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Hybrid Collage CAPTCHA

Divya Shanker, Prashant Gupta, Aditya Jaiswal

Abstract— Authentication is indeed at the heart of any secure system. CAPTCHAs, a class of HIPs tests, are a program that tells whether user is a human or a computer. CAPTCHAs currently in use have been broken. Thus, there is a need to employ stronger CAPTCHAs to keep these breaking attacks at bay while retaining ease of implementation on websites and ease of use for humans. One of the CAPTCHA methods is Collage CAPTCHA. It is a method for distinction between human and computer programs through recognition and finding a picture of an object among some objects. In this project we improve the resistance of Collage CAPTCHA method by an improved method called Hybrid Collage CAPTCHA. In this method we display images on left and right side of the screen. On left side screen we have an image. On right side screen we have the corresponding images along with different names in distorted form. Now the computer program asks user to choose the picture with correct name. If the user select correctly, then user is allowed to enter the name of the image in the given text box. If entered name is correct, then we guess that user is human.

Index Terms— Authentication, Denial of Service, CAPTCHA, Collage CAPTCHA, HIP (Human Interaction Prove), OCR & Non-OCR CAPTCHA, Multiple SEIMCHA

1. INTRODUCTION

Authentication is indeed at the heart of any secure system; a user has to be authenticated before he/she can be involved in online transactions, enter a secured vault, open a safe or reach his/her email account. With the development of the computer application in different field, internet has made a tremendous progress and become a special need in human life. It has application in a wide range of daily affairs including trade, education, daily purchases and dialogues take place with the use of Internet. One of the common actions in the Internet web sites, especially commercial and administrative ones, is to fill out registration forms for certain purposes. Unfortunately, there are some programs which automatically fill out these forms with incorrect information to abuse the site. This wastes a large volume of the resources of the site.

Moreover this type of activity on the sites leads to Denial of Service attack on certain sites. Due to such a problem the legitimate user cannot access the site in a proper manner. CAPTHCA is an acronym for Completely Automated Public Turing test to tell Computers and Humans. The term "CAPTCHA" was coined in 2000 by Luis Von Ahn, Manuel Blum, Nicholas J. Hopper (all of Carnegie Mellon University, and John Langford (then of IBM). It is a method used by many web sites to fight against computer-generated input. CAPTCHAs are challenge puzzles used to determine whether a user is human or not. Intuitively, a CAPTCHA is a program that can generate and grade tests that most humans can pass but current computer programs cannot pass. The goal of such a system is to ask simple question that a computer cannot pass, but a human can pass easily. CAPTCHAs must satisfy three basic properties. The tests must be

a) Easy for humans to pass.
b) Easy for a tester machine to generate and grade.
c) Hard for a software robot to pass. The only automaton that should be able to pass a CAPTCHA is the one generating the CAPTCHA.

An advanced version of CAPTCHA known as ADVANCED COLLAGE CAPTCHA has been proposed, wherein the CAPTCHA method displays another set of pictures but with different shapes in a similar form. The user is required to choose the match object as the one chosen previously to prove human interaction.
CAPTCHA methods can be generally divided into two groups:-

I. OCR-based CAPTCHA.
II. Non-OCR-Based CAPTCHA.

I. OCR-Based CAPTCHA Methods:-

In OCR-based methods, the image of a word with distortion and various pictorial effects is shown to the user and he/she asked to type that word. Due to presence of various pictorial effects, the computer will encounter problems in the recognition of these words and only a human user can recognize the word. But these methods usually result in dissatisfaction of users. On the other hand, efforts have been made for attacking these methods. Examples of these methods include Gimpy, Handwritten CAPTCHAs and Persian/Arabic CAPTCHA.

II. Non-OCR-Based CAPTCHA Methods

In contrast, we can point to Non-OCR-based methods which are easier to work with than OCR-based ones Non-OCR CAPTCHAs include audio, video, picture and logical CAPTCHAs. Examples of these methods include PIX, Text-to-Speech method, and Drawing CAPTCHA.

1.1. Collage CAPTCHA Method

Collage CAPTCHA is a method for distinction between human users and computer programs through recognition and finding a picture of an object among some objects. The structure of the suggested method is as follows: At first a bank of the pictures of objects is prepared. These pictures include objects, animals, different persons, flags of the countries, etc. The concerned program chooses some of these pictures randomly. Each of these pictures is rotated a little. Then all the pictures are shown on the screen. The pictures are putted in random places but the pictures don't overlap.

Computer chooses one of the shown pictures as a goal and asks the user to click on the picture of that object. If the user clicks on the goal picture, we can conclude that a human user has done the click and the user is not a computer program because a computer program should do two operations successfully in order to respond appropriately: First it must recognize the wanted object and has knowledge of its shape. Then it must find the place of the object on the screen.

1.2. The Improved Hybrid Collage CAPTCHA Method

The improved method is designed in such a way to increase the resistance of collage CAPTCHA method to hackers attack. The structure is as follows: In this method we display images on left and right side of the screen. On left side screen we have an image. On right side screen we have the corresponding images along with different names in distorted form. Now the computer program asks user to choose the picture with correct name. If the user select correctly, then user is allowed to enter the name of the image in the given text box. If entered name is correct, then we guess that user is human, not a bot. More over the text box remained disabled until use selects both the images correctly then only the text box is enabled and user can enter the name of the image in text box.

In this method computer requires four abilities to pass the test

I. To find out the shape of the concerned object
II. To find the concerned object on the screen
III. To find out the object containing the name of the "selected object" on the screen
IV. To enter the name of the image in the text box

It is difficult for the computer to realize these tasks in correct order, only a human user can recognize and choose the concerned object. This method can be implemented by Java programming language. The implementation is similar to original CAPTCHA method with some differences.

The CAPTCHA program select 6 images (objects) randomly that must be different from the previous images. The objects must be different from each other and should be placed on the left side of the screen Then corresponding images containing the name of the objects already present on the left side should appear on the right side of the screen (can be seen in fig 1).

A) Goal Picture (on left side of screen)

B) Corresponding collage image (on right hand side of the screen

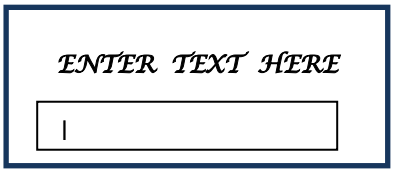

Fig 1: Implementation of Hybrid Collage CAPTCHA

2. TYPES OF CAPTCHA

On the basis of different methodology the CAPTCHA can be categorized as follows:-

2.1 Text CAPTCHAs

These are simple to implement. The simplest yet novel approach is to present the user with some questions which only a human user can solve. Examples of such questions are:

1. What are twenty minus three?
2. What is the third letter in UNIVERSITY?
3. Which of Yellow, Thursday and Richard is a color?
4. If yesterday was a Sunday, what is today?

Such questions are very easy for a human user to solve, but it's very difficult to program a computer to solve them.

These are also friendly to people with visual disability – such as those with color blindness. Other text CAPTCHAs involves text distortions and the user is asked to identify the text hidden

2.2 Graphic CAPTCHAs

Graphic CAPTCHAs are challenges that involve pictures or objects that have some sort of similarity that the users have to guess. They are visual puzzles, similar to Mensa tests. Computer generates the puzzles and grades the answers, but is itself unable to solve it.

2.3 Audio CAPTCHA

The final example we offer is based on sound. The program picks a word or a sequence of numbers at random, renders the word or the numbers into a sound clip and distorts the sound clip; it then presents the distorted sound clip to the user and asks users to enter its contents. This CAPTCHA is based on the difference in ability between humans and computers in recognizing spoken language. Nancy Chan of the City University in Hong Kong was the first to implement a sound-based system of this type. The idea is that a human is able to efficiently disregard the distortion and interpret the characters being read out while software would struggle with the distortion being applied, and need to be effective at speech to text translation in order to be successful. This is a crude way to filter humans and it is not so popular because the user has to understand the language and the accent in which the sound clip is recorded.

2.4 ReCAPTCHA and Book Digitization

To counter various drawbacks of the existing implementations, researchers at CMU developed a redesigned CAPTCHA aptly called the reCAPTCHA. About 200 million CAPTCHAs are solved by humans around the world every day. In each case, roughly ten seconds of human time are being spent. Individually, that's not a lot of time, but in aggregate these little puzzles consume more than 150,000 hours of work each day. What if we could make positive use of this human effort? reCAPTCHA does exactly that by channeling the effort spent solving CAPTCHAs online into "reading" books.

To archive human knowledge and to make information more accessible to the world, multiple projects are currently digitizing physical books that were written before the computer age. The book pages are being photographically scanned, and then transformed into text using "Optical Character Recognition" (OCR). The transformation into text is useful because scanning a book produces images, which are difficult to store on small devices, expensive to download, and cannot be searched. The problem is that OCR is not perfect.

ReCAPTCHA improves the process of digitizing books by sending words that cannot be read by computers to the Web in the form of CAPTCHAs for humans to decipher. More specifically, each word that cannot be read correctly by OCR is placed on an image and used as a CAPTCHA. This is possible because most OCR programs alert you when a word cannot be read correctly. But if a computer can't read such a CAPTCHA, how does the system know the correct answer to the puzzle? Here's how: Each new word that cannot be read correctly by OCR is given to a user in conjunction with another word for which the answer is already known. The user is then asked to read both words. If they solve the one for which the answer is known, the system assumes their answer is correct for the new one.

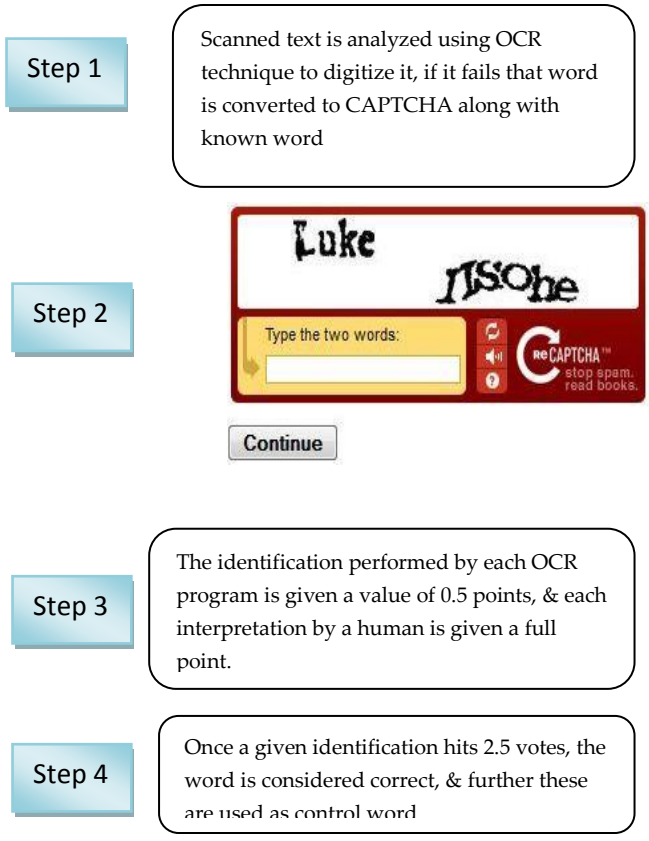

Fig 2: Steps implementation of reCAPTCHA

The system then gives the new image to a number of other people to determine, with higher confidence, whether the original answer was correct. Currently, reCAPTCHA is employed in digitizing books as part of the Google Books Project.

3. RELATED WORK

3.1 Bongo

BONGO is named after M.M. Bongard, who published a

book of pattern recognition problems in the 1970s. BONGO 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 in the right, and the user must find the characteristic that sets them apart.

3.2 Hand Gesture Based CAPTCHA

In our system we generate random character set and ask user to show gesture corresponding to certain character, User gesture is captured and processed to identify if it represents shown character, if gesture is correct CAPTCHA is solved and user is treated a human. A random word of 4 character length is generated and characters are represented by C1, C2, C3, C4 user gesture images are captured as I1, I2, I3, I4 corresponding to C1,C2,C3,C4. We apply Robust Scale-invariant feature transform (SIFT) algorithm to find key-points of input images against database images. Now we find matching by calculating distance between database test image and input image and find Validity ratio or percentages of matching and find if two or more matches exist then we make slight variations to parameters like threshold and perform key-point calculation, matching and percentage calculation to find exact match and identify gesture.

3.3 Question Based CAPTCHA

This test is an extension of simple question based test and proposes a simple mathematical according to a predefined pattern but instead of some object name, image of the object is placed.

3.4 ESP-PIX CAPTCHA

This CAPTHCA was initially proposed by Blum and Von Ahn and uses a larger database of photographs and animated images of everyday objects. The CAPTCHA system present a user with a set of images all associated with the same objects or concept. The user must enter the objects or concept to which all the images belong to e.g., the program might present the picture of Globe, Volleyball, Planet and baseball expecting the user to correctly associate all these pictures with the word ball.

3.5 Drawing CAPTCHA

In this method a large number of dots with a few distinguishable ones with some noise added to it are shown to the user. A few distinguishable dots differ from other by making them to have small holes in center or making them rectangular. The user is asked to connect these distinguishable dots to gain access to the service. This method is apparently consuming a larger space on the web page and is also prone to be broken by bots using intermediate image processing algorithms.

3.6 Image Block Exchange CAPTCHA

In this CAPTCHA an image is randomly chosen from the image database. On this image two non-overlapping blocks if the same size are exchanged and is show to the user. In order to pass the test, the user must click on the switched regions.

3.7 Face Recognition CAPTCHA

This technique requires the user to recognize some images of a subject (Face of the human being) with two distortions applied to it. As an extension of this technique different photos of the same individual to which different distortions are applied respectively can be used.

3.8 Multiple SEIMCHA

Multiple SEIMCHA system warps images by using geometric transformations and a 2-D view of warped image is shown to user. Users should click on the upright orientation of warped image as a semantic. Multiple SEIMCHA evaluates user based on the idea of almost right response instead of completely right response. This idea uses hardness rate concept which is defined based on user response rate to images. The proposed system has a great response time and success rate as usability metrics and it is secure to bots.

3.9 Color CAPTCHA

It a new CAPTCHA which is based on identifying the color of image, object or background. This actually requires analysis of complex contents of image, which humans usually performs well but machines or robots usually do not. There will a large database of different labeled colored images. All of these images are pictures of concrete objects (a car, a table, a fan, a flower, a computer etc.) but within only one color or it be a colored image only. The program picks any image at random basis presents them to the user and along with this it will provide a list of all colors to user for their convenience and then asks the question "what is the color in this picture?" Current computer programs should not be able to answer this question, because computer machine is unable to understand he question and judge the color.

4. APPLICATIONS

CAPTCHA's have several applications for practical security. Some of the applications are as follows:

- **Preventing Comment Spam in Blogs:** Most bloggers are familiar with programs that submit bogus comments, usually for the purpose of raising search engine ranks of some website. This is called comment spam. By using a CAPTCHA, only humans can enter comments on a blog. There is no need to make users sign up before they enter a comment, and no legitimate comments are ever lost.

- **Protecting Website Registration:** Several companies (Yahoo!, Microsoft, etc.) offer free email services. Up until a few years ago, most of these services suffered from a specific type of attack: "bots" that would sign up for thousands of email accounts every minute. The solution to this problem was to use CAPTCHAs to ensure that only humans obtain free accounts
- **Protecting Email Addresses From Scrapers:** Spammers crawl the Web in search of email addresses posted in clear text. CAPTCHAs provide an effective mechanism to hide your email address from Web scrapers. The idea is to require users to solve a CAPTCHA before showing your email address. A free and secure implementation that uses CAPTCHAs to obfuscate an email address can be found at reCAPTCHA Mail Hide.
- **Online Polls:** Online polls are attacked by bots and are susceptible to ballot stuffing. This gives unfair mileage to those that benefit from it.
- **Preventing Dictionary Attacks:** CAPTCHAs can also be used to prevent dictionary attacks in password systems. The idea is simple: prevent a computer from being able to iterate through the entire space of passwords by requiring it to solve a CAPTCHA after a certain number of unsuccessful logins. This is better than the classic approach of locking an account after a sequence of unsuccessful logins, since doing so allows an attacker to lock accounts at will.
- **Search Engine Bots:** It is sometimes desirable to keep webpage's unindexed to prevent others from finding them easily. There is an html tag to prevent search engine bots from reading web pages. The tag, however, doesn't guarantee that bots won't read a web page; it only serves to say "no bots, please." Search engine bots, since they usually belong to large companies, respect web pages that don't want to allow them in. However, in order to truly guarantee that bots won't enter a web site, CAPTCHAs are needed.
- **Preventing Unauthorized Access:** The CAPTCHA mechanism prevents a hacker who tries to crack a password using Brute force method or any other password cracking method.
- **Worms and Spam:** CAPTCHAs also offer a plausible solution against email worms and spam. Spammers register themselves with free email accounts such as those provided by Gmail or Hotmail and use their bots to send unsolicited mails to other users of that email service.

Table 1: A brief Overview of Various Schemes.

S.No.	Authors	Title	Description
1.	Ramesh Babu, Praveen Kumar, Dr. Srinivasa Rao	Implementation of Secure Multilayered CAPTCHA	This is a 3-layered dynamic CAPTCHA can be implemented by using the "layered" concept. Three layers are: Character Layer, Background Interference Layer and Foreground Interference Layer.
2.	Mandeep Kumar, Dr. Renu Dhir	Implementation of Colored CAPTCHA	It is a new CAPTCHA which is based on identifying the color of image, object or background. This actually requires analysis of complex contents of image, which humans usually performs well but machines or robots usually do not.
3.	Monica Chew, J. D. Tygar	Image Recognition CAPTCHAs	In this it is proposed and implemented three CAPTCHAs based on naming images, distinguishing images, and identifying an anomalous image out of a set. Novel contributions include proposals for two new CAPTCHAs, the first user study on image recognition CAPTCHAs, and a new metric for evaluating CAPTCHAs.

4.	Aditya Raj, Ashish Jain, Tushar Pahwa, Abhimanyu Jain	Picture CAPTCHAsWith Sequencing	In this approach, each CAPTCHA round comprises of object pictures, each of which may be accompanied by a Tag. The user is required to determine the logical sequence of the displayed object pictures based on the Tags. We identify two generation schemes - one in which object pictures indicate an inherent sequencing and one in which explicit Tags are displayed for determining the sequencing.
5.	Nisar A. Shah, M. Tariq Banday	Drag and Drop Image CAPTCHA	In the proposed technique a composite CAPTCHA image of a reasonable dimension and resolution is shown to the user. The user has to identify two small and simple embedded images (source image and target image) from the shown composite image as asked in the message appearing in the composite image itself. The user has to drag the source image and drop it over the target image to prove human interaction.
6.	B.Srinivas, G.Kalyan Raju, Dr. Koduganti Venkata Rao	Advanced CAPTCHA technique using Hand Gesture based on SIFT	This method is based on user gestures which make it unique and secure. It generates a random 4 character string number and shown to user. User should show gesture of particular characters in an order using computer webcam or using a mobile phone. A pattern matching algorithm is applied on those user images to identify gestures, and find matching.
7.	Maryam Mehrnejad, Abbas Ghaemi, Bafghi, Ahad Harati, Ehsan Toreini	Multiple SEIMCHA (Multiple SEmantic IMage CAPTCHA)	Multiple SEIMCHA system warps images by using geometric transformations and a 2-D view of warped image is shown to user. Users should click on the upright orientation of warped image as a semantic. Multiple SEIMCHA evaluates user based on the idea of almost right response instead of completely right response. This idea uses hardness rate concept which is defined based on user response rate to images.

5. CONCLUSION

In this project we improve the Collage CAPTCHA method by presenting a method for increasing the resistance of it. Although we can increase the rate of its difficulty in order to improve its resistance against the attacks by applying other effects such as increasing the objects present in the screen and decreasing the distance between the objects, this way the test will become more difficult even for a human user in addition to computer programs. Moreover we can also show the objects that can be overlapped some fashion that will be difficult task for a computer program to identify the two objects correctly. We can also implement this method in such a way that we can show the mirror image of the object on the right side of the screen that would be daunting task for a computer program to identify it correctly.

We can also implement this method on other devices such as mobile phone, PDA (Personal Digital Assistant), and the devices which have touch screens, because no keyboard is needed in this method and also there is no need to heavy processing. Besides its advantage of covering every age group, even children, we can also recommend it for disabled people. We can make this method specialized for specific websites for example we can use the specialized sport pictures (such as soccer players pictures) for sport news, websites.

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AUTHORS BIOGRAPHY

Divya Shanker is currently pursuing her Engineering (B.Tech.) Degree from Institute of Technology and Management, GIDA, Gorakhpur (U.P.). The college is affiliated to Gautam Buddha Technical University.

She is currently in her final semester and will be passing out in the year 2013. Her areas of interest include Network Security and Cryptography

Prashant Gupta is currently pursuing his Engineering (B.Tech.) Degree from Institute of Technology and Management (Integrated Technical Campus), GIDA, Gorakhpur (U.P.). The college is affiliated to Gautam Buddha Technical University. Lucknow.

He is currently in his final semester and will be passing out in the year 2013. His areas of interest include Network Security and Cryptography.

Aditya Jaiswal is currently pursuing his Engineering (B.Tech.) Degree from Institute of Technology and Management (Integrated Technical Campus), GIDA, Gorakhpur (U.P.). The college is affiliated to Gautam Buddha Technical University. Lucknow.

He is currently in his final semester and will be passing out in the year 2013. His areas of interest include Network Security, Cryptographic Algorithms & Distributed Computing.