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Security for Hard AI Problems Using CaRP Authentication

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Abstract: **Using hard AI problems for security is emerging as an exciting new paradigm, but has been underexplored. This approach present a new security primitive based on hard AI problems, namely, a novel family of graphical password systems built on top of Captcha technology, which is called Captcha as graphical passwords (CaRP). CaRP is both a Captcha and a graphical password scheme. CaRP addresses a number of security problems altogether, such as online guessing attacks, relay attacks, and, if combined with dual-view technologies, shoulder-surfing attacks. Notably, a CaRP password can be found only probabilistically by automatic online guessing attacks even if the password is in the search set.**

1. INTRODUCTION

Many security primitives are based on hard mathematical problems. Using hard AI problems for security is emerging as an exciting new paradigm, but has been underexplored. This approach present a new security primitive based on hard AI problems, namely, a novel family of graphical password systems built on top of Captcha technology, which is called Captcha as graphical passwords (CaRP). CaRP is both a Captcha and a graphical password scheme. CaRP addresses a number of security problems altogether, such as online guessing attacks, relay attacks, and, if combined with dual-view technologies, shoulder-surfing attacks. 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 Pass Points, 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.

2. LITERATURE SURVEY

Pass Points: Design and longitudinal evaluation of a graphical password system:

[1]Computer security depends largely on passwords to authenticate human users. However, users have difficulty remembering passwords over time if they choose a secure password, i.e. a password that is long and random. Therefore, they tend to choose short and insecure passwords. Graphical passwords, which consist of clicking on images rather than typing alphanumeric strings, may help to overcome the problem of creating secure and memorable passwords. The participants subsequently carried out three longitudinal trials to input their password over the course of 6 weeks. The results show that the graphical password users created a valid password with fewer difficulties than the alphanumeric users.

Investigating the Combination of Text and Graphical Passwords for a more secure and usable experience:

[2]Security has been an issue from the inception of computer systems and experts have related security issues with usability. Secured systems must be usable to maintain intended security. Password Authentication Systems have either been usable and not secure, or secure and not usable. Increasing either tends to complicate the other.

Against Spyware Using CAPTCHA in Graphical Password Scheme:

[3]Text-based password schemes have inherent security and usability problems, leading to the development of graphical password schemes. However, most of these alternate schemes are vulnerable to spyware attacks. A new scheme is proposed, using CAPTCHA (Completely Automated Public Turing tests to tell Computers and Humans Apart) that retaining the advantages of graphical password schemes, while simultaneously raising the cost of adversaries by orders of magnitude. Furthermore, some primary experiments are conducted and the results indicate that the usability should be improved in the future work.

CAPTCHA: Using Hard AI Problems for Security:

[4]Introducing here captcha, an automated test that humans can pass, but current computer programs can't pass: any program that has high success over a captcha can be used to solve an unsolved Artificial Intelligence (AI) problem.

Attacks and Design of Image Recognition CAPTCHAs:

[5]The design of image recognition CAPTCHAs (IRCs) will be studied systematically by first reviewing and examining all IRCs schemes known and evaluate each scheme against the practical requirements in CAPTCHA applications, particularly in large-scale real-life applications such as Gmail and Hotmail. Then a security analysis of the representative schemes which have identified will be presented.

On Predictive Models and User-Drawn Graphical Passwords:

[6]In commonplace text-based password schemes, users typically choose passwords that are easy to recall, exhibit patterns, and are thus vulnerable to brute-force dictionary attacks. This leads us to ask whether other types of passwords (e.g., graphical) are also vulnerable to dictionary attack due to users tending to choose memorable passwords.

Graphical Passwords: Learning from the First Twelve Years:

[9]Starting around 1999, a great many graphical password schemes have been proposed as alternatives to text-based password authentication. This provides a comprehensive overview of published research in the area, covering usability and security aspects, as well as system evaluation.

Revisiting Defenses against Large-Scale Online Password Guessing Attacks:

[10]Brute force and dictionary attacks on password-only remote login services are now widespread and ever increasing. Enabling convenient login for legitimate users while preventing such attacks is a difficult problem.

Existing System:

Security primitives are based on hard mathematical problems. Using hard AI problems for security is emerging as an exciting new paradigm, but has been underexplored. A fundamental task in security is to create cryptographic primitives based on hard mathematical problems that are computationally intractable.

Proposed System:

A new security primitive based on hard AI problems, namely, a novel family of graphical password systems built on top of Captcha technology, whichis called Captcha as graphical passwords (CaRP). CaRP is both a Captcha and a graphical password scheme. CaRP addresses a number of security problems altogether, such as online guessing attacks, relay attacks, and, if combined with dual-view technologies, shoulder-surfing attacks. 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 Pass Points, that often leads to weak password choices.

CaRP is not a panacea, but it offers reasonable security and usability and appears to fit well with some practical applications for improving online security.It presents exemplary CaRPs built on both text Captcha and image-recognition Captcha. One of them is a text CaRP wherein a password is a sequence of characters like a text password, but entered by clicking the right character sequence on CaRP images.

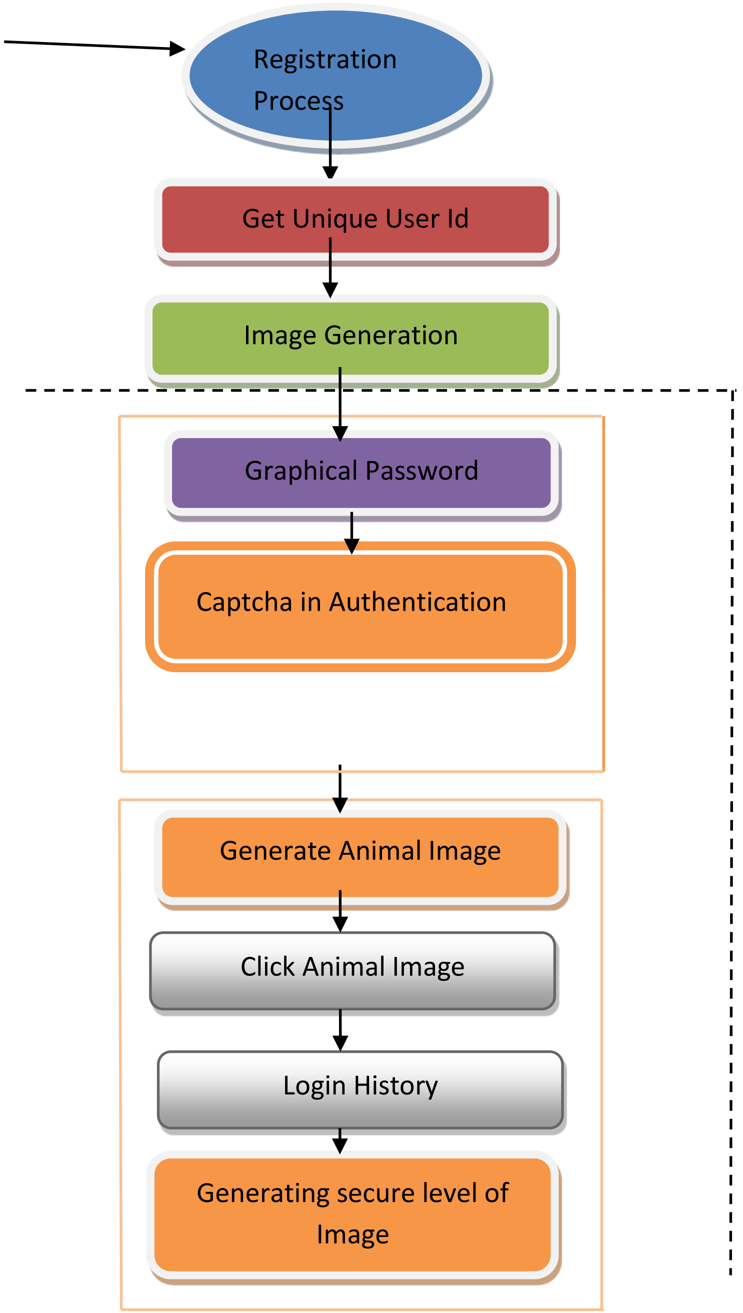
CaRP offers protection against online dictionary attacks on passwords, which have been for long time a major security threat for various online services. This threat is widespread and considered as a top cyber security risk. Defense against online dictionary attacks is a more subtle problem than it might appear.

Advantages:

It offers reasonable security and usability and appears to fit well with some practical applications for improving online security.

This threat is widespread and considered as a top cyber security risk. Defense against online dictionary attacks is a more subtle problem than it might appear.

3. ARCHITECTURE DIAGRAM



4. MODULES

Graphical Password:

Graphical Password can be classified into three categories according to the task involved in memorizing and entering passwords: recognition, recall, and cued recall.

A recognition-based scheme requires identifying among decoys the visual objects belonging to a password portfolio. A typical scheme is Pass faces wherein a user selects a portfolio of faces from a database in creating a password.

A recall-based scheme requires a user to regenerate the same interaction result without cueing. Draw-A-Secret (DAS) was the first recall-based scheme proposed. A user draws her password on a 2D grid. The system encodes the sequence of grid cells along the drawing path as a user drawn password. Pass-Go improves DAS's usability by encoding the grid intersection points rather than the grid cells.

Captcha:

Captcha relies on the gap of capabilities between humans and bots in solving certain hard AI problems. There are two types of visual Captcha: text Captcha and Image-Recognition Captcha (IRC).

Captcha in Authentication:

Using both Captcha and password in a user authentication protocol, which is called as Captcha-based Password Authentication (CbPA) protocol, to counter online dictionary attacks. The CbPA-protocol requires solving a Captcha challenge after inputting a valid pair of user ID and password unless a valid browser cookie is received. For an invalid pair of user ID and password, the user has a certain probability to solve a Captcha challenge before being denied access. An improved CbPA-protocol is proposed in by storing cookies only on user-trusted machines and applying a Captcha challenge only when the number of failed login attempts for the account has exceeded a threshold. It is further improved in by applying a small threshold for failed login attempts from unknown machines but a large threshold for failed attempts from known machines with a previous successful login within a given time frame.

Captcha was also used with recognition-based graphical passwords to address spyware, wherein a text Captcha is displayed below each image; a user locates her own pass-images from decoy images, and enters the characters at specific locations of the Captcha below each pass-image as her password during authentication. These specific locations were selected for each pass-image during password creation as a part of the password.

Thwart Guessing Attacks:

In a guessing attack, a password guess tested in an unsuccessful trial is determined wrong and excluded from subsequent trials. The number of undetermined password guesses decreases with more trials, leading to a better chance of finding the password. Mathematically, let S be the set of password guesses before any trial, ρ be the password to find, T denote a trial whereas Tn denote the n-th trial, and p(T = ρ) be the probability that ρ is tested in trial T .Let En be the set of password guesses tested in trials up to (including) T .

Click Text:

Click Text is a recognition-based CaRP scheme built on top of text Captcha. Its alphabet comprises characters without any visually-confusing characters. For example, Letter "O" and digit "0" may cause confusion in CaRP images, and thus one character should be excluded from the alphabet. A Click Text password is a sequence of characters in the alphabet, e.g., ρ ="AB#9CD87", which is similar to a text password. A Click Text image is generated by the underlying Captcha engine as if a Captcha image were generated except that all the alphabet characters should appear in the image.

Click Animal:

Captcha Zoo is a Captcha scheme which uses 3D models of horse and dog to generate 2D animals with different textures, colors, lightings and poses, and arranges them on a cluttered background. A user clicks all the horses in a challenge image to pass the test.

Click Animal is a recognition-based CaRP scheme built on top of Captcha Zoo, with an alphabet of similar animals such as dog, horse, pig, etc. Its password is a sequence of animal names such as ρ = "Turkey, Cat, Horse, Dog,…." For each animal, one or more 3D models are built.

Animal Grid:

The number of similar animals is much less than the number of available characters. Click Animal has a smaller alphabet, and thus a smaller password space, thenClick Text. CaRP should have a sufficiently-large effective password space to resist human guessing attacks. Animal Grid's password space can be increased by combining it with a grid-based graphical password, with the grid depending on the size of the selected animal.

Image Generation:

Text Points images look identical to Click Text images and are generated in the same way except that the locations of all the clickable points are checked to ensure that none of them is occluded or its tolerance region overlaps another clickable point's. This simply generates another image if the check fails. As such failures occur rarely due to the fact that clickable points are all internal points, the restriction due to the check has a negligible impact on the security of generated images.

Authentication:

When creating a password, all clickable points are marked on corresponding characters in a CaRP image for a user to select. During authentication, the user first identifies her chosen characters, and clicks the password points on the right characters. The authentication server maps each user-clicked point on the image to find the closest clickable point. If their distance exceeds a tolerable range, login fails. Otherwise a sequence of clickable points is recovered, and its hash value is computed to compare with the stored value.

Dynamic:

The locations of clickable points and their context (i.e., characters) vary from one image to another. The clickable points in one image are computationally independent of the clickable points in another image, as it will be seen in Section VI-B.

Contextual:

Whether a similarly structured point is a clickable point or not depends on its context. It is only if within the right context, i.e., at the right location of a right character.

5. CONCLUSION

This proposed CaRP, a new security primitive relying on unsolved hard AI problems. CaRP is both a Captcha and a graphical password scheme. The notion of CaRP introduces a new family of graphical passwords, which adopts a new approach to counter online guessing attacks: a new CaRP image, which is also a Captcha challenge, is used for every login attempt to make trials of an online guessing attack computationally independent of each other. Animal Grid and Click Text easier to use than Pass Points and a combination of text password and Captcha. Both Animal Grid and Click Text had better password memorability 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.

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