation Based on Moving Objects Recognition Problem*, International Conference on E-Business and E-Government, 978-0-7695-3997-3/10