

CAPTCHAs with a Purpose

Suhas Aggarwal
suhasagg@gmail.com

Abstract

In this paper, we develop some new Captchas belonging to genre — “CAPTCHAs with a purpose.” These CAPTCHAs apart from having its applications serve some useful purpose. reCAPTCHA is one such Captcha developed at Carnegie Mellon University. It helps to digitize books. Another such Captcha is Asirra developed at Microsoft which provides homes for homeless animals. In this paper, we present Time based, Sentence based, Human Emotion based CAPTCHAs which have range of other useful purpose such as measuring reaction time of people, promoting news, general knowledge facts, jokes among people while engaging in routine activities such as checking email. Also, one can be used for conducting online polls on a very large scale. We also showcase a New Game with a Purpose called “Identical Emotions” which helps to assign tags describing emotions depicted by the images, to varied images. It can also be used to serve Emotion Based CAPTCHA. We also present a new scheme which renders attack on CAPTCHAs useless and make old CAPTCHAs reusable and help in using CAPTCHAs which might serve some practical purpose which otherwise might be vulnerable to use. This system also enables to use different CAPTCHAs with a purpose in conjunction with each other. At present most websites deploy only a single algorithm reCAPTCHA whose practical purpose is to digitize books, thus is limited to one domain. This system can thus, broaden the application domain of CAPTCHAs.

1 Introduction

A CAPTCHA or an HIP is a program that protects websites against bots by generating and grading tests that humans can pass but current computer programs cannot[1]. For example, humans can read distorted text, but current computer programs can't. The term CAPTCHA (for Completely Automated Public Turing Test To Tell Computers and Humans Apart) was coined in 2000 by Luis von Ahn, Manuel Blum, Nicholas Hopper and John Langford of Carnegie Mellon University.

Copyright © 2012, Association for the Advancement of Artificial Intelligence (www.aaai.org). All rights reserved.

1.1 Applications

CAPTCHAs are used 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 the webmail services of Gmail, Hotmail, and Yahoo! Mail. CAPTCHAs found active use in stopping automated posting to blogs, forums and wikis, whether as a result of commercial promotion, or harassment and vandalism. CAPTCHAs also serve an important function in rate limiting, as automated usage of a service might be desirable until such usage is done in excess, and to the detriment of human users. In such a case, a CAPTCHA can enforce automated usage policies as set by the administrator when certain usage metrics exceed a given threshold. The article rating systems used by many news web sites are another example of an online facility vulnerable to manipulation by automated software.

1.2 CAPTCHAs with a Purpose

In this paper we develop a new genre of Captchas called CAPTCHAs with a purpose. These Captchas apart from having its applications serve some useful purpose. reCAPTCHA [2] is one such Captcha developed at Carnegie Mellon University. It helps to digitize books. Another such Captcha is Asirra [3] developed at Microsoft. In this paper, we present Captchas which have range of other useful purpose such as measuring reaction time of people, promoting news, general knowledge facts, jokes among people while engaging in routine activities such as checking email, conducting online polls on a very large scale.

2 Time Based Captcha

1) Splash random alphabets on random positions on a screen at different time instants. Alphabets will appear for an instance and then disappear. User will have to type alphabets in a sequence they appeared.

2) Display simple images in a sequence. Images will appear for an instance and then disappear. User will have to give caption to the images displayed, in a sequence they appeared. Sample images are such as those labelled by an ESP game and can be obtained from ESP Game database [4].

These CAPTCHAs expire, if they don't receive a response in a particular time interval. Idea behind this is to make use

of challenges which humans can solve quickly but computers take some time to solve.

Purpose: As user will have to quickly respond to the alphabets displayed as they appear and disappear, this can be used to check whether user is able to react to the alphabets presented in a certain time frame, so it can be a suitable means to measure certain reaction capabilities of human beings, though the environment in which person is present may affect the quality of data.

Analysis: There is some challenge in implementation of these CAPTCHAs, if implementation is done using flash, then flash file might be downloaded. Current implementation makes use of animated gif. Please note that letters are distorted to make it harder for computers. Also, this captcha can be made harder by asking users to enter the repeated sequence as well and playing repeated sequence random no. of times. In this way even if, program is able to extract frames from animated gif and recognize individual alphabets, it may not know, how many times sequence of alphabets is to be entered. Some experiments can be designed by altering time gaps at which alphabets are splashed (For e.g., reducing 1 second to 0.5 second) and recording how many Captchas were solved for different time gaps which may give some idea of human abilities. Also, if system is detected to be under abuse, time gaps can be increased significantly to make CAPTCHA solving time consuming and expensive.

3 Sentence Based Captcha

A sentence is selected. Two random words are selected from the sentence and are swapped. A Random alphabet is filled in each whitespace present in the sentence. Sentence is degraded by crippling its text (GIMPY) for interfaces with GUI support or by using Text or Graphics character based CAPTCHAs [5] for interfaces with text support only such as SSH accounts. Challenge is to guess the sentence and write the sentence in correct format by inserting whitespaces between words. A possible reversible attack can be to write a program which can guess correct words in the sentence and perform a search over the web and identify the correct sentence from the results obtained. A new degrading scheme which can be useful in this scenario is to omit out certain alphabets from the words and present a sentence composed of partially “eaten up” words.

Purpose: Educating people. Sentence can be general knowledge facts, thoughts of the day, recent headlines. (Imagine how cool! will it be, if one can catch up with the latest news while just checking regular emails!)

Solutions: (a) None of us is as smart as all of us — Word “of” and “all” are swapped and garbage alphabet is filled in the white space. — Intelligence Quote.

(b) Anna Hazare breaks fast after 288 hours — Words “Hazare” and “after” are swapped and garbage is filled. — A News Headline

(c) Bad officials are elected by good citizens who do not vote — Words “elected” and “citizens” are swapped. — Humorous Quote

Analysis: There is an argument that sentence based CAPTCHA is bit difficult for humans. It might also be

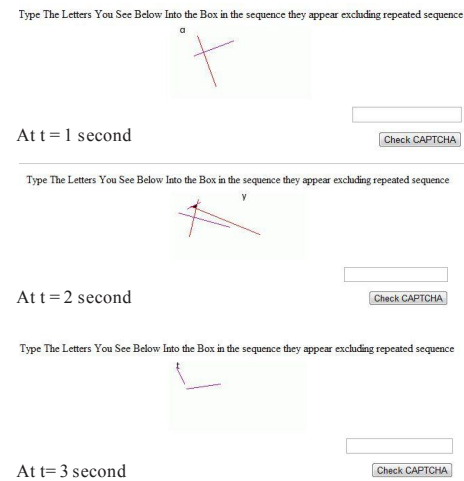


Figure 1: Time based Captcha with time gap = 1 second
Solution for this Captcha will be – ayt.

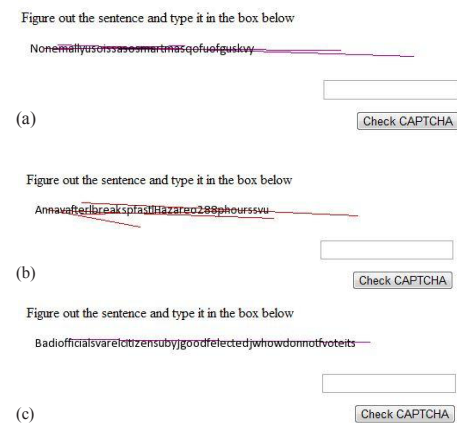


Figure 2: Sentence Based Captcha with sentences of different genre.

possible to attack it using natural language processing techniques using language model techniques for example. Sentences making use of common sense facts might be more useful to follow taking into account that machines don't have access to this information but then this CAPTCHA will lose its practical utility. How to use this CAPTCHA so that it can serve its purpose is discussed later in the paper.

4 Human Emotion Based Captcha

A statement or a graphic is displayed to the user depicting human emotion. User has to type string describing his emotion as an answer. There can also be “NULL” images which do not depict any emotion corresponding to which user has to type “NULL” as an answer.

The solution for the emotion based Captcha (figure 3) is (a) Happy (b) Beautiful (c) Shock.

Sentences:



Figure 3: Emotion based Captcha

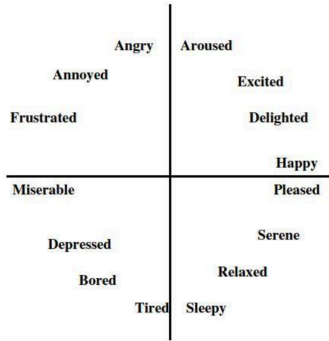


Figure 4: Russells circumplex model of emotion.

- Are children who act in rated “R” movies allowed to see them?
- The man who smiles when things go wrong has thought of someone to blame it on.
- Hewlett Packards first product was an automatic urinal flusher
- In the late 1990s, Microsoft secretly developed its own version of Linux, but shelved it after quality control researchers deemed it “too stable.”

One measure for comparing emotions can be the Russell circumplex model of emotion [11][15], illustrated in Figure 4. The two principal axes are excitement and pleasure. Russell states that these axes are orthogonal. For example, the emotion distress implies high excitement and displeasure, and so distress falls in the upper left quadrant of the model. However, low excitement and displeasure correspond to depression in the lower left quadrant. Emotions that are close to each other on the model are perceptually similar to humans, and vice versa. Opposite, or most dissimilar, emotions are diagonal to each other on the model. So, we can categorize emotions on the basis of the quadrant in which they lie and in this way group similar and dissimilar emotions. This model can be deployed in Emotion based CAPTCHA for identifying correct and incorrect answers when tags depicting emotion attached with the image are not sufficient, thus will improve the accuracy of CAPTCHA.

Purpose: Can be indirectly used for conducting online polls on a very large scale. When an important poll is being conducted sometimes, all answers given by the users will be marked as acceptable and their different reactions corresponding to an event can be obtained. It won't affect the security of CAPTCHA as poll is conducted sometimes and it is not possible to know when it will be conducted.

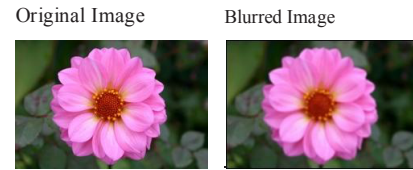


Figure 5: Blurring can be achieved by using ConvolveOp operator in java.

Example: Austrian-born actor Arnold Schwarzenegger has won the race to become governor of California, pledging to become a “governor of the people.” Poll distribution was: 35%, 35%, and 30%.

Analysis: Security analysis of this CAPTCHA is similar to that of Asirra CAPTCHA. It is argued that this CAPTCHA is based on the security of the database but as there are plenty of such images available from different sources on the web, it is an easy task to upgrade the database frequently, hence it becomes difficult to attack this CAPTCHA. KittenAuth suffered from a database attack because its database made use of only 42 images but there can be millions of images which can be used for this CAPTCHA. Moreover, the technique used is not merely image recognition as employed in CAPTCHAs such as Asirra which have been attacked, one has to depict emotion displayed by images. Database for emotion based Captcha can be constructed using a game with a Purpose. A simple game is “Identical Emotions.” A player and partner are given same image and they have to type emotion corresponding to that image, they keep on getting images till their emotions are same, when their emotions differ, game is over, more their emotions are identical, more points they get. Also, image for which their emotions differ is displayed to them and they also see each others responses for it. Further, images displayed are slightly blurred each time to different degrees, making image recognition and database construction for images difficult as a single image is converted into multiple images with different blurring levels.

Different blurring levels can be achieved by varying values of the following matrix

```
float[] matrix = {
0. 111f, 0. 111f, 0. 111f,
0. 111f, 0. 111f, 0. 111f,
0. 111f, 0. 111f, 0. 111f,
\};
```

Blurring can be achieved by using ConvolveOp operator in java. `BufferedImageOp op = new ConvolveOp (new Kernel(3, 3, matrix)); blurredImage = op.filter(sourceImage, destImage);` (figure 5)

So, it can be observed that lot of suitable blurring levels are possible. Further, security can be increased by locking Captcha using Token Bucket Algorithm, which will be discussed and its implementation will be shown in later section of the paper.



Figure 6: Identical Emotions Game displaying image to the player.



Figure 7: Next image being displayed and score increment when players have “Identical emotions”

4.1 Identical Emotions

‘Game with a Purpose’ was innovative idea developed at CMU. These games help computers learn to think more like humans. One plays the game, computers get smarter. Some of these games include ESP game which helps to label images on the web, Verbosity which help to collect common sense facts, Matchin which helps to generate best images etc. These Games are available at www.gwap.com/gwap.

This game is an extension of “ESP” Game whose main purpose was to label images on the web. Identical emotions, instead of assigning description to the image, helps to assign emotions to the images, thus provides tags describing emotions depicted by the images. This helps to classify images according to different genre such as “sorrowful,” funny,” “shocking,” “beautiful,” etc.

Description of the system The game is played by two partners and is meant to be played online by a large number of pairs at once. Partners are randomly assigned from among all the people playing the game.

Players are not told whom their partners are, nor are they allowed to communicate with their partners. The only thing partners have in common is an image they can both see. Challenge imposed by Identical Emotion to players is that they have to type “emotion” the image is depicting and player and his partner have to type same emotion to win points. Once both players have typed the same string, they move on to the next image and we say that their emotions are “identical.”

In the Figure 6, when player and partner type the same emotion depicted by image for example love, they move on to the next image (Figure 7).

Partners strive to agree on as many images as they can in 3



Figure 8:

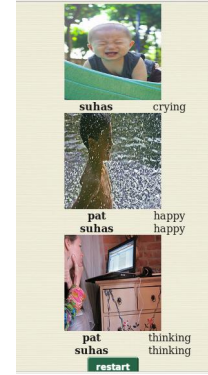


Figure 9:

minutes. Every time two partners have “Identical Emotions” on an image, they get a certain number of points. More their emotions are Identical, more points they get. Players can also choose to pass or opt out on difficult images. If a player clicks the pass button, a message is generated on their partners screen; a pair cannot pass on an image until both have hit the pass button. As the player and his partner have to type same string describing emotion for the image to move on, they have to agree on the same emotion depicted by the image, thus string which they type can act as a good tag for the image, describing emotion conveyed by the image.

Off-Limit Words If an image has been labeled many times before, system generated off limit words and players cannot use this words for labeling. These words act as Taboo words. These words make the game harder as the players now, will have to think of another possible emotion which image is conveying. Taboo words are obtained from the game itself. The first time an image is used in the game, it will have no taboo words. When it has been labeled by players in previous games, it will start having taboo words.

For example — Figure 8 can have off limit word “love” associated with it and players will have to type another emotion depicted. In this example it can be “happy.” These taboo words guarantee that image will get different tags describing emotions associated with it. When the game is over, player and partner can review the labels they submitted for the image as shown in Figure 9.

Selecting the images For game to be successful images presented to the user should be evocative. Images are retrieved from flickr database. Images are searched for different keywords such as “face,” “nature,” “flowers,” “ex-



Figure 10: Tag: love.



Figure 11: Tag: happy.

pression,” “celebration,” “emotion,” “movie,” “baby,” “children,” “books,” “god,” etc. Keywords are selected intelligently such as search will return images depicting different emotions. Moreover, for the game to be able to create a good database and to be able to serve Emotion based Captcha, images should pass through the system multiple times. This mean same image should be labeled by different players. More times a particular label depicting emotion has been assigned by different players to the image, more accurate the tag is for the image. Thus, system also selects the images which have already been presented to previous players and are present in the database. This, also helps in obtaining multiple tags for the images which is also essential for accuracy. In some cases, if Images are not evocative, Images could also be labeled NULL or simply passed for smooth functioning of the game.

When is an image done? One image passes through the system multiple times. When it has acquired many labels which become off limit words, image becomes too difficult for players such that they begin to pass it each time. At this point of time, image is removed from the database.

Results Figure 10 collages illustrate different images on flickr with their emotional tags obtained from “Identical Emotions.”

Some other Games with a Purpose Under Development

Currently, game for tagging articles such as news articles and game for tagging videos is under development. Some of the interesting features of the games are 1) User are asked to enter multiple labels, maximum three for one video or a news article. As objects such as a video or news articles contains lot of information, matching single common keywords

Step 4 : Make Payment

Credit Card


Credit Card (EMI)
ICICI & HDFC cards

Net Banking

Debit Card

Cash On Delivery

Others

 Redeem your Gift Coupon

You can Pay using Cash On Delivery


Amount Payable on Delivery : ₹6999/-

Cash-on-Delivery Order Verification:

Please type the Emotion Depicted by the Image Below:

Choose from following Emotions:

happy,sad,shock,thinking,love,beautiful,horror



Get a new image

Type Emotion in the box :

Letters shown are case-sensitive

Shipping Cart Summary

Nokia Asha 300 (Graphite)	
PRICE:	₹ 7400
BUY AT:	₹ 6999
QUANTITY: 1	
SUBTOTAL:	₹ 6999
YOU SAVE:	₹ 410
SHIPPING:	Free

Grand Total :

₹ 6999


 Shipping Address

Figure 12: Example of Emotion based Captcha to be solved in an Online Shopping Portal before placing an order in COD mode.

for these objects can be a bit difficult which will be a bit unfair for the players. So, users are asked to enter three or less, best keywords for a given object. For matching, these keywords might not be same strings, they are analyzed if they belong to the same context, whether are synonyms and matched accordingly, also a subset of keywords might be matched. If for a given object more keywords match, more points player and his partner gets.

2) Players can also choose the category for their labels. They can communicate with each other to mutually agree on a category. For example, if they wish to label with emotions they can choose emotions. Categories can be emotions, generic.

5 Implementation of Emotion Based Captcha in an ecommerce application

Figure 12 shows implementation of Emotion based captcha in an online shopping website. Before, placing an order with payment mode cash on delivery, user is required to solve Emotion based Captcha. User can get a new image, if he finds current image too difficult. It can be observed that image is slightly blurred. Also, below figure shows an example of online poll being conducted. User is shown pictures of products being sold on online shopping portal and they have to give a response, choosing from Emotions — happy, sad, shock, beautiful, love. Each of the emotion has a particular score. For example, Love has a maximum score of 30 points, followed by beautiful 25 points, happy 20 points, sad, 10 points, shock, 25 points. In this case, when Emotion based Captcha operates in poll mode, images are selected from a different set (For example, Here images are that of the products being sold) and all the answers given by the users are recorded. Whatever emotion user chooses, he enters it in the box, and clicks on the button Place order and his order is placed. As polls are conducted sometimes, it does not affect the overall security of the system. Cumulative scores of products are calculated based on answers given by the users, which help in generating useful and accurate product reviews/analysis and enhance the quality of business. Moreover, user gets incentive of earning points if they answer correctly. Also, user can choose the product he

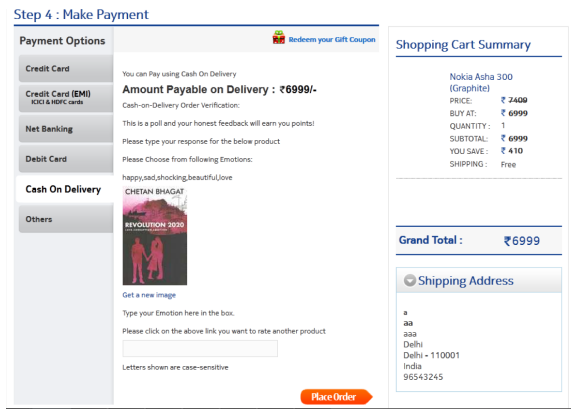


Figure 13: A book getting displayed to get reviews/feedback of users

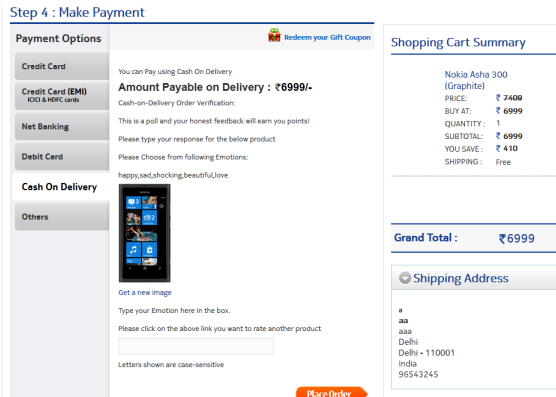


Figure 14: Nokia Model getting displayed to get reviews/feedback of users

wants to rate by clicking on “Get a new image” button.

6 Scenario Based Captcha

Most of the Captchas employed today are based on the difficulty of image recognition, such as identifying degraded words etc. With the advancement in field of computer vision these Captchas have already been broken. Idea behind this CAPTCHA is to utilize the analytic and understanding capability of humans rather than merely recognizing objects. A scenario is presented to the user. Figure 15 consists of a few figures depicting a scenario.

Figure 15 illustrates various scenarios such as a monkey eating a banana, a couple dancing, a student studying at night, two people wrestling. A graphic like this is presented to the user. He has to type in the expression depicting a scenario. Answer is a simple expression such as those described above. There can be multiple answers possible as well such as a chimp eating, a couple performing a ball-room dance, a student studying for his exam etc. These expressions are simply paraphrases and can be easily tackled due to advancements in computational linguistics today. Paraphrase recognition systems such as iSTART [6] can be used for recognizing paraphrases. This Captcha uses a step

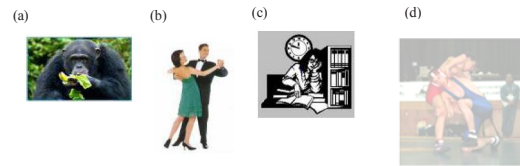


Figure 15: Depicting a scenario.

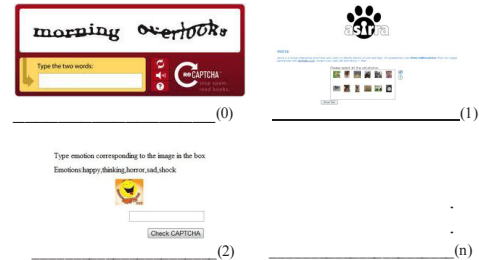


Figure 16: Selection from Different CAPTCHAs

higher than object recognition that is identifying the objects present in the picture as well as how they are related. By using object recognition techniques we can analyse various objects present in the images but identifying relationship among them is a hard AI problem to crack. Moreover they may be related in multiple ways and unique relationship can only be identified from image shown. Distortions such as blurring images can also be added to make it complex for computers to tackle. Such image database can be easily constructed from a popular online game called Phetch [7] which is a game with a purpose designed at Carnegie Mellon University and it helps to obtain explanatory sentences for randomly chosen images.

7 Security of CAPTCHAs, Means of Reusing Old CAPTCHAs and Enabling Them to Serve their Purpose.

Most of the websites today use a single CAPTCHA to secure the login interface. As there are plenty of CAPTCHAs available today, different CAPTCHA problems can be used to secure a single login interface. Set of different CAPTCHA problems is maintained and a random CAPTCHA is selected from these CAPTCHAs before a login prompt is granted.

Figure 16 illustrates different CAPTCHA problems generated from different CAPTCHA scripts. A Random CAPTCHA script, (A random CAPTCHA problem) is selected each time before giving login prompt to the user. If a login is unsuccessful, a random CAPTCHA problem is selected and presented to the user. As CAPTCHAs of different genre are presented randomly, this makes it very difficult to attack these CAPTCHAs. Even if a program is written to attack one CAPTCHA problem, devising an online password guessing attack becomes infeasible as after one unsuccessful try, a different random CAPTCHA problem will be presented to the user and attacking program should be capable to solve that as well. This problem, introduces a

new problem of identifying CAPTCHAs, before attacking a CAPTCHA, attacking program will have to identify which CAPTCHA, it is as well.

How it aids in enabling CAPTCHAs serve some practical purpose? CAPTCHAs such as sentence based CAPTCHA presented earlier might be bit annoying to people if presented to people everytime, but as in the above technique, a random CAPTCHA is presented each time, people might encounter it sometimes and might be willing to solve it to gain some useful knowledge. Moreover, as random CAPTCHAs are presented to the user, it is not possible to attack them as a graphic can be a sentence, image with different challenges such as figuring out sentence, typing emotion corresponding to image, typing letters, so each CAPTCHA has a different solution which can be figured out by humans more easily but is difficult for computer as it does not know what to give as a answer.

Possible attack HTML protectors must be deployed to prevent automated CAPTCHA classification by content analysis of html, javascript returned from servers. Some softwares such as by Antsoft, creabit are available for this purpose.

8 Increasing the Usability of CAPTCHAs using Partial Credit and Token Bucket Algorithm

Some simple usability tests for Captchas, were conducted on people from varied age groups from 11th grade to PhD. Most of them found Emotion based Captcha and Time Based Captcha bit easier and Sentence based Captcha bit difficult. Most of them, found Emotion based Captcha more fun as compared to others.

Partial credit scheme is discussed in Asirra [3]. It can be used to make CAPTCHAs bit easy for people which are otherwise difficult. For, e.g., if in a Sentence based CAPTCHA, sentence being presented to the user is bit difficult and he is able to figure out say 5 out of 7 words, he is given partial credit and a second CAPTCHA is presented to the user, this scheme can be combined with the above the system. Second CAPTCHA presented to the user may or may not be Sentence Based CAPTCHA, for example it might be Text based CAPTCHA and if person is able to get that partially correct as well, he is believed to have solved CAPTCHA challenge completely. Also, Token bucket schemes [3] which makes use of fact that bots used small number of IP addresses that submit a very large number of incorrect responses, interspersed with a much smaller number of correct responses can be used to increase the security of CAPTCHAs.

8.1 Case of Emotion Based Captcha

According to formula of Gambling [18] — the number of trials N necessary for an event of probability p to appear with the degree of certainty DC is given by

$$N = \frac{\log(1 - DC)}{\log(1 - p)}$$

```
[java] Verify10
[java] bucket....9
[java] false
[java] Verify9
[java] bucket....8
[java] false
[java] Verify8
[java] bucket....7
[java] false
[java] Verify7
[java] bucket....6
[java] false
[java] Verify6
[java] bucket....5
```

Figure 17: Bucket value getting decreased for each incorrect attempt.

```
[java] Verify-1
[java] bucket....-2
[java] false
[java] Verify-2
[java] bucket....-3
[java] false
```

Figure 18: Bucket values goes below zero.

If we take 7 emotions, then number of trials required to ensure that captcha is solved once with degree of certainty over 90% is given by

$$\frac{\log(1 - 90/100)}{\log(1 - 1/7)}$$

which evaluates close to slightly greater than 14.

Now, initialise bucket with a capacity, we can set it to 10 in this case, when an incorrect attempts occur decrease its capacity by one, order of decrement can also increase if no. of successive incorrect attempts are large. When capacity becomes zero or less, even if a captcha guess is correct, treat it as incorrect. This implies, captcha is locked

Example Integration in an online shopping portal is shown in figures 17 and 18.

Thus, on large no. of incorrect attempts bucket values goes below zero and Captcha is locked, i.e User will have to login to shopping portal again to place an order

9 Conclusion and Future Work

In this paper, we have developed and discussed the need to use CAPTCHAs with a purpose which serve some other useful, practical purpose so that human hours spend in solving CAPTCHAs are channelised for benefit of human community. We have also developed a New Game With a Purpose called Identical Emotions. We have also shown a system which enables CAPTCHAs having different practical purpose to be used in conjunction with each other. At present, most websites deploy reCAPTCHA which help to digitize books, this CAPTCHA can be used in conjunction with other CAPTCHAs with a purpose to broaden the application domain of CAPTCHAs and make CAPTCHA solving more interesting and beneficial to the human community. For seeing demo of Captchas/Games, please visit sites.google.com/sites/ahasproject/profile/site/webpage/captchaswithapurpose or sites.google.com/sites/ahasproject/profile/site/webpage/gameswithapurpose.

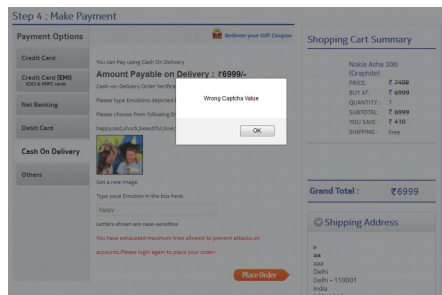


Figure 19: Figure shows that Captcha gets locked when bucket capacity reaches below zero, even though answer entered is correct, message shows incorrect attempt and message gets displayed to the user, to login again and place order.

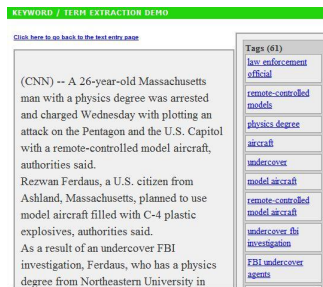


Figure 20: Tags generated by Alchemy API for a news article

Future work involves, studying applications of games under development discussed earlier. Use of AlchemyAPI for keyword extraction is a popular choice. For example, see figure 20.

AlchemyAPI extracts keywords from articles using statistical algorithms and natural language processing techniques to analyze data, extracting keywords that can be utilized to index content, generate tag clouds. But it can be observed from Figure 18 that number of tags it generates are pretty large in number compromising quality. For indexing purpose, if these tags or keywords can be filtered out/ or ranked based on human computation game, it will greatly enhance tag quality and thus enhancing the quality of index. Also, a game can be designed to obtain summaries/pictorial representation of articles, which makes them easy and quick to understand. Idea of pictorial representation is similar to motion captcha [21] which ask users to draw shapes. Also, developing online games which can help in translating online portals such as shopping, travel portals to different languages will be an interesting area to work on.

Developing Personal Assistants is a challenging task. For example, developing a medical assistant will be a good idea. There are computational APIs available for analyzing nutritional information in food, calories burned in exercise according to physical characteristics. For example, APIs provided by wolfram alpha. But to develop assistant, it will need input from its users on a regular basis for long period which is bit difficult to obtain, but as Captchas are part of

daily life of people, they can be a useful source of input. Concept is to ask questions from people regarding their diet, their exercise/sleeping habits and recording their answers and then analyzing information for eg - nutritional content in their food and then make health recommendations.

Another example, can be of recommending music, based on musical interests of people.

10 References

- [1] Luis von Ahn, Manuel Blum, Nicholas Hopper and John Langford. CAPTCHA: Using Hard AI Problems for Security. Advances in Cryptology, Eurocrypt 2003. pp 294-311
- [2] Luis von Ahn, Ben Maurer, Colin McMillen, David Abraham and Manuel Blum. reCAPTCHA: Human-Based Character Recognition via Web Security Measures. Science, September 12, 2008. pp 1465-1468
- [3] Jeremy Elson, John R. Douceur, Jon Howell, and Jared Saul, Asirra: A CAPTCHA that Exploits Interest-Aligned Manual Image Categorization , in Proceedings of 14th ACM Conference on Computer and Communications Security (CCS) , Association for Computing Machinery, Inc. , October 2007
- [4] Luis von Ahn. Games With A Purpose. IEEE Computer Magazine, June 2006. pp 96-98.
- [5] Dailey, M. and Namprempre, C. 2004. A text graphics character CAPTCHA for password authentication. In Proceedings of the IEEE Region 10 Conference (TENCON, Nov. 21–24) , 45–48.
- [6] Boonthum, C. (2004) . iSTART: Paraphrase Recognition. Proceedings of the Student Research Workshop: ACL 2004. 42nd Annual Meeting of the Association of Computational Linguistics, Barcelona, Spain. pp 31-36.
- [7] Luis von Ahn, Shiry Ginosar, Mihir Kedia and Manuel Blum. Improving Accessibility of the Web with a Computer Game. ACM Conference on Human Factors in Computing Systems, CHI Notes 2006. pp 79-82.
- [8] Luis von Ahn, Mihir Kedia and Manuel Blum. Verbosity: A Game for Collecting Common-Sense Knowledge. ACM Conference on Human Factors in Computing Systems, CHI Notes 2006. pp 75-78.
- [9] Luis von Ahn, Ruoran Liu and Manuel Blum. Peekaboom: A Game for Locating Objects in Images. ACM Conference on Human Factors in Computing Systems, CHI 2006. pp 55-64.
- [10] Baird, H. S. and Riopka, T. 2005. Scatter Type: A reading CAPTCHA resistant to segmentation attack. In Proceedings of the SPIE/IS&T Conference on Document Recognition and Retrieval XII (San Jose, CA, Jan.) .
- [11] Collaborative filtering CAPTCHAs. M. Chew and J. D. Tygar. In Human Interactive Proofs: Second International Workshop (HIP 2005) , eds. H. Baird and D. Lopresti, Springer, May 2005, pp. 66-81.
- [12] Phish and HIPs: Human interactive proofs to detect phishing attacks. R. Dhamija and J. D. Tygar. In Human Interactive Proofs: Second International Workshop (HIP 2005) , eds. H. Baird and D. Lopresti, Springer, May 2005, pp. 127-141.
- [13] Deapesh Misra , Kris Gaj, Face Recognition CAPTCHAs, Proceedings of the Advanced Int'l Conference on Telecommunications and Int'l Conference on Internet and Web Applications and Services, p. 122, February 19-25, 2006
- [14] <http://code.google.com/p/esp-game-course-project>
- [15] J. A. Russell. A circumplex model of affect. Journal of Personality and Social Psychology, 39:1161-1178, 1980.
- [16] <http://www.wolframalpha.com>
- [17] <http://www.alchemyapi.com>
- [18] <http://saliu.com/Saliu2.htm>
- [19] <http://www.gwap.com/gwap>
- [20] http://www.halfbakery.com/idea/Emotional_20Captchas
- [21] <http://www.josscrowcroft.com/projects/motioncaptcha-jquery-plugin>