



## Picture in Picture Captcha: A Cognition Based Drag and Drop Approach for Secured Authentication in Web Applications

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**Abstract**— Captcha stands for completely automated public turing test to tell computers and humans apart. Captcha a human interactive proof, which identify the user on website is whether a human or computer. Captcha prevents the entry of automated scripts known as bots which replicate the behavior of human and carry out malicious activities in web applications. Presently various types of Captcha have been deployed in most of the websites as a protective arrangement to prevent bot attacks. Rapid growth in OCR technology pose a great threat to the text based Captcha used in popular websites. Cognition based Captcha becomes one of the best alternate for the security of websites. The proposed Picture in Picture Captcha is a Cognition based image approach offer enhanced security for the web applications. It is a very simple and novel method provides hassle free environment to all section of users to complete the Captcha test and it is robust to any kind of attacks by automated bot programs.

**Keywords**— Cognition, bots, PIP, authentication, security

### I. INTRODUCTION

Internet becomes the essential need of human in all day to day activities. Web applications like e-mail, social networking sites, online banking and other applications become essential part in human life. The swift development of Internet also faces threat to the security of its applications by automated bots. Bots sign up free email accounts, post comments in blogs and cast multiple votes in online polls, which makes the web services unavailable to legitimate users. To protect the websites from bot attacks, Captcha, a human interactive proof [1] has been introduced in most of the web sites. Captcha is a simple challenge response test, which is easy for most human to complete and hard for bots to complete.

Captcha can be classified based on text, image, audio and video [2]. In the text based Captcha a distorted and twisted word in noisy background is displayed to the user, the user has to identify and type the word in the textbox for authentication. Image based Captcha are designed based on recognition and matching concept. The user need to match the goal image from the set of option images or solving some picture based puzzles for authentication. Audio Captcha becomes user friendly for the visually challenged people. Video Captcha is another robust approach used only in very few web applications. The user needs to identify the specific words in the running video and should enter in the text box to prove him as human A perfect Captcha design should focus the two primary goals[3],

- Easy to Generate, Implement and Evaluate
- Easy for Humans and Hard for bots

### II. RELATED WORK

Samruddu D.Bhalani et al [4] proposed a novel drag and drop Captcha method. In this an image is selected randomly and divided in to 4 or 6 pieces and displayed to the user in shuffled order. The user needs to rearrange it correctly by dragging the pieces to the input box for authentication. Darryl D Souza et al [5], proposed a novel Avatar Captcha. In this method the user has to identify the avatar faces from a set of 12 grayscale images displayed to the user which comprising of a mix of human and avatar faces. Differentiating human faces and avatar faces will be a difficult task for the bots whereas it is easy for humans. Abdulaziz S Almazayad et al [6] proposed a new multi modal Captcha which consists both picture and text. An image is rendered on the screen with many text labels drawn over it. The user has to identify the correct name of the underlying image among the set of text labels that are scattered over it, in order to pass the verification test. The author also proposed cursive text instead of plain text labels.

M. Shirali-Shahreza et al [7] proposed a new Captcha method on the basis of showing a movie of a person's action. The user has to describe the movement of that person by selecting the sentence from the list of sentences displayed. If the user chooses the right sentence then the user is identified as a human and not a computer program. Rizwan ur Rahman et al [8] proposed dynamic image Captcha, in this, the user is required to match the goal image with a grid of six optional images. The user is required to submit correct images in all the five filtered stage of images to clear the test. Tariq Banday et al [9] proposed a drag and drop method based on images. In this a group of images are displayed to the user in noisy background and user is asked to drag the goal image and drop it over the target image to get authentication. Steven A. Ross et al [10] proposed a novel Captcha, in which the user presented with a set of images in

tilted position, and the user must choose an upright orientation for each image. This requires understanding of the semantic content of the image, which is very difficult for automatic bots to complete.

### III. PROPOSED METHOD

Picture in picture is well known and familiar concept to all humans watching TV channels irrespective of age and technical background. All the TV channels frequently telecast news, sports and other entertainments in picture in picture mode. The proposed Captcha test is designed based on this concept. One picture image is displayed in the full window, and one or more picture images are displayed in inset windows. The concept is shown in fig 1.



Fig.1. Concept of Picture in Picture

In the proposed approach a Captcha image consisting of a two pictures, in the picture in picture format, is displayed to the user in signup page. One picture is known as main picture or picture 1. Another image is known as picture in picture (PIP) or picture 2. Six option images consisting of goal images and other random images are also displayed for drag and drop operation to complete the Captcha test. The screen shot of Signup page is shown in fig 2.

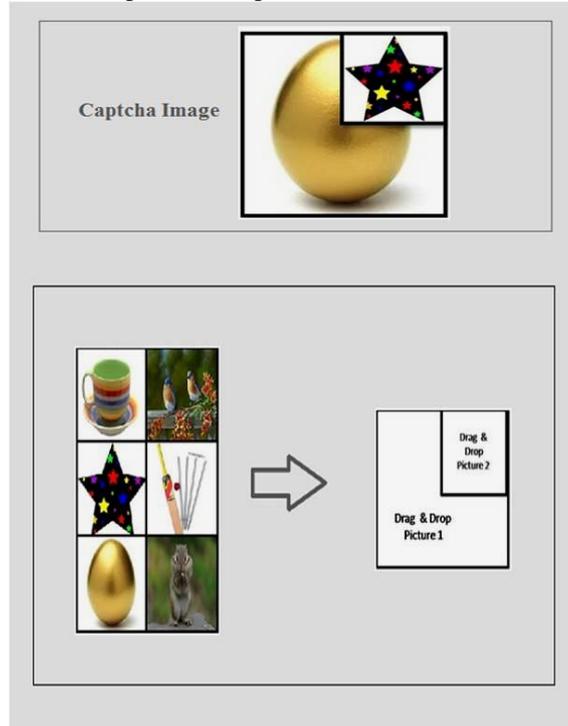
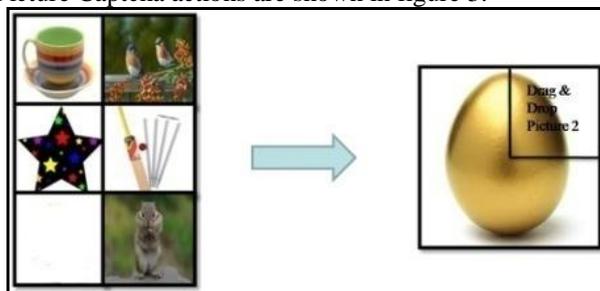


Fig.2. Signup page of Picture in Picture Captcha

The user by cognition first selects the picture 1. Then by drag operation the image is moved to the input box and dropped in the place of picture 1. Similarly the PIP image is selected from the given option images and dragged the image to the inset window. Finally the PIP image is dropped in the input box to complete the authentication process. The screen shot image of Picture in Picture Captcha actions are shown in figure 3.



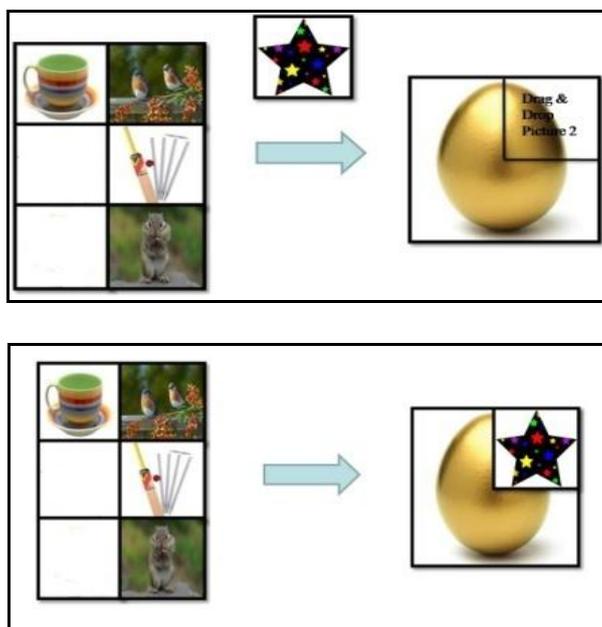


Fig.3. Picture in Picture Captcha in action

#### IV. USABILITY AND SECURITY ANALYSIS

Usability refers the human friendliness in Captcha design [11]. A usable Captcha should be easy for humans to solve and hard for bots to complete. To increase the security level, the Captcha character design has been changed day by day with more twist, distortion, overlap and noise, which makes them robust to any kind of bot attacks, however suffers usability problems. But the proposed picture in picture Captcha ensures more user friendliness in design. A survey has been conducted with 20 users of different age group and profession. Each user is asked to complete the Captcha test engaged in the popular websites and based on their response the average execution time has been calculated and tabulated in Table. I. It is observed from the survey that the execution time of PIP Captcha is very low when compared to the other methods and it is user friendly to all human users.

Table I Execution Time of Various Captcha methods

Sl. No	Website	Captcha type	Ave.Exe. Time in Sec.
1	Yahoo	Six character Text	8.12
2	Amazon	Six character Text	8.79
3	Wikipedia	Nine character Text	10.64
4	Microsoft	Eight character Text	12.81
5	PIP	Two images	6.35

The proposed PIP Captcha also ensures better security by two step validation method. In the first step, the validation process identifies the correctness of the user input for the goal image. In the second stage the input option images are also validated, to identify the drag operation by human users. If drag operation is performed then the respective input cells will be represented by null character. The two step validation protects PIP Captcha from any type of automated attacks and ensures the presence of human in web services.

The option images are represented in an array format by,

- A [0, 0] – image 1
- A [0, 1] – image 2
- A [0, 2] – image 3
- A [1, 0] – image 4
- A [1, 1] – image 5
- A [1, 2] – image 6

The Goal image is represented by,

- G [0, 0] – picture 1
- G [0, 1] – picture 2

While validation, the value of goal image should be,

- G [0, 0] – image 3

G [0, 1] – image 2

And the value of option image should be

A [0, 0] – image 1

A [0, 1] – Null

A [0, 2] – Null

A [1, 0] – image 4

A [1, 1] – image 5

A [1, 2] – image 6

If both goal image validation and input image validation is success then the user will be granted access to the web applications. The drag and drop cognitive actions are possible only by humans. Bots unable to perform drag and drop mouse operations hence authentication is denied.

In order to increase the security level, the Captcha design may be modified as shown in Fig.4.

- By adding dummy PIP windows in the Captcha image
- PIP windows may be designed in multiple shapes for each user randomly.

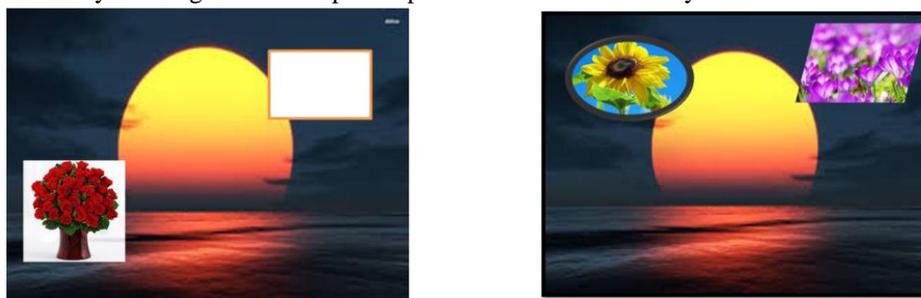


Fig.4. Picture in Picture Captcha with dummy PIP and different inset window shapes

## V. CONCLUSION

Cognitive abilities are brain-based skills that humans only possess and able to perform simple task to complex task. Humans only can do some special operations with the mechanisms of how we learn, remember, problem-solve and pay attention rather than with any actual knowledge.

The Picture in Picture Captcha involves the following cognition activities:

- Perception - Identification of picture 1, and Identification of main window in Captcha input box for picture 1
- Motor skill - Drag operation using mouse on picture 1, and drop operation in main window
- Perception - Identification of picture 2 and Identification of inset window for picture 2.
- Motor skill - Drag operation using mouse on picture 2, and drop operation on inset window
- Motor skill - Click operation on submit button

Humans are well responsive to the cognition based actions. The proposed PIP Captcha method is familiar and user friendly to all section of human users, therefore it is easy for them to complete the Captcha test. Cognitive actions ensure the presence of humans and hence authentication is established to the web services. Bots unable to perform any cognition based actions hence authentication is denied. Thus the proposed picture in picture Captcha endows enhanced security and usability in web applications.

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